# PCA9517 Level-Translating I²C Bus Repeater

## 1 Features

- Two-Channel Bidirectional Buffer
- I²C Bus and SMBus Compatible
- Operating Supply Voltage Range of 0.9 V to 5.5 V on A Side
- Operating Supply Voltage Range of 2.7 V to 5.5 V on B Side
- Voltage-Level Translation From 0.9 V to 5.5 V and 2.7 V to 5.5 V
- Footprint and Function Replacement for PCA9515A
- Active-High Repeater-Enable Input
- Open-Drain I²C I/O
- 5.5-V Tolerant I²C and Enable Input Support Mixed-Mode Signal Operation
- Lockup-Free Operation
- Accommodates Standard Mode and Fast Mode I²C Devices and Multiple Masters
- Powered-Off High-Impedance I²C Pins
- 400-kHz Fast I²C Bus
- 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)

## 2 Description

This dual bidirectional I²C buffer is operational at 2.7 V to 5.5 V.

The PCA9517 is a BiCMOS integrated circuit intended for I²C bus and SMBus systems. It can also provide bidirectional voltage-level translation (up-translation/down-translation) between low voltages (down to 0.9 V) and higher voltages (2.7 V to 5.5 V) in mixed-mode applications. This device enables I²C and similar bus systems to be extended, without degradation of performance even during level shifting.

The PCA9517 buffers both the serial data (SDA) and the serial clock (SCL) signals on the I²C bus, thus allowing two buses of 400-pF bus capacitance to be connected in an I²C application. This device can also be used to isolate two halves of a bus for voltage and capacitance.

The PCA9517 has two types of drivers—A-side drivers and B-side drivers. All inputs and I/Os are overvoltage tolerant to 5.5 V, even when the device is unpowered ($V_{CCB}$ and/or $V_{CCA}$ = 0 V).

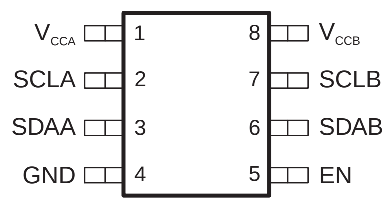
The PCA9517 doesnot support clock stretching and arbitration across the repeater.

**Device Information(1)**

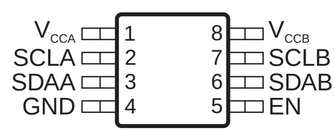
| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|---|---|---|
| PCA9517 | SOIC (8) | 4.90 mm × 3.91 mm |
| | VSSOP (8) | 3.00 mm × 3.00 mm |

(1) For all available packages, see the orderable addendum at the end of the datasheet.

**D PACKAGE**
**(TOP VIEW)**




**DGK PACKAGE**
**(TOP VIEW)**



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## 3 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision D (March 2012) to Revision E | Page |
|---|---|
| • Added Clock Stretching Errata section. | 10 |
| • Added Load Dependent Undershoot Errata section. | 10 |
| • Added Glitch/Noise Susceptibility Errata section. | 11 |
| • Added Load Susceptibility Errata section. | 11 |

| Changes from Revision B (May 2010) to Revision C | Page |
|---|---|
| • Deleted all references to arbitration and clock stretching support. This does not effect min/max specifications. | 1 |

## 4 Description (Continued)

The B-side drivers operate from 2.7 V to 5.5 V and behave like the drivers in the PCA9515A. The output low level for this internal buffer is approximately 0.5 V, but the input voltage must be 70 mV or more below the output low level when the output internally is 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 it from being used in series with the PCA9515A and another PCA9517 (B side). This is because these devices do not recognize buffered low signals as a valid low and do not propagate it as a buffered low again.

The A-side drivers operate from 0.9 V to 5.5 V and drive more current. They do not require the buffered low feature (or the static offset voltage). This means that a low signal on the B side translates to a nearly 0-V low on the A side, which accommodates smaller voltage swings of lower-voltage logic. The output pulldown on the A side drives a hard low, and the input level is set at 0.3 $V_{CCA}$ to accommodate the need for a lower low level in systems where the low-voltage-side supply voltage is as low as 0.9 V.

The A side of two or more PCA9517s can be connected together to allow a star topography, 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 PCA9517s can be connected in series, A side to B side, with no buildup in offset voltage and with only time-of-flight delays to consider.

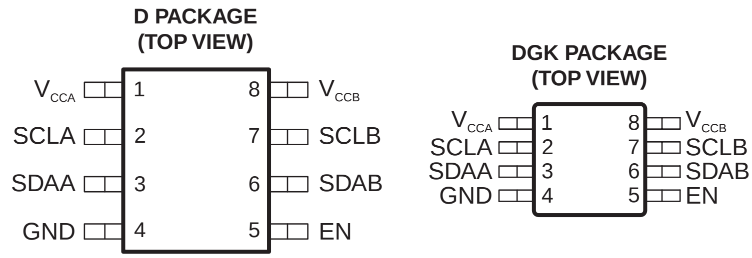
The PCA9517 drivers are enabled when $V_{CCA}$ is above 0.8 V and $V_{CCB}$ is above 2.5 V.

The PCA9517 has an active-high enable (EN) input with an internal pullup to $V_{CCB}$, which allows the user to select when the repeater is active. This can be used to isolate a badly behaved slave on power-up reset. It should never change state during an $I^2C$ operation, because disabling during a bus operation hangs the bus, and enabling part way through a bus cycle could confuse the $I^2C$ parts being enabled. The EN input should change state only when the global bus and repeater port are in an idle state, to prevent system failures.

The PCA9517 includes a power-up circuit that keeps the output drivers turned off until $V_{CCB}$ is above 2.5 V and the $V_{CCA}$ is above 0.8 V. $V_{CCB}$ and $V_{CCA}$ can be applied in any sequence at power up. After power up and with the EN high, a low level on the A side (below 0.3 $V_{CCA}$) turns the corresponding B-side driver (either SDA or SCL) on and drives the B side down to approximately 0.5 V. When the A side rises above 0.3 $V_{CCA}$, the B-side pulldown driver is turned off and the external pullup resistor pulls the pin high. When the B side falls first and goes below 0.3 $V_{CCB}$, the A-side driver is turned on and the A side pulls down to 0 V. The B-side pulldown is not enabled unless the B-side voltage goes below 0.4 V. If the B-side low voltage does not go below 0.5 V, the A-side driver turns off when the B-side voltage is above 0.7 $V_{CCB}$. If the B-side low voltage goes below 0.4 V, the B-side pulldown driver is enabled, and the B side is able to rise to only 0.5 V until the A side rises above 0.3 $V_{CCA}$. Then the B side continues to rise, being pulled up by the external pullup resistor. $V_{CCA}$ is only used to provide the 0.3 $V_{CCA}$ reference to the A-side input comparators and for the power-good-detect circuit. The PCA9517 logic and all I/Os are powered by the $V_{CCB}$ pin.

As with the standard $I^2C$ system, pullup resistors are required to provide the logic-high levels on the buffered bus. The PCA9517 has standard open-collector configuration of the $I^2C$ bus. The size of these pullup resistors depends on the system, but each side of the repeater must have a pullup resistor. The device is designed to work with Standard mode and Fast mode $I^2C$ devices in addition to SMBus devices. Standard mode $I^2C$ devices only specify 3 mA in a generic $I^2C$ system, where Standard mode devices and multiple masters are possible. Under certain conditions, higher termination currents can be used.

# 5 Pin Configuration and Functions




**Pin Functions**

| PIN | | DESCRIPTION |
|---|---|---|
| NAME | NO. | |
| $V_{CCA}$ | 1 | A-side supply voltage (0.9 V to 5.5 V) |
| SCLA | 2 | Serial clock bus, A side. Connect to $V_{CCA}$ through a pullup resistor. |
| SDAA | 3 | Serial data bus, A side. Connect to $V_{CCA}$ through a pullup resistor. |
| GND | 4 | Supply ground |
| EN | 5 | Active-high repeater enable input |
| SDAB | 6 | Serial data bus, B side. Connect to $V_{CCB}$ through a pullup resistor. |
| SCLB | 7 | Serial clock bus, B side. Connect to $V_{CCB}$ through a pullup resistor. |
| $V_{CCB}$ | 8 | B-side and device supply voltage (2.7 V to 5.5 V) |

# 6 Specifications

## 6.1 Absolute Maximum Ratings[(1)]

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

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $V_{CCB}$ | Supply voltage range | | –0.5 | 7 | V |
| $V_{CCA}$ | Supply voltage range | | –0.5 | 7 | V |
| $V_I$ | Enable input voltage range[(2)] | | –0.5 | 7 | V |
| $V_{I/O}$ | $I^2C$ bus voltage range[(2)] | | –0.5 | 7 | V |
| $I_{IK}$ | Input clamp current | $V_I < 0$ | | –50 | mA |
| $I_{OK}$ | Output clamp current | $V_O < 0$ | | –50 | mA |
| $I_O$ | Continuous output current | | | ±50 | mA |
| $I_O$ | Continuous current through $V_{CC}$ or GND | | | ±100 | mA |

(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.

## 6.2 Handling Ratings

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $T_{stg}$ | Storage temperature range | | –65 | 150 | °C |
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins[(1)] | 0 | 2000 | V |
| $V_{(ESD)}$ | Electrostatic discharge | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins[(2)] | 0 | 1000 | V |

(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.

## 6.3 Recommended Operating Conditions

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

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $V_{CCA}$ | Supply voltage, A-side bus | | 0.9[1] | 5.5 | V |
| $V_{CCB}$ | Supply voltage, B-side bus | | 2.7 | 5.5 | V |
| $V_{IH}$ | High-level input voltage | SDAA, SCLA | $0.7 \times V_{CCA}$ | 5.5 | V |
| | | SDAB, SCLB | $0.7 \times V_{CCB}$ | 5.5 | |
| | | EN | $0.7 \times V_{CCB}$ | 5.5 | |
| $V_{IL}$ | Low-level input voltage | SDAA, SCLA | –0.5 | $0.28 \times V_{CCA}$ | V |
| | | SDAB, SCLB | –0.5[2] | $0.3 \times V_{CCB}$ | |
| | | EN | –0.5 | $0.3 \times V_{CCB}$ | |
| $I_{OL}$ | Low-level output current | $V_{CCB}$ = 2.7 V | | 6 | mA |
| | | $V_{CCB}$ = 3 V | | 6 | |
| $T_A$ | Operating free-air temperature | | –40 | 85 | °C |

(1) Low-level supply voltage
(2) $V_{IL}$ specification is for the first low level seen by the SDAB and SCLB lines. $V_{ILc}$ is for the second and subsequent low levels seen by the SDAB and SCLB lines.

## 6.4 Thermal Information

| THERMAL METRIC[1] | | PCA9517 | | UNIT |
|---|---|---|---|---|
| | | D | DGK | |
| | | 8 PINS | 8 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 97 | 172 | °C/W |

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.

## 6.5 Electrical Characteristics

$V_{CCB}$ = 2.7 V to 5.5 V, GND = 0 V, $T_A$ = –40°C to 85°C (unless otherwise noted)

| PARAMETER | | | TEST CONDITIONS | $V_{CCB}$ | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IK}$ | Input clamp voltage | | $I_I$ = –18 mA | 2.7 V to 5.5 V | | | –1.2 | V |
| $V_{OL}$ | Low-level output voltage | SDAB, SCLB | $I_{OL}$ = 100 µA or 6 mA, $V_{ILA}$ = $V_{ILB}$ = 0 V | 2.7 V to 5.5 V | 0.45 | 0.52 | 0.7 | V |
| | | SDAA, SCLA | $I_{OL}$ = 6 mA | | | 0.1 | 0.2 | |
| $V_{OL} – V_{ILc}$ | Low-level input voltage below low-level output voltage | SDAB, SCLB | | 2.7 V to 5.5 V | | | 70 | mV |
| $V_{ILC}$ | SDA and SCL low-level input voltage contention | SDAB, SCLB | | 2.7 V to 5.5 V | –0.5 | 0.4 | | V |
| $I_{CC}$ | Quiescent supply current for $V_{CCA}$ | | Both channels low, SDAA = SCLA = GND and SDAB = SCLB = open, or SDAA = SCLA = open and SDAB = SCLB = GND | | | | 1 | mA |
| $I_{CC}$ | Quiescent supply current | | Both channels high, SDAA = SCLA = $V_{CCA}$ and SDAB = SCLB = $V_{CCB}$ and EN = $V_{CCB}$ | 5.5 V | | 1.5 | 4 | mA |
| | | | Both channels low, SDAA = SCLA = GND and SDAB = SCLB = open, or SDAA = SCLA = open and SDAB = SCLB = GND | | | 1.5 | 5 | |
| | | | In contention, SDAA = SCLA = GND and SDAB = SCLB = GND | | | 1.5 | 5 | |
| $I_I$ | Input leakage current | SDAB, SCLB | $V_I$ = $V_{CCB}$ | 2.7 V to 5.5 V | | | ±1 | µA |
| | | | $V_I$ = 0.2 V | | | | 10 | |
| | | SDAA, SCLA | $V_I$ = $V_{CCB}$ | | | | ±1 | |
| | | | $V_I$ = 0.2 V | | | | 10 | |
| | | EN | $V_I$ = $V_{CCB}$ | | | | ±1 | |
| | | | $V_I$ = 0.2 V | | | –10 | –30 | |
| $I_{OH}$ | High-level output leakage current | SDAB, SCLB | $V_O$ = 3.6 V | 2.7 V to 5.5 V | | | 10 | µA |
| | | SDAA, SCLA | | | | | 10 | |
| $C_I$ | Input capacitance | EN | $V_I$ = 3 V or 0 V | 3.3 V | | 6 | 7 | pF |
| | | SCLA, SCLB | $V_I$ = 3 V or 0 V | 3.3 V | | 6 | 9 | |
| | | | | 0 V | | 6 | 8 | |
| $C_{IO}$ | Input/output capacitance | SDAA, SDAB | $V_I$ = 3 V or 0 V | 3.3 V | | 6 | 9 | pF |
| | | | | 0 V | | 6 | 8 | |

## 6.6 Timing Requirements

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

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| $t_{su}$ | Setup time, EN high before Start condition (1) | 100 | | ns |
| $t_h$ | Hold time, EN high after Stop condition (1) | 100 | | ns |

(1) EN should change state only when the global bus and the repeater port are in an idle state.

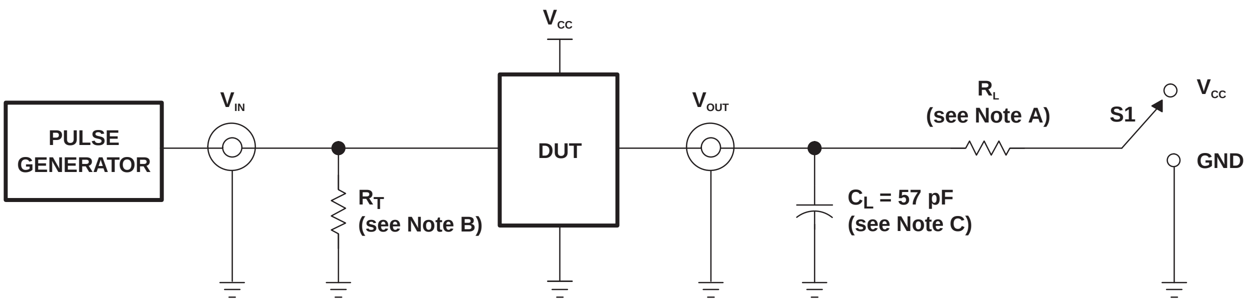
## 6.7 $I^2C$ Interface Timing Requirements

$V_{CCB}$ = 2.7 V to 5.5 V, GND = 0 V, $T_A$ = –40°C to 85°C (unless otherwise noted)

| PARAMETER | | | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP[(1)] | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| $t_{PLZ}$ | Propagation delay | | SDAB, SCLB[(2)] (see Figure 4) | SDAA, SCLA[(2)] (see Figure 4) | | 100 | 169 | 255 | ns |
| | | | SDAA, SCLA[(3)] (see Figure 3) | SDAB, SCLB[(3)] (see Figure 3) | | 25 | 67 | 110 | |
| $t_{PZL}$ | Propagation delay | | SDAB, SCLB | SDAA, SCLA | $V_{CCA}$ ≤ 2.7 V (see Figure 2) | 15 | 68[(4)] | 110 | ns |
| | | | | | 2.7 V ≤ $V_{CCA}$ ≤ 3 V (see Figure 2) | 20 | 79 | 130 | |
| | | | | | $V_{CCA}$ ≥ 3 V (see Figure 2) | 10 | 103[(5)] | 300 | |
| | | | SDAA, SCLA[(3)] (see Figure 3) | SDAB, SCLB[(3)] (see Figure 3) | | 45 | 118 | 230 | |
| $t_{TLH}$ | Transition time | B side to A side (see Figure 3) | 20% | 80% | | 1 | 6 | 30 | ns |
| | | A side to B side (see Figure 2) | | | | 20 | 31 | 170 | |
| $t_{THL}$ | Transition time | B side to A side | 80% | 20% | $V_{CCA}$ ≤ 2.7 V (see Figure 3) | 1 | 3[(6)] | 105 | ns |
| | | | | | 2.7 V ≤ $V_{CCA}$ ≤ 3 V (see Figure 2) | 1 | 6 | 120 | |
| | | | | | $V_{CCA}$ ≥ 3 V (see Figure 3) | 1 | 25[(7)] | 175 | |
| | | A side to B side (see Figure 2) | | | | 1 | 12 | 90 | |

(1) Typical values were measured with $V_{CCA}$ = $V_{CCB}$ = 2.7 V at $T_A$ = 25°C, unless otherwise noted.
(2) The $t_{PLH}$ delay data from B to A side is measured at 0.5 V on the B side to 0.5 $V_{CCA}$ on the A side when $V_{CCA}$ is less than 2 V, and 1.5 V on the A side if $V_{CCA}$ is greater than 2 V.
(3) The proportional delay data from A to B side is measured at 0.3 $V_{CCA}$ on the A side to 1.5 V on the B side.
(4) Typical value measured with $V_{CCA}$ = 0.9 V at $T_A$ = 25°C
(5) Typical value measured with $V_{CCA}$ = 5.5 V at $T_A$ = 25°C
(6) Typical value measured with $V_{CCA}$ = 0.9 V at $T_A$ = 25°C
(7) Typical value measured with $V_{CCA}$ = 5.5 V at $T_A$ = 25°C

# 7 Parameter Measurement Information




| TEST | S1 |
|---|---|
| $t_{PLZ}/t_{PZL}$ | $V_{CC}$ |

**TEST CIRCUIT FOR OPEN-DRAIN OUTPUT**

A. $R_L$ = 167 Ω on the A side and 1.35 kΩ on the B side

B. $R_T$ termination resistance should be equal to $Z_{OUT}$ of pulse generators.

C. $C_L$ includes probe and jig capacitance.

D. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, $Z_O$ = 50 Ω, slew rate ≥ 1 V/ns.

E. The outputs are measured one at a time, with one transition per measurement.

F. $t_{PLH}$ and $t_{PHL}$ are the same as $t_{pd}$.

G. $t_{PLZ}$ and $t_{PHZ}$ are the same as $t_{dis}$.

H. $t_{PZL}$ and $t_{PZH}$ are the same as $t_{en}$.

**Figure 1. Test Circuit**

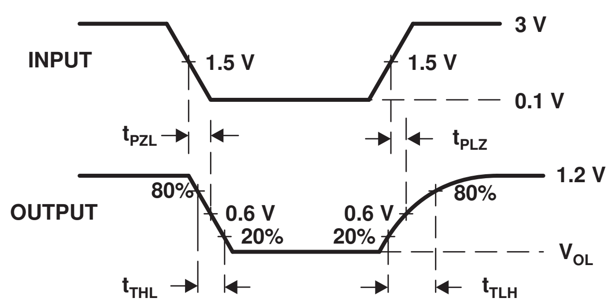



**Figure 2. Waveform 1 – Propagation Delay and Transition Times for B Side to A Side**

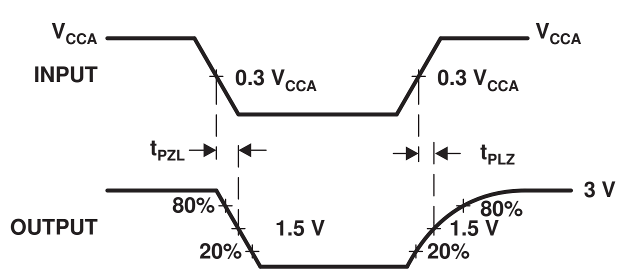



**Figure 3. Waveform 2 – Propagation Delay and Transition Times for A Side to B Side**

## Parameter Measurement Information (continued)

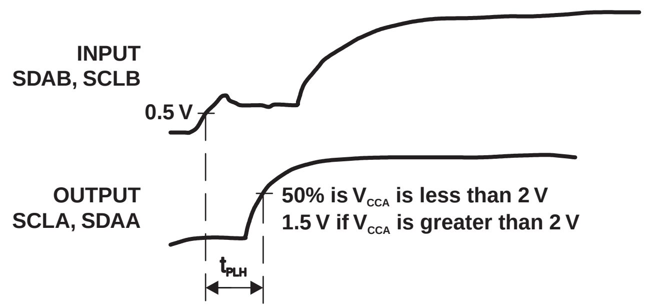
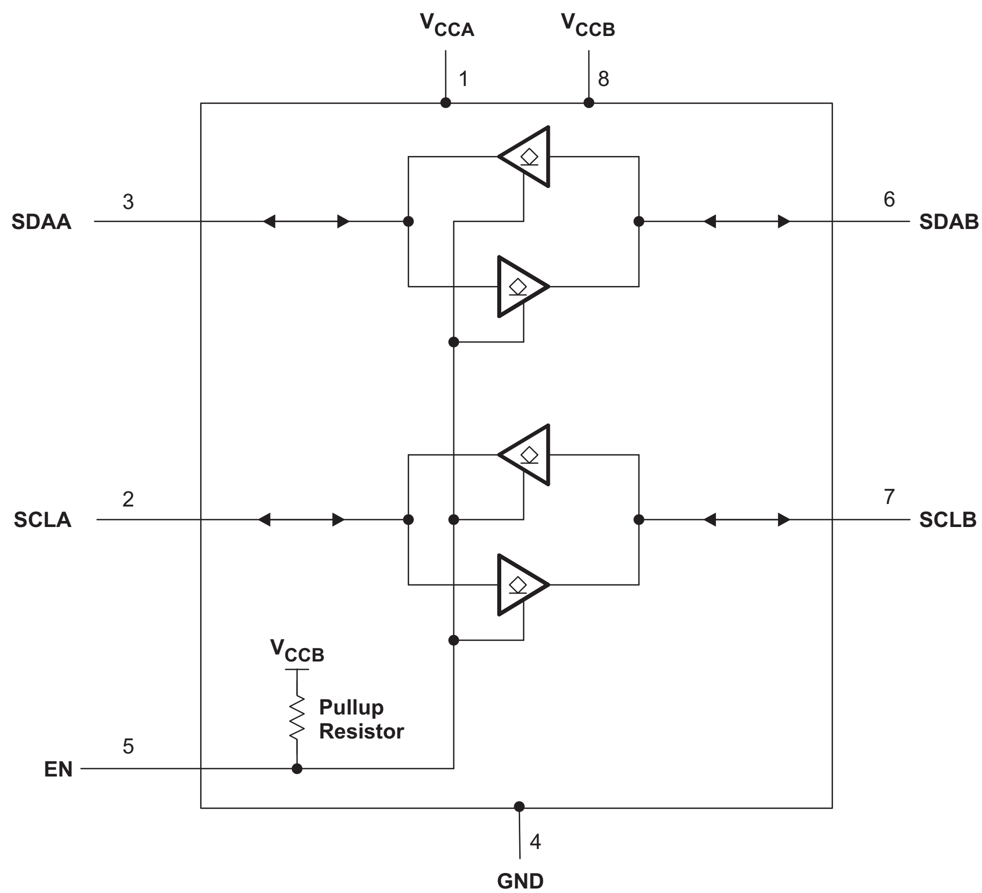



**Figure 4. Waveform 3**

# 8 Detailed Description

## 8.1 Functional Block Diagram



## 8.2 Feature Description

### 8.2.1 Clock Stretching Errata

#### Description

Due to the static offset on the B-side and the possibility of an overshoot above 500mV during events like clock stretching, the device should not be used with rise time accelerators on the B-side.

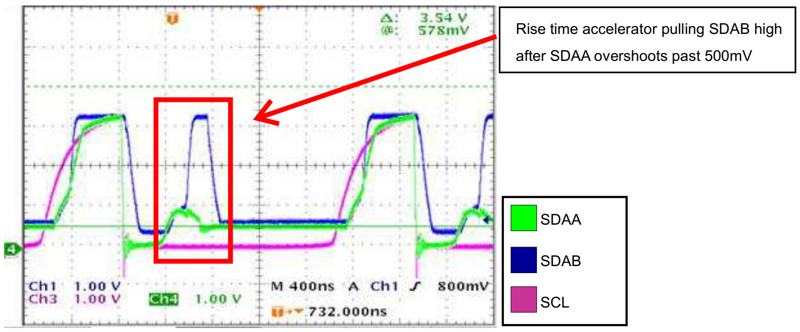



**Figure 5. Waveform of Clock Stretching with Rise Time Accelerator on the Bus**

#### System Impact

An incorrect logic state will be transferred to circuits, creating an I2C communication failure on the bus.

#### System Workaround

Usage of the TCA9517 is recommended.

There are two possible workarounds to avoid an I2C communication failure:

- Removing rise-time accelerators from the B-side bus
- Adding a larger capacitive load to the bus will limit the overshoot

### 8.2.2 Load Dependent Undershoot Errata

#### Description

There is a case in which a combination of weak pull-up resistance and light bus loading will cause communication failure through the bus due to undershoot. During a low-to-high transition, when the B-side releases from its 500mV $V_{OL}$, an undershoot below VILC can occur. In this event, the A-side will recognize this as a valid low coming from the B-side, causing the A-side to be pulled down by the buffer. The A-side being improperly pulled down by the buffer will trigger the B-side to be pulled low. Since the B-side will be pulled to 500mV, this will not force the A-side to stay low. As the A-side begins transitioning high again, the issue will repeat itself.

#### System Impact

An incorrect logic state will be transferred to circuits, creating an I2C communication failure on the bus.

#### System Workaround

Usage of the TCA9517 is recommended.

There are two possible workarounds to avoid an I2C communication failure:

- Removing rise-time accelerators from the B-side bus
- Adding a larger capacitive load to the bus will limit the overshoot

## Feature Description (continued)

### 8.2.3 Glitch/Noise Susceptibility Errata

#### Description

During the event of a glitch on the SDA/SCL line on one side of the buffer, this glitch can be propagated through and widened by the device during transfer to the other side of the buffer

#### System Impact

The widened glitch can be recognized as a valid transmission logic, causing a communication failure on the I2C bus

#### System Workaround

Usage of the TCA9517 is recommended.

Ensure glitch free SDA/SCL lines.

### 8.2.4 Load Susceptibility Errata

#### Description

There is a possibility of a race condition of the internal logic of the device that can arise due to bus loading. Within a narrow window, dependent on the following parameters, the internal latch controlling the direction of transfer is set in the wrong state after a falling edge on SCLA/SDAA

- Pull-up resistance
- Bus capacitance
- Temperature

This window location will shift based on the combination of these parameters, therefore cannot be bounded. The typical bus capacitance window is observed to be ~2pF wide for a given pull-up resistance and at a given temperature. The typical temperature window for a given pull-up resistance and bus capacitance is observed to be ~0.8°C wide. This phenomenon can be exacerbated by noise/glitching on the bus.

#### System Impact

An incorrect logic state will be transferred through the device creating an I2C communication failure on the bus (Figure 6). The bus has the potential to lock under certain external conditions.

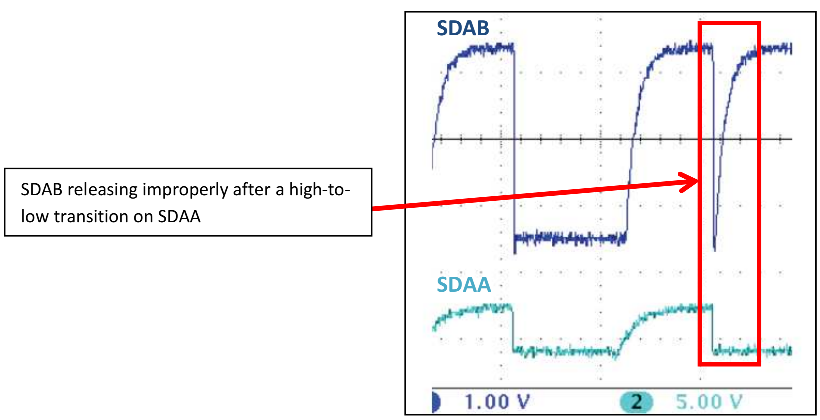



**Figure 6. Load Susceptibility Failure Signature**

#### System Workaround

Usage of the TCA9517 is recommended.

### 8.3 Device Functional Modes

**Table 1. Function Table**

| INPUT<br>EN | FUNCTION |
|---|---|
| L | Outputs disabled |
| H | SDAA = SDAB<br>SCLA = SCLB |

# 9 Application and Implementation

## 9.1 Typical Application

A typical application is shown in Figure 7. In this example, the system master is running on a 3.3-V I²C bus, and the slave is connected to a 1.2-V bus. Both buses run at 400 kHz. Master devices can be placed on either bus.

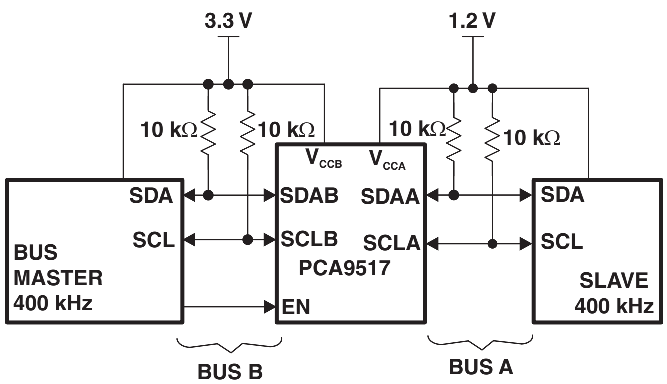



**Figure 7. Typical Application**

## Typical Application (continued)

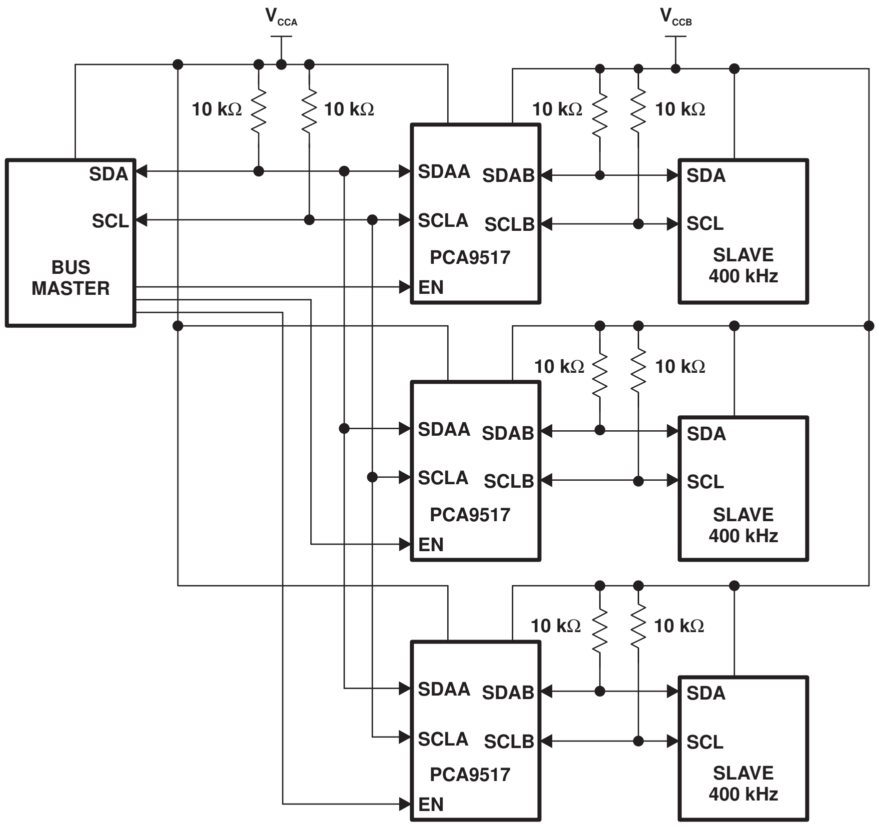



**Figure 8. Typical Star Application**

### 9.1.1 Design Requirements

The PCA9517 is 5-V tolerant, so it does not require any additional circuitry to translate between 0.9-V to 5.5-V bus voltages and 2.7-V to 5.5-V bus voltages.

When the A side of the PCA9517 is pulled low by a driver on the $I^2C$ bus, a comparator detects the falling edge when it goes below 0.3 $V_{CCA}$ and causes the internal driver on the B side to turn on, causing the B side to pull down to about 0.5 V. When the B side of the PCA9517 falls, first a CMOS hysteresis-type input detects the falling edge and causes the internal driver on the A side to turn on and pull the A-side pin down to ground. In order to illustrate what would be seen in a typical application, refer to Figure 9 and Figure 10. If the bus master in Figure 7 were to write to the slave through the PCA9517, waveforms shown in Figure 9 would be observed on the A bus. This looks like a normal $I^2C$ transmission, except that the high level may be as low as 0.9 V, and the turn on and turn off of the acknowledge signals are slightly delayed.

On the B-side bus of the PCA9517, the clock and data lines would have a positive offset from ground equal to the $V_{OL}$ of the PCA9517. After the eighth clock pulse, the data line is pulled to the $V_{OL}$ of the slave device, which is very close to ground in this example. At the end of the acknowledge, the level rises only to the low level set by the driver in the PCA9517 for a short delay, while the A-bus side rises above 0.3 $V_{CCA}$ and then continues high.

## Typical Application (continued)

### 9.1.2 Detailed Design Procedure

Multiple PCA9517 A sides can be connected in a star configuration, allowing all nodes to communicate with each other.

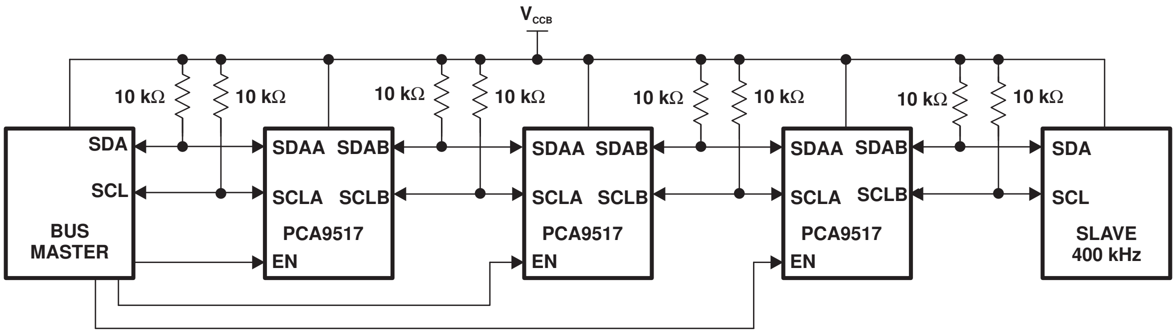



**Figure 9. Typical Series Application**

Multiple PCA9517s can be connected in series as long as the A side is connected to the B side. I²C bus slave 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.

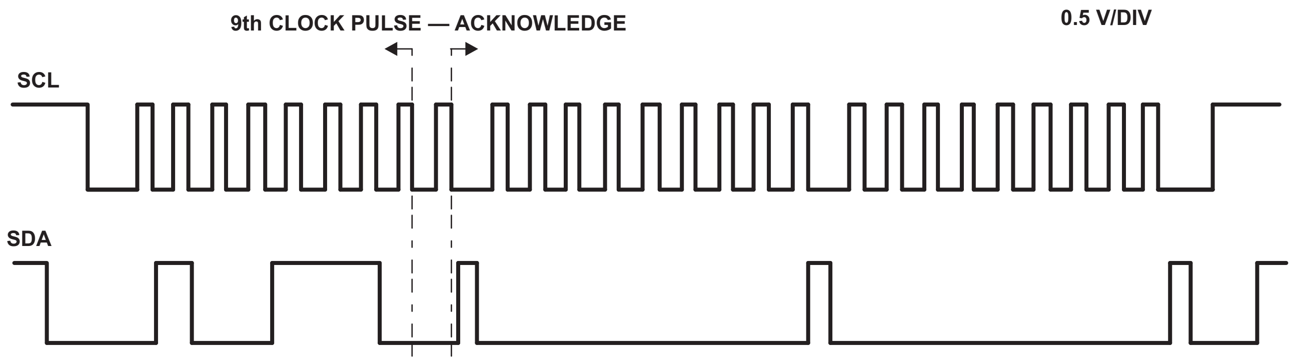



**Figure 10. Bus A (0.9-V to 5.5-V Bus) Waveform**

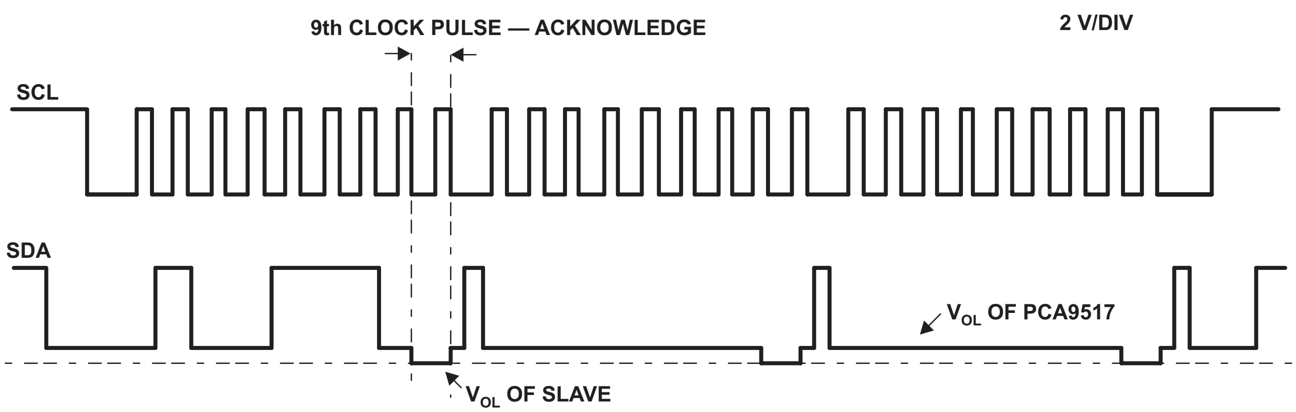



**Figure 11. Bus B (2.7-V to 5.5-V Bus) Waveform**

# 10 Device and Documentation Support

## 10.1 Trademarks

All trademarks are the property of their respective owners.

## 10.2 Electrostatic Discharge Caution

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## 10.3 Glossary

SLYZ022 — *TI Glossary*.

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

# 11 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) |
|---|---|---|---|---|---|---|---|---|---|
| PCA9517DGKR | NRND | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU \| NIPDAUAG | Level-1-260C-UNLIM | -40 to 85 | (7EA, 7EE, 7EF) |
| PCA9517DGKR.A | NRND | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (7EA, 7EE, 7EF) |
| PCA9517DGKRG4 | NRND | Production | VSSOP (DGK) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | (7EA, 7EE, 7EF) |
| PCA9517DR | NRND | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PD517 |
| PCA9517DR.A | NRND | Production | SOIC (D) \| 8 | 2500 \| LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PD517 |

(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.

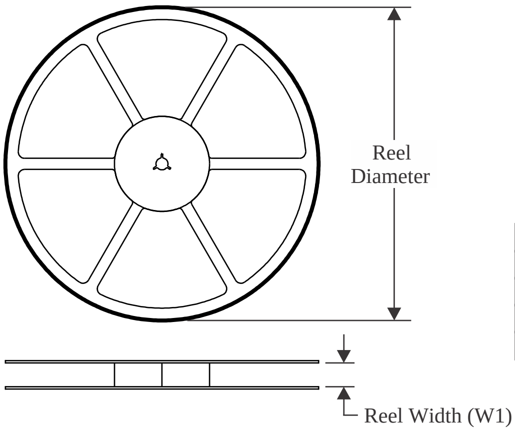
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

**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.

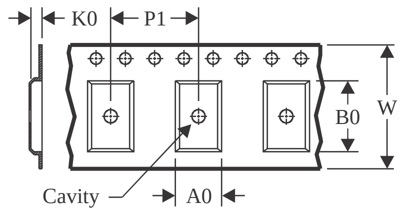
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

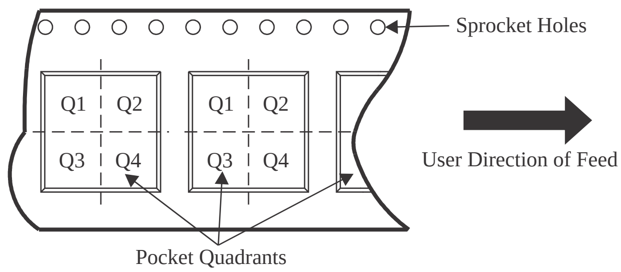



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

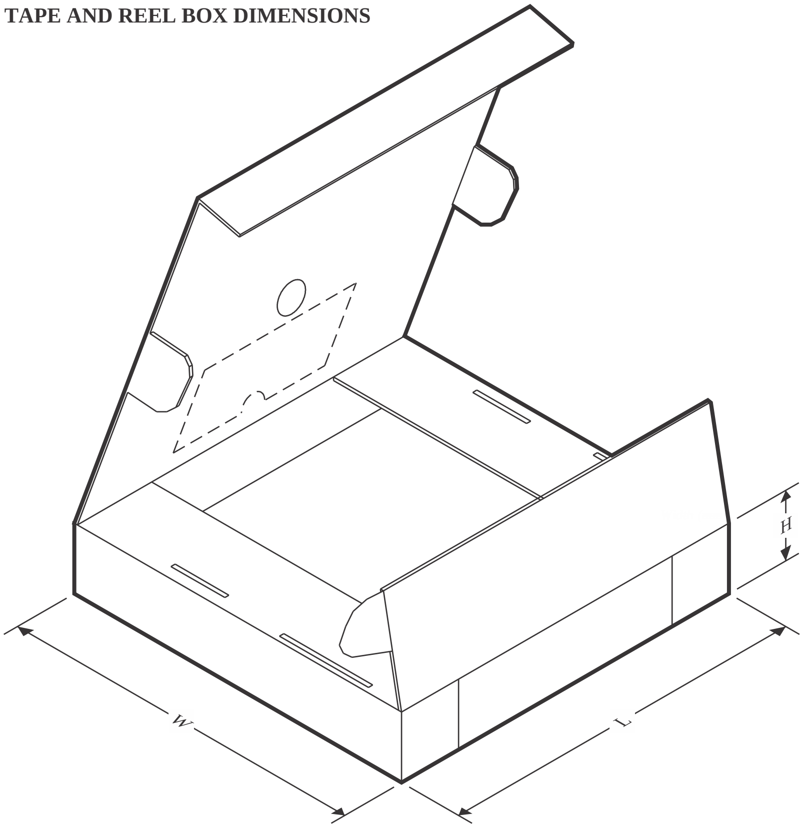
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCA9517DGKR | VSSOP | DGK | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| PCA9517DR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |

**TAPE AND REEL BOX DIMENSIONS**

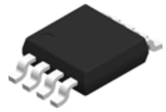



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| PCA9517DGKR | VSSOP | DGK | 8 | 2500 | 364.0 | 364.0 | 27.0 |
| PCA9517DR | SOIC | D | 8 | 2500 | 356.0 | 356.0 | 35.0 |

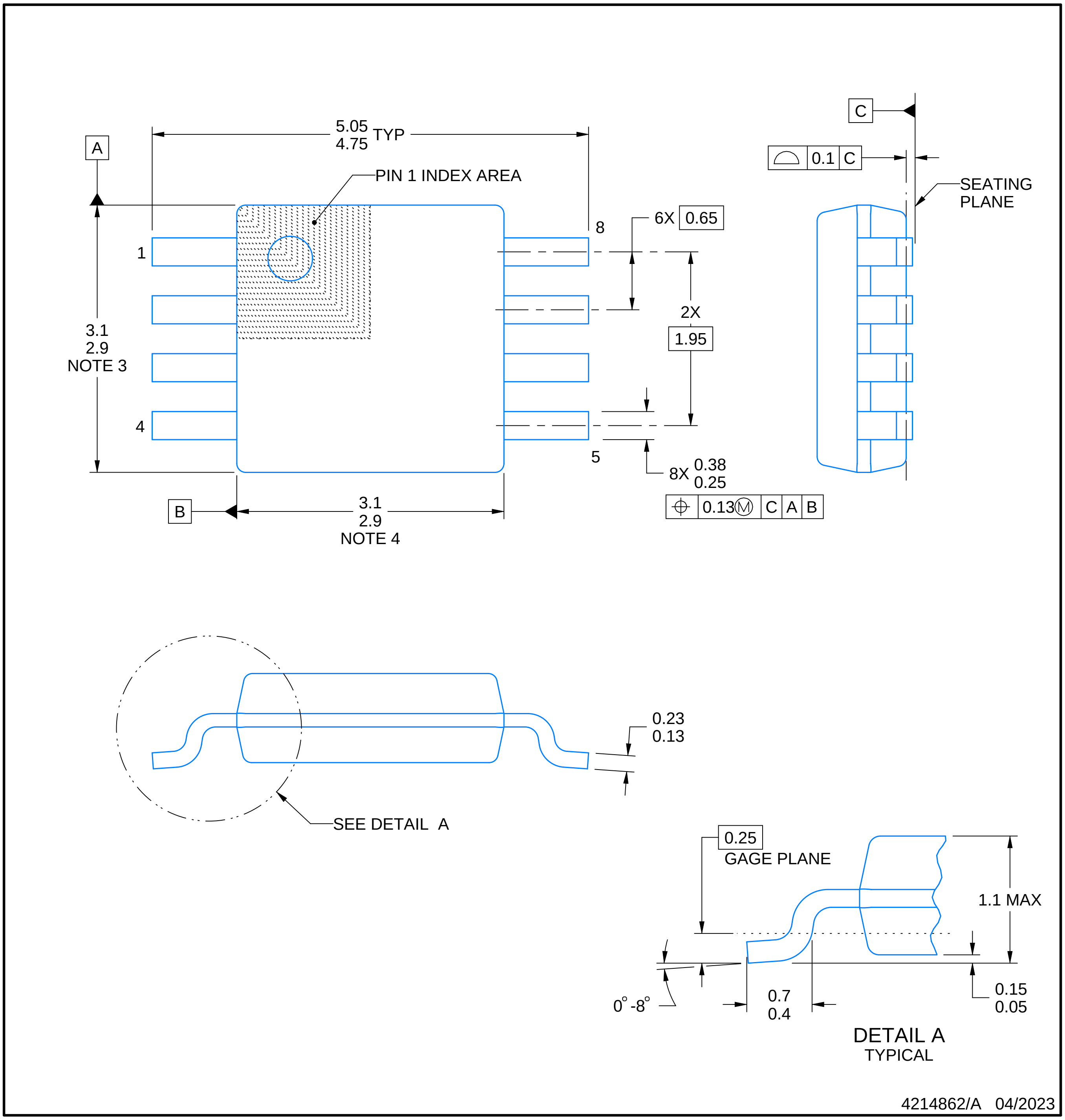
# PACKAGE OUTLINE

## DGK0008A



**VSSOP - 1.1 mm max height**

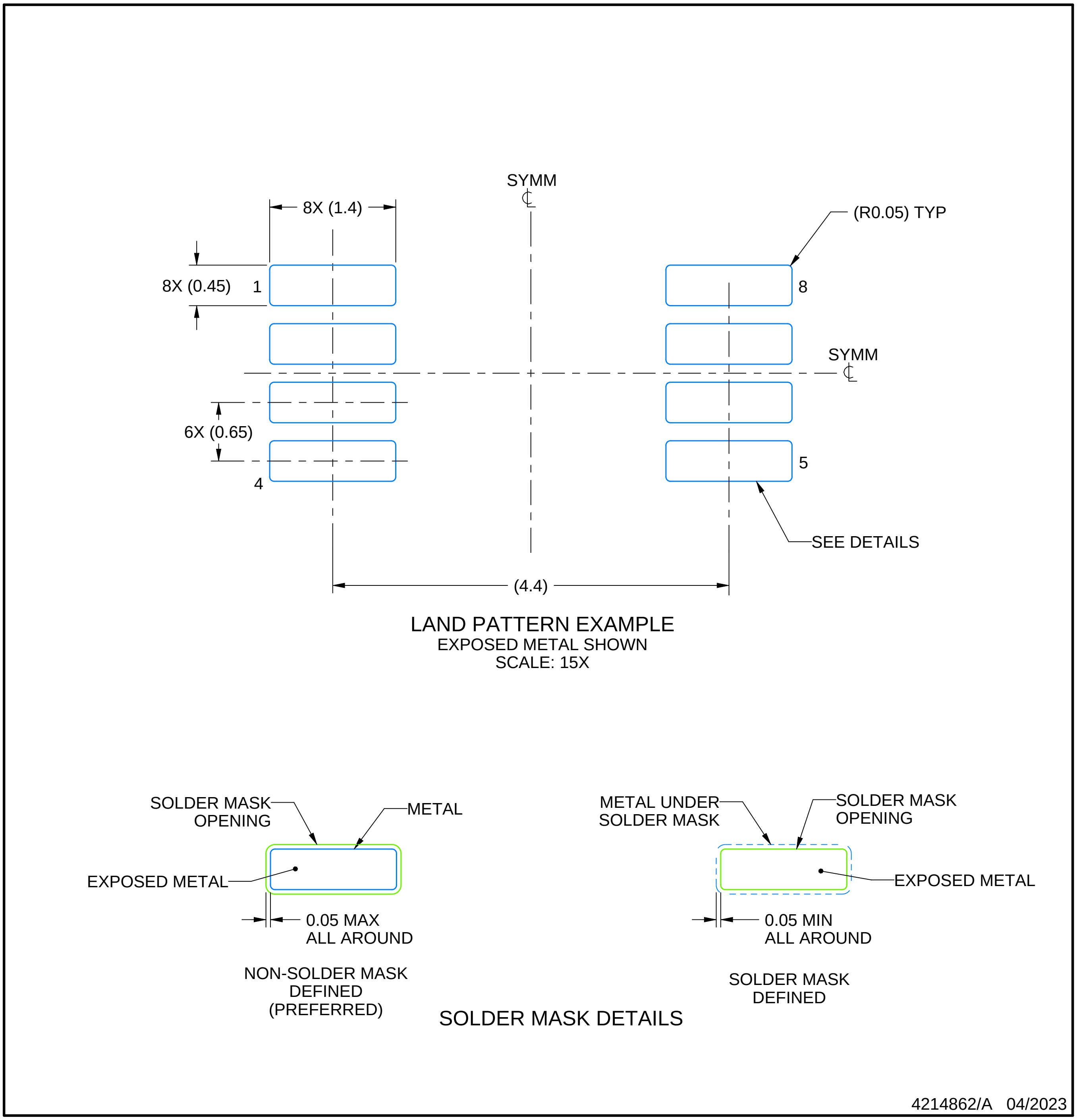
SMALL OUTLINE PACKAGE




PowerPAD is a trademark of Texas Instruments.

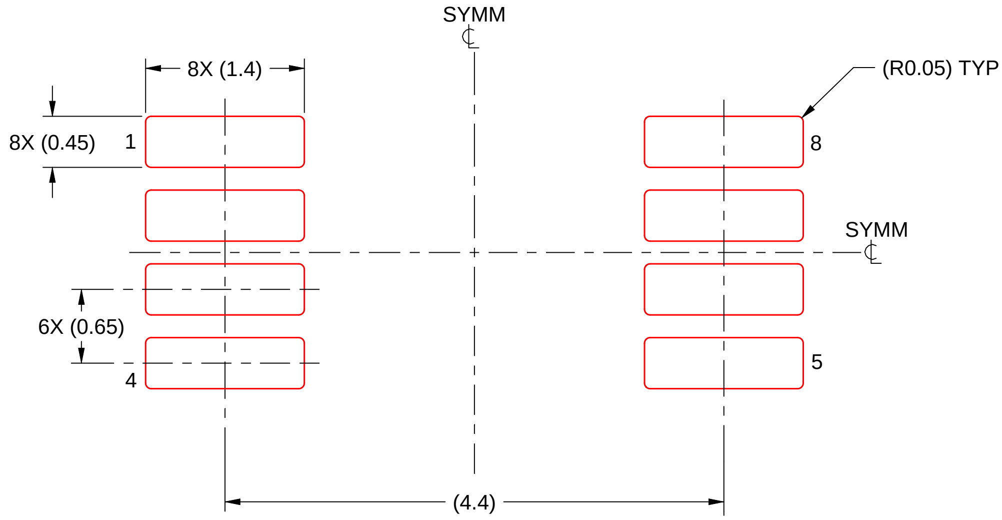
NOTES:

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.




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.



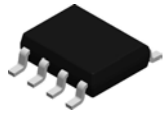

SOLDER PASTE EXAMPLE
SCALE: 15X

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.

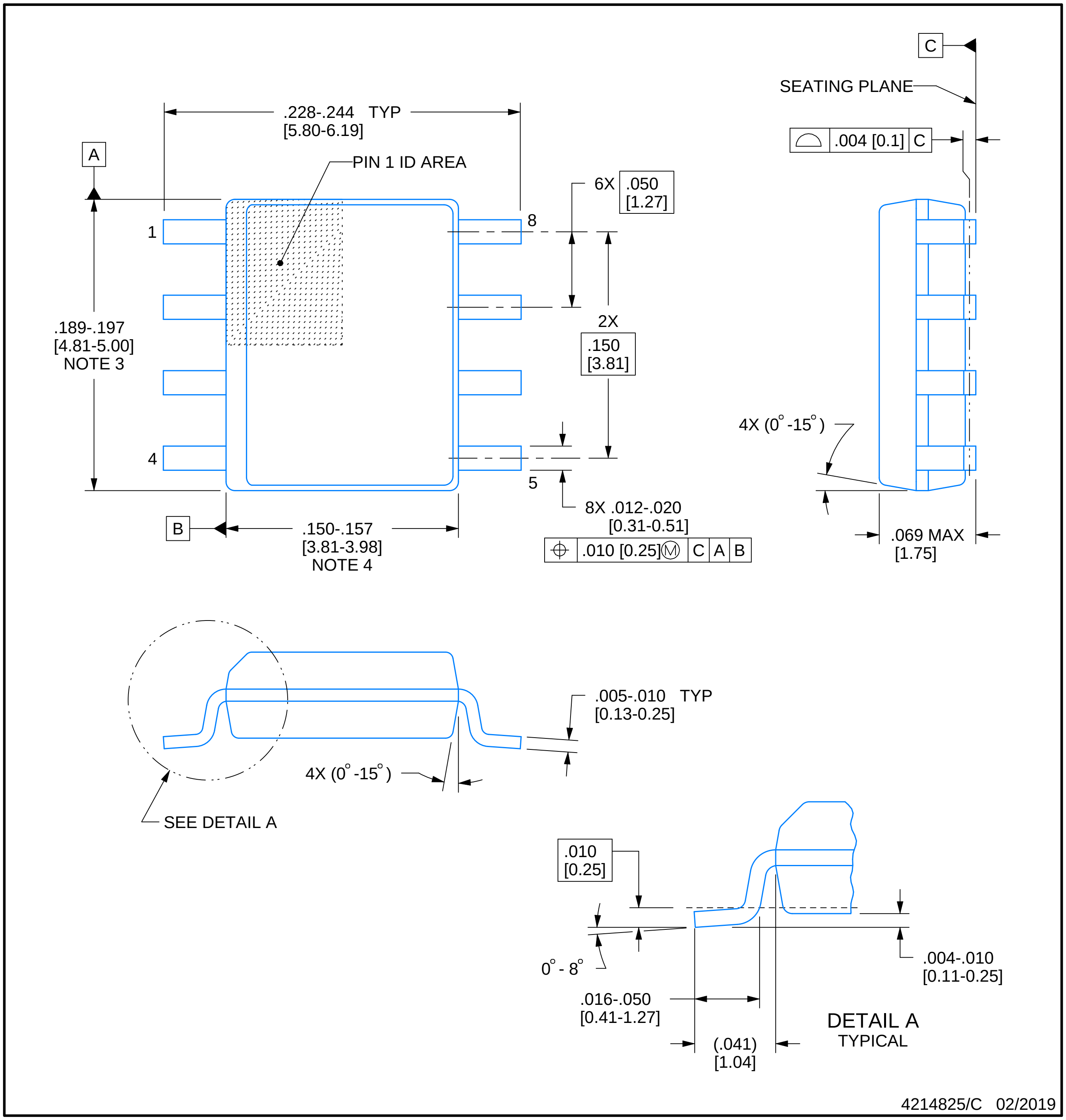
# PACKAGE OUTLINE



# D0008A

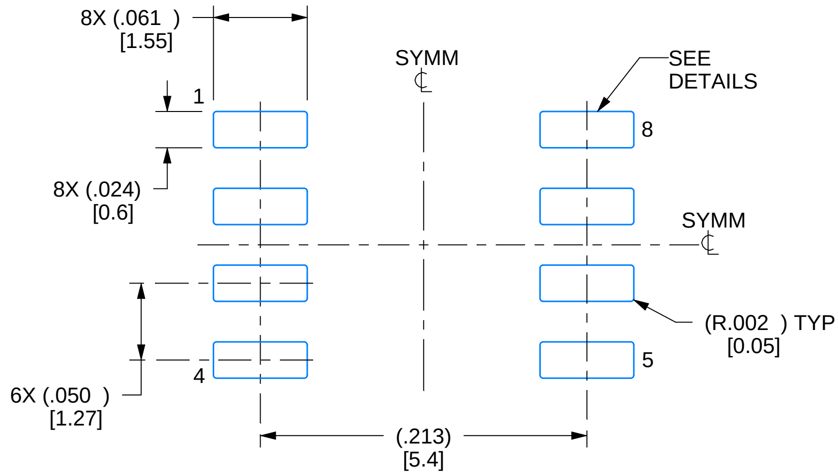
## SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

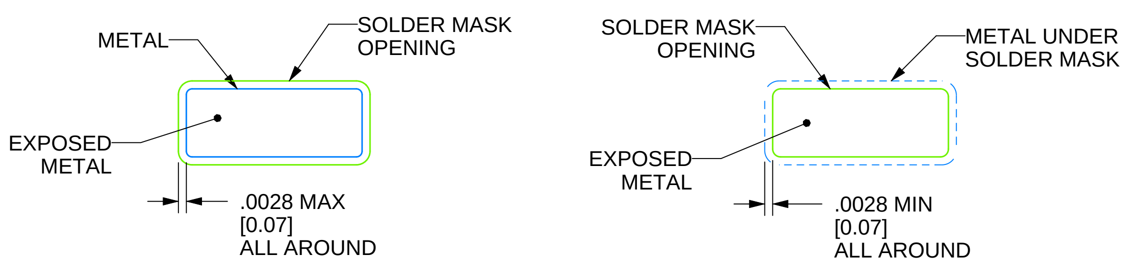



NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. 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 .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X




NON SOLDER MASK
DEFINED

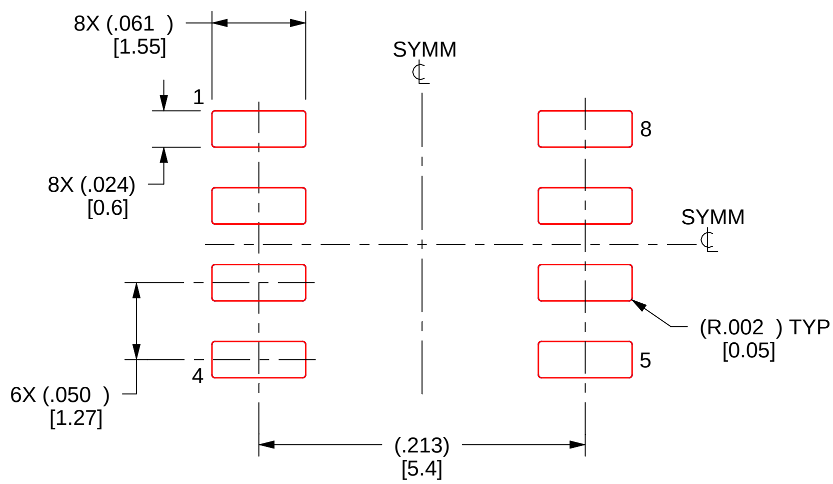
SOLDER MASK
DEFINED

SOLDER MASK DETAILS

4214825/C 02/2019

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.




SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

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