

SNx4HC595 8-Bit Shift Registers With 3-State Output Registers

1 Features

- 8-bit serial-in, parallel-out shift
- Wide operating voltage range of 2 V to 6 V
- High-current 3-state outputs can drive up to 15 LSTTL loads
- Low power consumption: 80- μ A (maximum) I_{CC}
- $t_{pd} = 13$ ns (typical)
- ± 6 -mA output drive at 5 V
- Low input current: 1 μ A (maximum)
- Shift register has direct clear
- On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

2 Applications

- Network switches
- Power infrastructure
- LED displays
- Servers

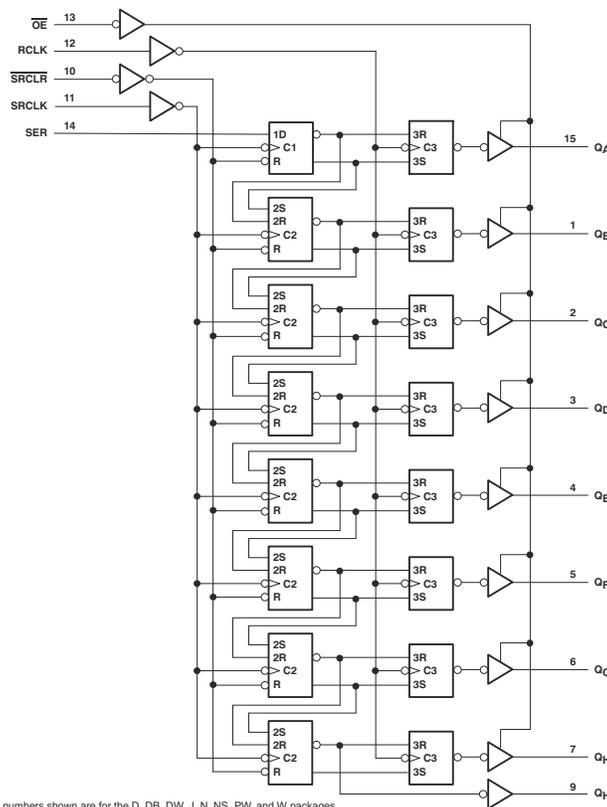
3 Description

The SNx4HC595 devices contain an 8-bit, serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. The storage register has parallel 3-state outputs. Separate clocks are provided for both the shift and storage register. The shift register has a direct overriding clear (SRCLR) input, serial (SER) input, and serial outputs for cascading. When the output-enable (\overline{OE}) input is high, the outputs are in the high-impedance state.

Device Information

| PART NUMBER | PACKAGE ⁽¹⁾ | BODY SIZE (NOM) |
|-------------|------------------------|--------------------|
| SN54HC595FK | LCCC (20) | 8.89 mm × 8.89 mm |
| SN54HC595J | CDIP (16) | 21.34 mm × 6.92 mm |
| SN74HC595N | PDIP (16) | 19.31 mm × 6.35 mm |
| SN74HC595D | SOIC (16) | 9.90 mm × 3.90 mm |
| SN74HC595DW | SOIC (16) | 10.30 mm × 7.50 mm |
| SN74HC595DB | SSOP (16) | 6.20 mm × 5.30 mm |
| SN74HC595PW | TSSOP (16) | 5.00 mm × 4.40 mm |

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



Functional Block Diagram



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4 Revision History

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

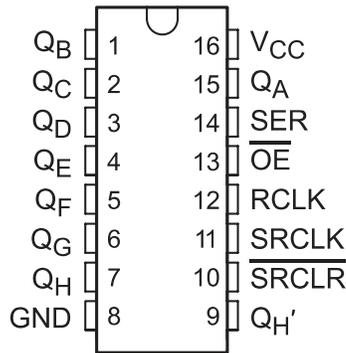
Changes from Revision H (November 2009) to Revision I (August 2015) Page

- Added *Applications* section, *Device Information* table, *Pin Configuration and Functions* section, *ESD Ratings* table, *Thermal Information* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section 1
- Deleted *Ordering Information* table. 1
- Added Military Disclaimer to *Features* list..... 1

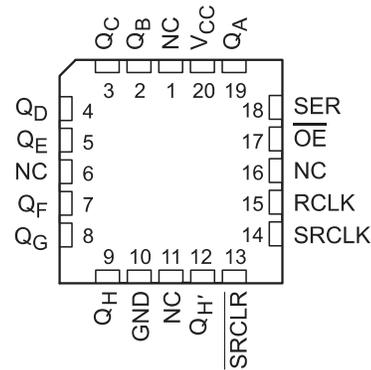
Changes from Revision I (August 2015) to Revision J (October 2021) Page

- Updated the device information table, ESD ratings table, and the device functional modes table to fit modern data sheet standards..... 1

5 Pin Configuration and Functions



D, N, NS, J, DB, or PW Package
16-Pin SOIC, PDIP, SO, CDIP, SSOP, or TSSOP
Top View



FK Package
20-Pin LCCC
Top View

Table 5-1. Pin Functions

| NAME | PIN | | I/O ⁽¹⁾ | DESCRIPTION |
|--------------------|--------------------------------------|------|--------------------|--------------------------|
| | SOIC, PDIP, SO, CDIP, SSOP, or TSSOP | LCCC | | |
| GND | 8 | 10 | — | Ground Pin |
| \overline{OE} | 13 | 17 | I | Output Enable |
| Q _A | 15 | 19 | O | Q _A Output |
| Q _B | 1 | 2 | O | Q _B Output |
| Q _C | 2 | 3 | O | Q _C Output |
| Q _D | 3 | 4 | O | Q _D Output |
| Q _E | 4 | 5 | O | Q _E Output |
| Q _F | 5 | 7 | O | Q _F Output |
| Q _G | 6 | 8 | O | Q _G Output |
| Q _H | 7 | 9 | O | Q _H Output |
| Q _{H'} | 9 | 12 | O | Q _{H'} Output |
| RCLK | 12 | 14 | I | RCLK Input |
| SER | 14 | 18 | I | SER Input |
| SRCLK | 11 | 14 | I | SRCLK Input |
| \overline{SRCLR} | 10 | 13 | I | \overline{SRCLR} Input |
| NC | — | 1 | — | No Connection |
| | | 16 | | |
| | | 11 | | |
| | | 16 | | |
| V _{CC} | — | 20 | — | Power Pin |

(1) Signal Types: I = Input, O = Output, I/O = Input or Output.

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT |
|------------------|---------------------------------------------------|--------------------------------------------------------|-----|-----------|
| V _{CC} | Supply voltage | -0.5 | 7 | V |
| I _{IK} | Input clamp current ⁽²⁾ | V _I < 0 or V _I > V _{CC} | | ±20 mA |
| I _{OK} | Output clamp current ⁽²⁾ | V _O < 0 or V _O > V _{CC} | | ±20 mA |
| I _O | Continuous output current | V _O = 0 to V _{CC} | | ±35 mA |
| | Continuous current through V _{CC} or GND | | | ±70 mA |
| T _J | Junction temperature | | | 150 °C |
| T _{stg} | Storage temperature | -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 and output voltage ratings may be exceeded if the input and output current ratings are observed.

6.2 ESD Ratings

| | | VALUE | UNIT |
|--------------------|-------------------------|-----------------------------------------------------------------------|------|
| V _(ESD) | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | 2000 |
| | | Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002 ⁽²⁾ | 1000 |

- (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)⁽¹⁾

| | | SN54HC595 | | | SN74HC595 | | | UNIT |
|-----------------|---------------------------------------------------|-------------------------|-----|-----------------|-----------|-----|-----------------|------|
| | | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} | Supply voltage | 2 | 5 | 6 | 2 | 5 | 6 | V |
| V _{IH} | High-level input voltage | V _{CC} = 2 V | | 1.5 | 1.5 | | | V |
| | | V _{CC} = 4.5 V | | 3.15 | 3.15 | | | |
| | | V _{CC} = 6 V | | 4.2 | 4.2 | | | |
| V _{IL} | Low-level input voltage | V _{CC} = 2 V | | | 0.5 | | 0.5 | V |
| | | V _{CC} = 4.5 V | | | 1.35 | | 1.35 | |
| | | V _{CC} = 6 V | | | 1.8 | | 1.8 | |
| V _I | Input voltage | 0 | | V _{CC} | 0 | | V _{CC} | V |
| V _O | Output voltage | 0 | | V _{CC} | 0 | | V _{CC} | V |
| Δt/Δv | Input transition rise or fall time ⁽²⁾ | V _{CC} = 2 V | | | 1000 | | 1000 | ns |
| | | V _{CC} = 4.5 V | | | 500 | | 500 | |
| | | V _{CC} = 6 V | | | 400 | | 400 | |
| T _A | Operating free-air temperature | -55 | | 125 | -40 | | 85 | °C |

- (1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. See the TI application report, *Implications of Slow or Floating CMOS Inputs*, [SCBA004](#).
- (2) If this device is used in the threshold region (from V_{IL} max = 0.5 V to V_{IH} min = 1.5 V), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at t_i = 1000 ns and V_{CC} = 2 V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.

6.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | SN74HC595 | | | | | | UNIT |
|---------------------------------------------------------|-----------|-----------|-----------|----------|---------|------------|------|
| | D (SOIC) | DB (SSOP) | DW (SOIC) | N (PDIP) | NS (SO) | PW (TSSOP) | |
| | 16 PINS | 16 PINS | 16 PINS | 16 PINS | 16 PINS | 16 PINS | |
| R _{θJA} Junction-to-ambient thermal resistance | 73 | 82 | 57 | 67 | 64 | 108 | °C/W |

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

6.5 Electrical Characteristics

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

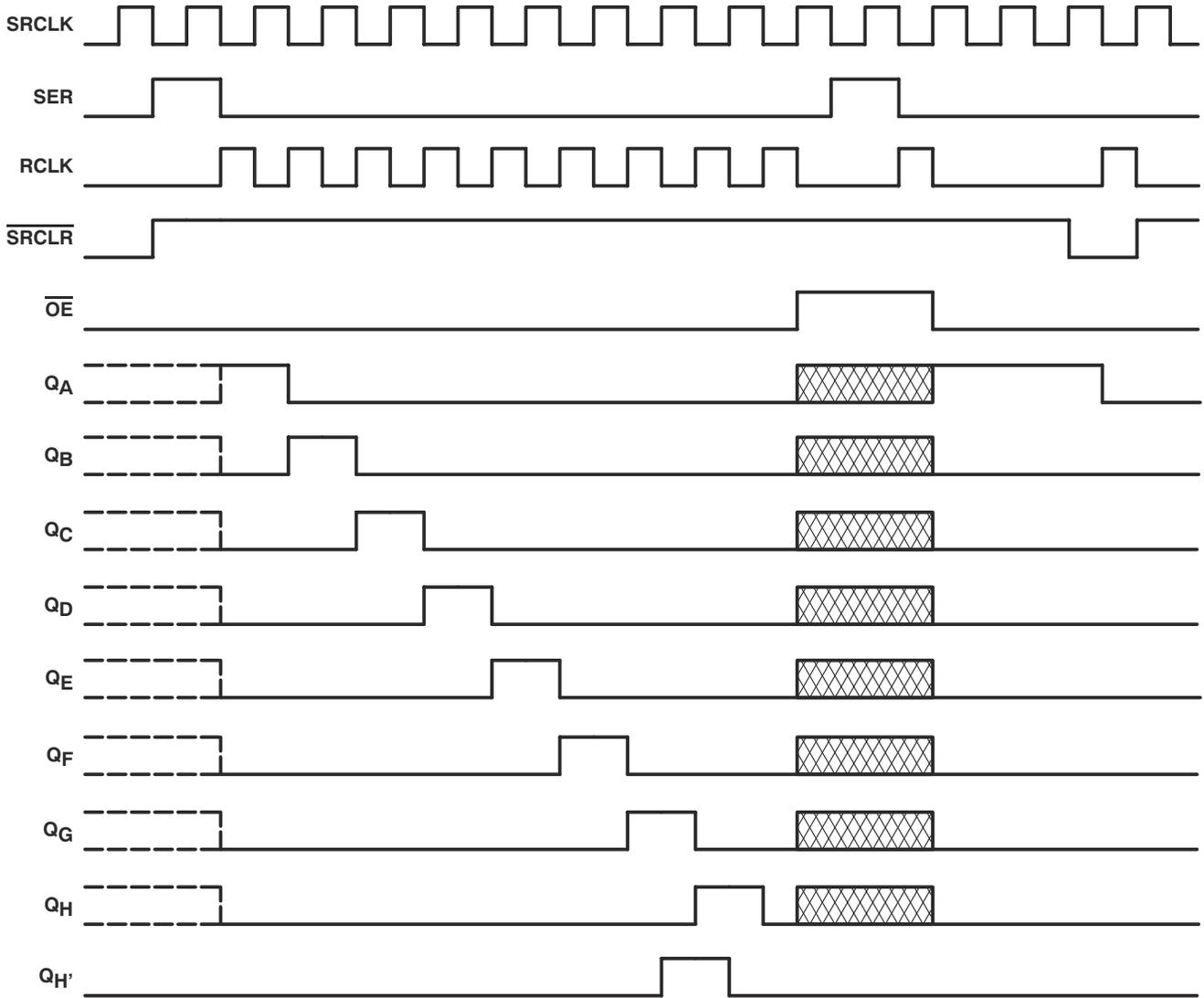
| PARAMETER | TEST CONDITIONS | | V _{CC} | T _A = 25°C | | | SN54HC595 | | SN74HC595 | | UNIT |
|-----------------|------------------------------------------------------------------------|--------------------------|-----------------------------------------------------------|-----------------------|-------|------|-----------|-------|-----------|-----|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| V _{OH} | V _I = V _{IH} or V _{IL} | I _{OH} = -20 μA | 2 V | 1.9 | 1.998 | | 1.9 | | 1.9 | V | |
| | | | 4.5 V | 4.4 | 4.499 | | 4.4 | | 4.4 | | |
| | | | 6 V | 5.9 | 5.999 | | 5.9 | | 5.9 | | |
| | | 4.5 V | Q _H , I _{OH} = -4 mA | 3.98 | 4.3 | | 3.7 | | 3.84 | | |
| | | | Q _A - Q _H , I _{OH} = -6 mA | 3.98 | 4.3 | | 3.7 | | 3.84 | | |
| | | | Q _H , I _{OH} = -5.2 mA | 5.48 | 5.8 | | 5.2 | | 5.34 | | |
| 6 V | Q _A - Q _H , I _{OH} = -7.8 mA | 5.48 | 5.8 | | 5.2 | | 5.34 | | | | |
| V _{OL} | V _I = V _{IH} or V _{IL} | I _{OL} = 20 μA | 2 V | | 0.002 | 0.1 | | 0.1 | 0.1 | V | |
| | | | 4.5 V | | 0.001 | 0.1 | | 0.1 | 0.1 | | |
| | | | 6 V | | 0.001 | 0.1 | | 0.1 | 0.1 | | |
| | | 4.5 V | Q _H , I _{OL} = 4 mA | | 0.17 | 0.26 | | 0.4 | 0.33 | | |
| | | | Q _A - Q _H , I _{OL} = 6 mA | | 0.17 | 0.26 | | 0.4 | 0.33 | | |
| | | | Q _H , I _{OL} = 5.2 mA | | 0.15 | 0.26 | | 0.4 | 0.33 | | |
| 6 V | Q _A - Q _H , I _{OL} = 7.8 mA | | 0.15 | 0.26 | | 0.4 | 0.33 | | | | |
| I _I | V _I = V _{CC} or 0 | 6 V | | ±0.1 | ±100 | | ±1000 | ±1000 | nA | | |
| I _{OZ} | V _O = V _{CC} or 0, Q _A - Q _H | 6 V | | ±0.01 | ±0.5 | | ±10 | ±5 | μA | | |
| I _{CC} | V _I = V _{CC} or 0, I _O = 0 | 6 V | | | 8 | | 160 | 80 | μA | | |
| C _i | | 2 V to 6 V | | 3 | 10 | | 10 | 10 | pF | | |

6.6 Timing Requirements

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

| | | V _{CC} | T _A = 25°C | | SN54HC595 | | SN74HC595 | | UNIT |
|--------------------|-------------------------------------|-----------------|-----------------------|-----|-----------|-----|-----------|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| f _{clock} | Clock frequency | 2 V | 6 | | 4.2 | | 5 | | MHz |
| | | 4.5 V | 31 | | 21 | | 25 | | |
| | | 6 V | 36 | | 25 | | 29 | | |
| t _w | SRCLK or RCLK high or low | 2 V | 80 | | 120 | | 100 | ns | |
| | | 4.5 V | 16 | | 24 | | 20 | | |
| | | 6 V | 14 | | 20 | | 17 | | |
| | SRCLR low | 2 V | 80 | | 120 | | 100 | | |
| | | 4.5 V | 16 | | 24 | | 20 | | |
| | | 6 V | 14 | | 20 | | 17 | | |
| t _{su} | SER before SRCLK↑ | 2 V | 100 | | 150 | | 125 | ns | |
| | | 4.5 V | 20 | | 30 | | 25 | | |
| | | 6 V | 17 | | 25 | | 21 | | |
| | SRCLK↑ before RCLK↑ ⁽¹⁾ | 2 V | 75 | | 113 | | 94 | | |
| | | 4.5 V | 15 | | 23 | | 19 | | |
| | | 6 V | 13 | | 19 | | 16 | | |
| | SRCLR low before RCLK↑ | 2 V | 50 | | 75 | | 65 | | |
| | | 4.5 V | 10 | | 15 | | 13 | | |
| | | 6 V | 9 | | 13 | | 11 | | |
| | SRCLR high (inactive) before SRCLK↑ | 2 V | 50 | | 75 | | 60 | | |
| | | 4.5 V | 10 | | 15 | | 12 | | |
| | | 6 V | 9 | | 13 | | 11 | | |
| t _h | Hold time, SER after SRCLK↑ | 2 V | 0 | | 0 | | 0 | ns | |
| | | 4.5 V | 0 | | 0 | | 0 | | |
| | | 6 V | 0 | | 0 | | 0 | | |

(1) This set-up time allows the storage register to receive stable data from the shift register. The clocks can be tied together, in which case the shift register is one clock pulse ahead of the storage register.



NOTE:  implies that the output is in 3-State mode.

Figure 6-1. Timing Diagram

6.7 Switching Characteristics

Over recommended operating free-air temperature range.

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | V _{CC} | T _A = 25°C | | | SN54HC595 | | SN74HC595 | | UNIT |
|------------------|---------------------------|---------------------------------|------------------|-----------------|-----------------------|-----|-----|-----------|-----|-----------|-----|------|
| | | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| f _{max} | | | 50 pF | 2 V | 6 | 26 | | 4.2 | 5 | MHz | | |
| | | | | 4.5 V | 31 | 38 | | 21 | 25 | | | |
| | | | | 6 V | 36 | 42 | | 25 | 29 | | | |
| t _{pd} | SRCLK | Q _{H'} | 50 pF | 2 V | | 50 | 160 | 240 | 200 | ns | | |
| | | | | 4.5 V | | 17 | 32 | 48 | 40 | | | |
| | | | | 6 V | | 14 | 27 | 41 | 34 | | | |
| | RCLK | Q _A – Q _H | 50 pF | 2 V | | 50 | 150 | 225 | 187 | | | |
| | | | | 4.5 V | | 17 | 30 | 45 | 37 | | | |
| | | | | 6 V | | 14 | 26 | 38 | 32 | | | |
| t _{PHL} | $\overline{\text{SRCLR}}$ | Q _{H'} | 50 pF | 2 V | | 51 | 175 | 261 | 219 | ns | | |
| | | | | 4.5 V | | 18 | 35 | 52 | 44 | | | |
| | | | | 6 V | | 15 | 30 | 44 | 37 | | | |
| t _{en} | $\overline{\text{OE}}$ | Q _A – Q _H | 50 pF | 2 V | | 40 | 150 | 255 | 187 | ns | | |
| | | | | 4.5 V | | 15 | 30 | 45 | 37 | | | |
| | | | | 6 V | | 13 | 26 | 38 | 32 | | | |
| t _{dis} | $\overline{\text{OE}}$ | Q _A – Q _H | 50 pF | 2 V | | 42 | 200 | 300 | 250 | ns | | |
| | | | | 4.5 V | | 23 | 40 | 60 | 50 | | | |
| | | | | 6 V | | 20 | 34 | 51 | 43 | | | |
| t _t | | Q _A – Q _H | 50 pF | 2 V | | 28 | 60 | 90 | 75 | ns | | |
| | | | | 4.5 V | | 8 | 12 | 18 | 15 | | | |
| | | | | 6 V | | 6 | 10 | 15 | 13 | | | |
| | | Q _{H'} | 50 pF | 2 V | | 28 | 75 | 110 | 95 | | | |
| | | | | 4.5 V | | 8 | 15 | 22 | 19 | | | |
| | | | | 6 V | | 6 | 13 | 19 | 16 | | | |
| t _{pd} | RCLK | Q _A – Q _H | 150 pf | 2 V | | 60 | 200 | 300 | 250 | ns | | |
| | | | | 4.5 V | | 22 | 40 | 60 | 50 | | | |
| | | | | 6 V | | 19 | 34 | 51 | 43 | | | |
| t _{en} | $\overline{\text{OE}}$ | Q _A – Q _H | 150 pf | 2 V | | 70 | 200 | 298 | 250 | ns | | |
| | | | | 4.5 V | | 23 | 40 | 60 | 50 | | | |
| | | | | 6 V | | 19 | 34 | 51 | 43 | | | |
| t _t | | Q _A – Q _H | 150 pf | 2 V | | 45 | 210 | 315 | 265 | ns | | |
| | | | | 4.5 V | | 17 | 42 | 63 | 53 | | | |
| | | | | 6 V | | 13 | 36 | 53 | 45 | | | |

6.8 Operating Characteristics

T_A = 25°C

| PARAMETER | TEST CONDITIONS | TYP | UNIT |
|-----------------------------------------------|-----------------|-----|------|
| C _{pd} Power dissipation capacitance | No load | 400 | pF |

6.9 Typical Characteristics

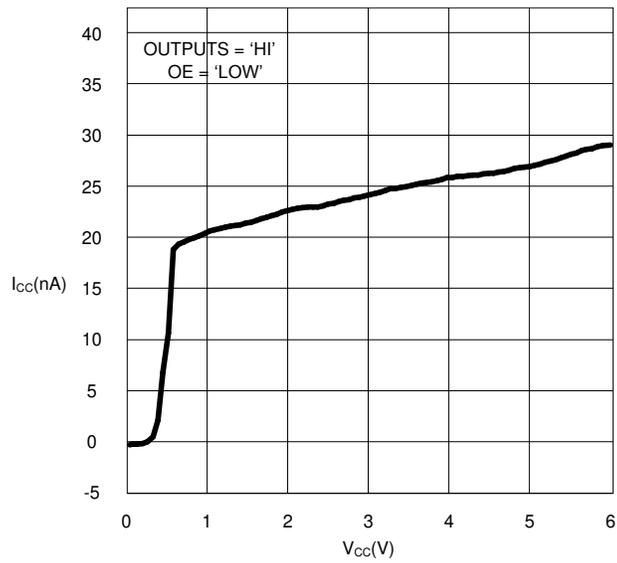
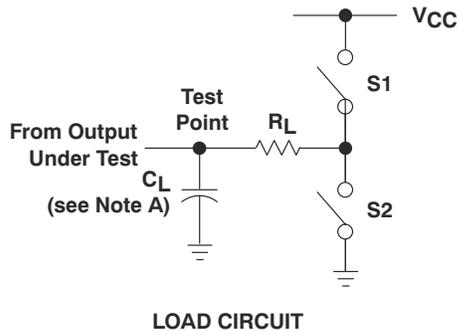
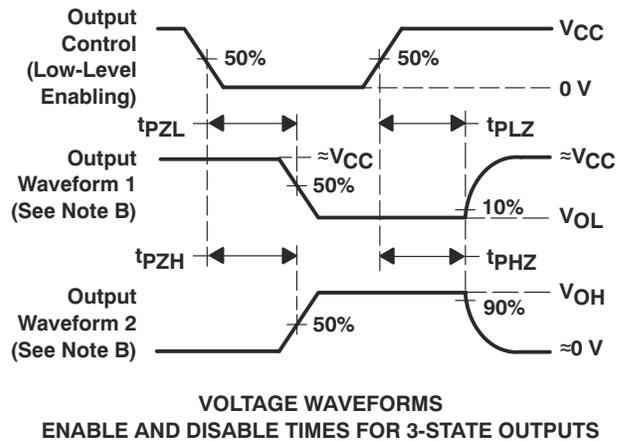
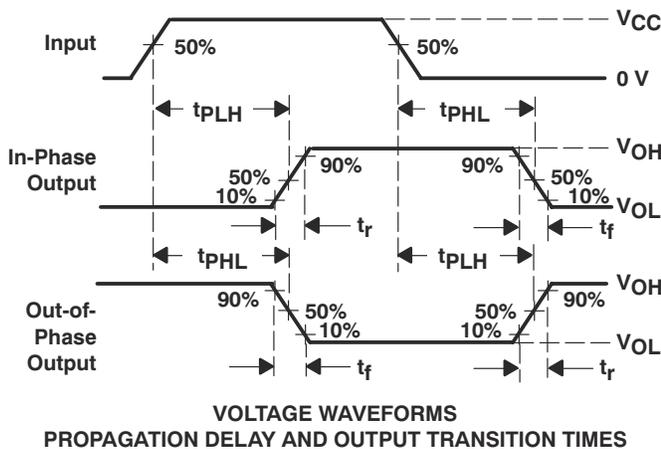
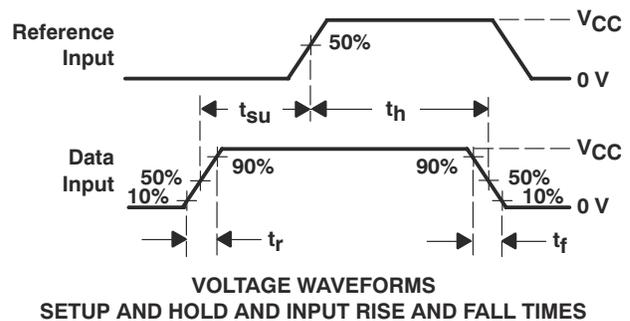
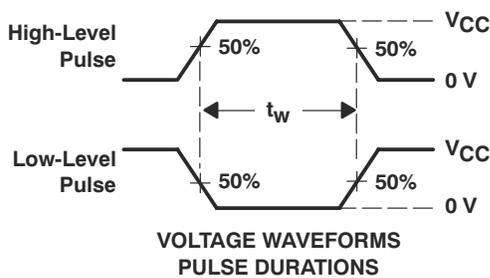


Figure 6-2. SN74HC595 I_{CC} vs. V_{CC}

7 Parameter Measurement Information



| PARAMETER | R_L | C_L | S1 | S2 |
|-------------------|--------------|-----------------|--------|--------|
| t_{en} | 1 k Ω | 50 pF or 150 pF | Open | Closed |
| | | | Closed | Open |
| t_{dis} | 1 k Ω | 50 pF | Open | Closed |
| | | | Closed | Open |
| t_{pd} or t_t | | 50 pF or 150 pF | Open | Open |



- NOTES: A. C_L includes probe and test-fixture capacitance.
 B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
 C. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1$ MHz, $Z_O = 50 \Omega$, $t_r = 6$ ns, $t_f = 6$ ns.
 D. For clock inputs, f_{max} is measured when the input duty cycle is 50%.
 E. The outputs are measured one at a time, with one input transition per measurement.
 F. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 G. t_{PZL} and t_{PZH} are the same as t_{en} .
 H. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 7-1. Load Circuit and Voltage Waveforms

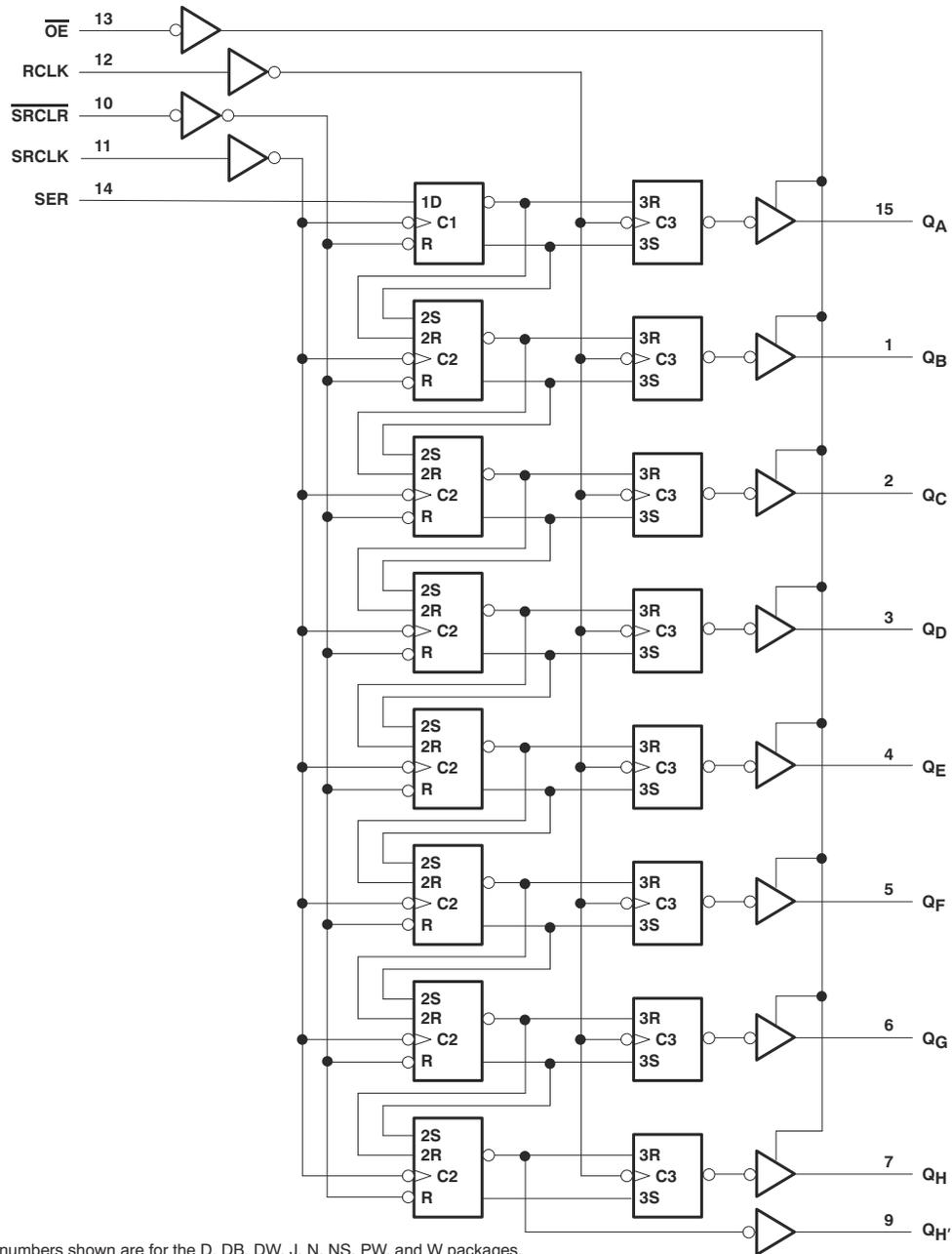
8 Detailed Description

8.1 Overview

The SNx4HC595 is part of the HC family of logic devices intended for CMOS applications. The SNx4HC595 is an 8-bit shift register that feeds an 8-bit D-type storage register.

Both the shift register clock (SRCLK) and storage register clock (RCLK) are positive-edge triggered. If both clocks are connected together, the shift register always is one clock pulse ahead of the storage register.

8.2 Functional Block Diagram



8.3 Feature Description

The SNx4HC595 devices are 8-bit Serial-In, Parallel-Out Shift Registers. They have a wide operating current of 2 V to 6 V, and the high-current 3-state outputs can drive up to 15 LSTTL Loads. The devices have a low power consumption of 80- μ A (Maximum) I_{CC} . Additionally, the devices have a low input current of 1 μ A (Maximum) and a ± 6 -mA Output Drive at 5 V.

8.4 Device Functional Modes

Table 8-1 lists the functional modes of the SNx4HC595 devices.

Table 8-1. Function Table

| INPUTS | | | | | FUNCTION |
|--------|------------|-------|------------|-----------------|--------------------------------------------------------------------------------------------------------------|
| SER | SRCLK | SRCLR | RCLK | \overline{OE} | |
| X | X | X | X | H | Outputs $Q_A - Q_H$ are disabled. |
| X | X | X | X | L | Outputs $Q_A - Q_H$ are enabled. |
| X | X | L | X | X | Shift register is cleared. |
| L | \uparrow | H | X | X | First stage of the shift register goes low. Other stages store the data of previous stage, respectively. |
| H | \uparrow | H | X | X | First stage of the shift register goes high. Other stages store the data of previous stage, respectively. |
| X | X | X | \uparrow | X | Shift-register data is stored in the storage register. |

9 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.

9.1 Application Information

The SNx4HC595 is a low-drive CMOS device that can be used for a multitude of bus interface type applications where output ringing is a concern. The low drive and slow edge rates will minimize overshoot and undershoot on the outputs.

9.2 Typical Application

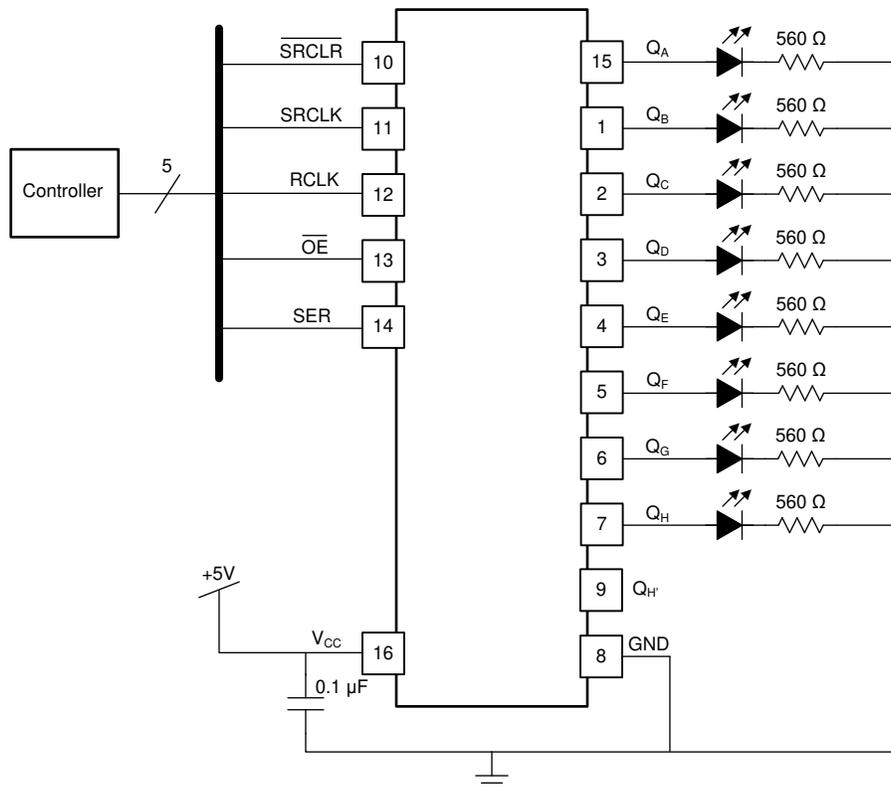


Figure 9-1. Typical Application Schematic

9.2.1 Design Requirements

This device uses CMOS technology and has balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits. The high drive will also create fast edges into light loads so routing and load conditions should be considered to prevent ringing.

9.2.2 Detailed Design Procedure

- Recommended input conditions
 - Specified high and low levels. See (V_{IH} and V_{IL}) in [Section 6.3](#) table.
 - Specified high and low levels. See (V_{IH} and V_{IL}) in [Section 6.3](#) table.
 - Inputs are overvoltage tolerant allowing them to go as high as 5.5 V at any valid V_{CC}
- Recommend output conditions
 - Load currents should not exceed 35 mA per output and 70 mA total for the part
 - Outputs should not be pulled above V_{CC}

9.2.3 Application Curves

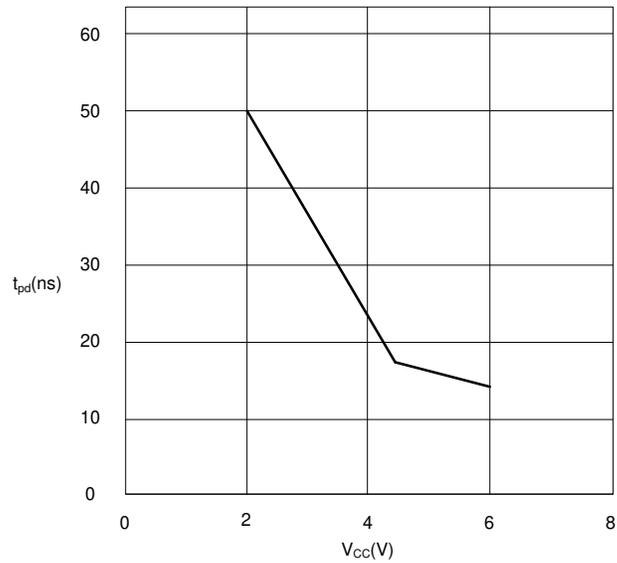


Figure 9-2. SN75HC595 t_{pd} vs. V_{CC}

10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in [Section 6.3](#) table.

Each V_{CC} pin should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, 0.1 μf is recommended; if there are multiple V_{CC} pins, then 0.01 μf or 0.022 μf is recommended for each power pin. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. A 0.1 μf and a 1 μf are commonly used in parallel. The bypass capacitor should be installed as close to the power pin as possible for best results.

11 Layout

11.1 Layout Guidelines

When using multiple-bit logic devices, inputs should never float.

In many cases, functions or parts of functions of digital logic devices are unused, for example, when only two inputs of a triple-input AND gate are used or only 3 of the 4 buffer gates are used. Such input pins should not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. [Figure 11-1](#) specifies the rules that must be observed under all circumstances. All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. The logic level that should be applied to any particular unused input depends on the function of the device. Generally they will be tied to GND or V_{CC} , whichever makes more sense or is more convenient. It is generally acceptable to float outputs, unless the part is a transceiver. If the transceiver has an output enable pin, it will disable the output section of the part when asserted. This will not disable the input section of the I/Os, so they cannot float when disabled.

11.2 Layout Example

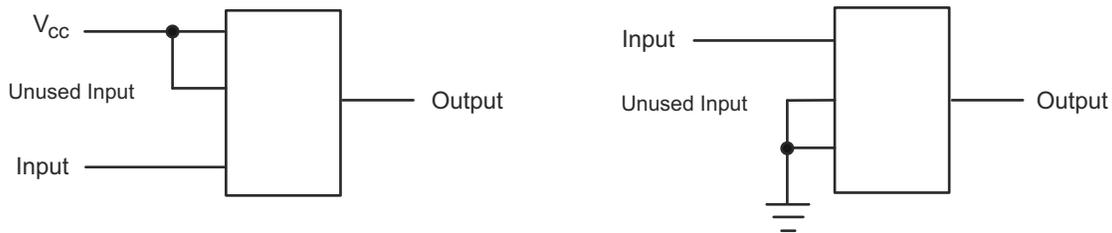


Figure 11-1. Layout Diagram

12 Device and Documentation Support

12.1 Documentation Support

12.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, [Implications of Slow or Floating CMOS Inputs application brief](#)

12.2 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.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

12.3 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

12.4 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.

12.5 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

13 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) |
|---------------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|----------------------------------------|
| 5962-86816012A | NRND | Production | LCCC (FK) 20 | 55 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962- 86816012A SNJ54HC 595FK |
| 5962-8681601EA | Active | Production | CDIP (J) 16 | 25 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-8681601EA SNJ54HC595J |
| 5962-8681601VEA | Active | Production | CDIP (J) 16 | 25 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-8681601VE A SNV54HC595J |
| 5962-8681601VEA.A | Active | Production | CDIP (J) 16 | 25 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-8681601VE A SNV54HC595J |
| 5962-8681601VFA | Active | Production | CFP (W) 16 | 25 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-8681601VF A SNV54HC595W |
| 5962-8681601VFA.A | Active | Production | CFP (W) 16 | 25 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-8681601VF A SNV54HC595W |
| SN54HC595J | NRND | Production | CDIP (J) 16 | 25 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | SN54HC595J |
| SN54HC595J.A | NRND | Production | CDIP (J) 16 | 25 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | SN54HC595J |
| SN74HC595DBR | Active | Production | SSOP (DB) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595DBR.A | Active | Production | SSOP (DB) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595DBRE4 | Active | Production | SSOP (DB) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595DBRG4 | Active | Production | SSOP (DB) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595DR | Active | Production | SOIC (D) 16 | 2500 LARGE T&R | Yes | NIPDAU SN | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595DR.A | Active | Production | SOIC (D) 16 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595DRE4 | Active | Production | null (null) | 2500 LARGE T&R | - | Call TI | Call TI | -40 to 85 | |
| SN74HC595DRG3 | Active | Production | SOIC (D) 16 | 2500 LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595DRG3.A | Active | Production | SOIC (D) 16 | 2500 LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595DRG4 | Active | Production | SOIC (D) 16 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595DRG4.A | Active | Production | SOIC (D) 16 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595DT | Obsolete | Production | SOIC (D) 16 | - | - | Call TI | Call TI | -40 to 85 | HC595 |

| 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) |
|--------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|--------------------------------|
| SN74HC595DW | Obsolete | Production | SOIC (DW) 16 | - | - | Call TI | Call TI | -40 to 85 | |
| SN74HC595DWR | Active | Production | SOIC (DW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595DWR.A | Active | Production | SOIC (DW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595N | Active | Production | PDIP (N) 16 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 85 | SN74HC595N |
| SN74HC595N.A | Active | Production | PDIP (N) 16 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 85 | SN74HC595N |
| SN74HC595NE4 | Active | Production | PDIP (N) 16 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -40 to 85 | SN74HC595N |
| SN74HC595NSR | Active | Production | SOP (NS) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595NSR.A | Active | Production | SOP (NS) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595PW | Obsolete | Production | TSSOP (PW) 16 | - | - | Call TI | Call TI | -40 to 85 | HC595 |
| SN74HC595PWR | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU SN | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595PWR.A | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595PWRG4 | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SN74HC595PWRG4.A | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC595 |
| SNJ54HC595FK | NRND | Production | LCCC (FK) 20 | 55 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-86816012A SNJ54HC595FK |
| SNJ54HC595FK.A | NRND | Production | LCCC (FK) 20 | 55 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-86816012A SNJ54HC595FK |
| SNJ54HC595J | Active | Production | CDIP (J) 16 | 25 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-8681601EA SNJ54HC595J |
| SNJ54HC595J.A | Active | Production | CDIP (J) 16 | 25 TUBE | No | SNPB | N/A for Pkg Type | -55 to 125 | 5962-8681601EA SNJ54HC595J |

(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.

OTHER QUALIFIED VERSIONS OF SN54HC595, SN54HC595-SP, SN74HC595 :

- Catalog : [SN74HC595](#), [SN54HC595](#)
- Enhanced Product : [SN74HC595-EP](#), [SN74HC595-EP](#)
- Military : [SN54HC595](#)
- Space : [SN54HC595-SP](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications
- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



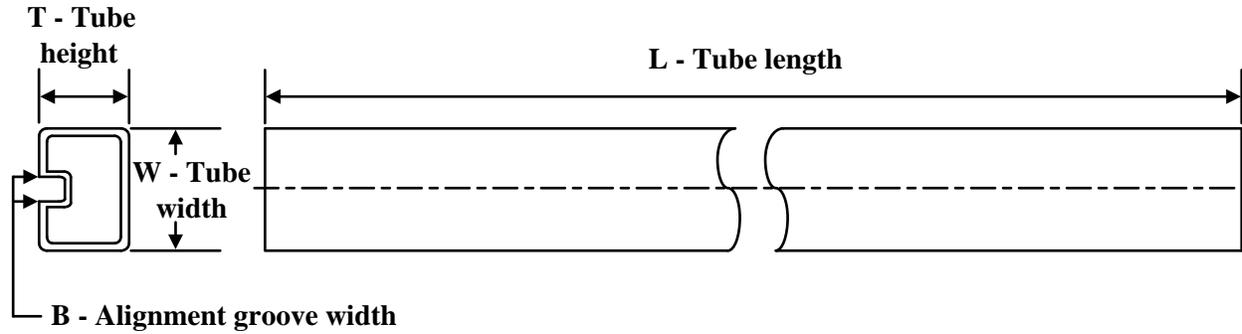
*All dimensions are nominal

| 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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74HC595DBR | SSOP | DB | 16 | 2000 | 330.0 | 16.4 | 8.35 | 6.6 | 2.4 | 12.0 | 16.0 | Q1 |
| SN74HC595DR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC595DR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC595DRG3 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.6 | 9.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC595DRG4 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC595DRG4 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC595DWR | SOIC | DW | 16 | 2000 | 330.0 | 16.4 | 10.75 | 10.7 | 2.7 | 12.0 | 16.0 | Q1 |
| SN74HC595NSR | SOP | NS | 16 | 2000 | 330.0 | 16.4 | 8.1 | 10.4 | 2.5 | 12.0 | 16.0 | Q1 |
| SN74HC595NSR | SOP | NS | 16 | 2000 | 330.0 | 16.4 | 8.45 | 10.55 | 2.5 | 12.0 | 16.2 | Q1 |
| SN74HC595PWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74HC595PWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74HC595PWRG4 | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.3 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74HC595PWRG4 | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 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) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74HC595DBR | SSOP | DB | 16 | 2000 | 353.0 | 353.0 | 32.0 |
| SN74HC595DR | SOIC | D | 16 | 2500 | 340.5 | 336.1 | 32.0 |
| SN74HC595DR | SOIC | D | 16 | 2500 | 340.5 | 336.1 | 32.0 |
| SN74HC595DRG3 | SOIC | D | 16 | 2500 | 366.0 | 364.0 | 50.0 |
| SN74HC595DRG4 | SOIC | D | 16 | 2500 | 353.0 | 353.0 | 32.0 |
| SN74HC595DRG4 | SOIC | D | 16 | 2500 | 340.5 | 336.1 | 32.0 |
| SN74HC595DWR | SOIC | DW | 16 | 2000 | 350.0 | 350.0 | 43.0 |
| SN74HC595NSR | SOP | NS | 16 | 2000 | 353.0 | 353.0 | 32.0 |
| SN74HC595NSR | SOP | NS | 16 | 2000 | 353.0 | 353.0 | 32.0 |
| SN74HC595PWR | TSSOP | PW | 16 | 2000 | 353.0 | 353.0 | 32.0 |
| SN74HC595PWR | TSSOP | PW | 16 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74HC595PWRG4 | TSSOP | PW | 16 | 2000 | 367.0 | 367.0 | 35.0 |
| SN74HC595PWRG4 | TSSOP | PW | 16 | 2000 | 353.0 | 353.0 | 32.0 |

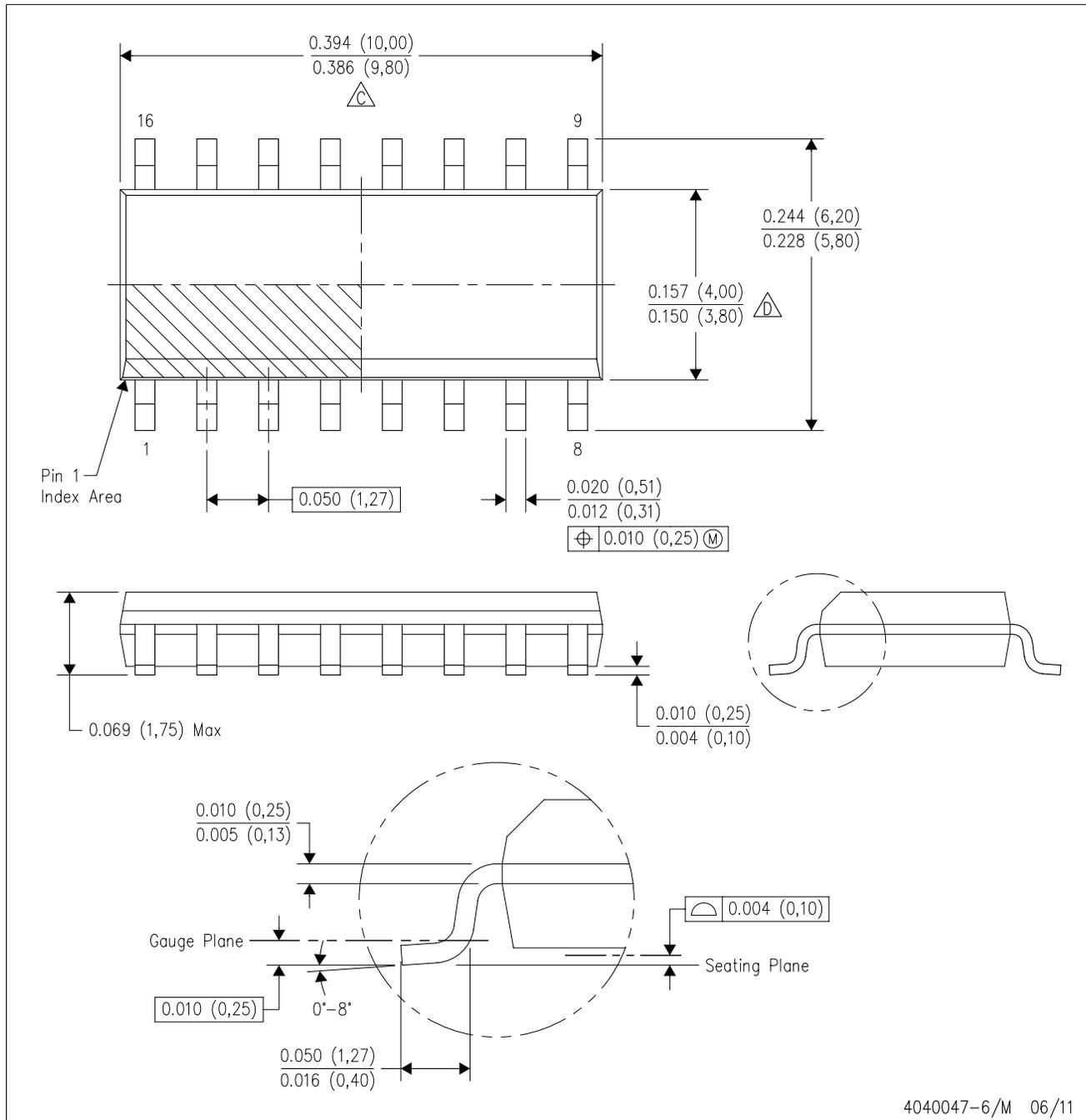
TUBE


*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 5962-86816012A | FK | LCCC | 20 | 55 | 506.98 | 12.06 | 2030 | NA |
| 5962-8681601EA | J | CDIP | 16 | 25 | 506.98 | 15.24 | 13440 | NA |
| 5962-8681601VEA | J | CDIP | 16 | 25 | 506.98 | 15.24 | 13440 | NA |
| 5962-8681601VEA.A | J | CDIP | 16 | 25 | 506.98 | 15.24 | 13440 | NA |
| 5962-8681601VFA | W | CFP | 16 | 25 | 506.98 | 26.16 | 6220 | NA |
| 5962-8681601VFA.A | W | CFP | 16 | 25 | 506.98 | 26.16 | 6220 | NA |
| SN74HC595N | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74HC595N | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74HC595N.A | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74HC595N.A | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74HC595NE4 | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74HC595NE4 | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SNJ54HC595FK | FK | LCCC | 20 | 55 | 506.98 | 12.06 | 2030 | NA |
| SNJ54HC595FK.A | FK | LCCC | 20 | 55 | 506.98 | 12.06 | 2030 | NA |
| SNJ54HC595J | J | CDIP | 16 | 25 | 506.98 | 15.24 | 13440 | NA |
| SNJ54HC595J.A | J | CDIP | 16 | 25 | 506.98 | 15.24 | 13440 | NA |

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - 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 0.006 (0,15) each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

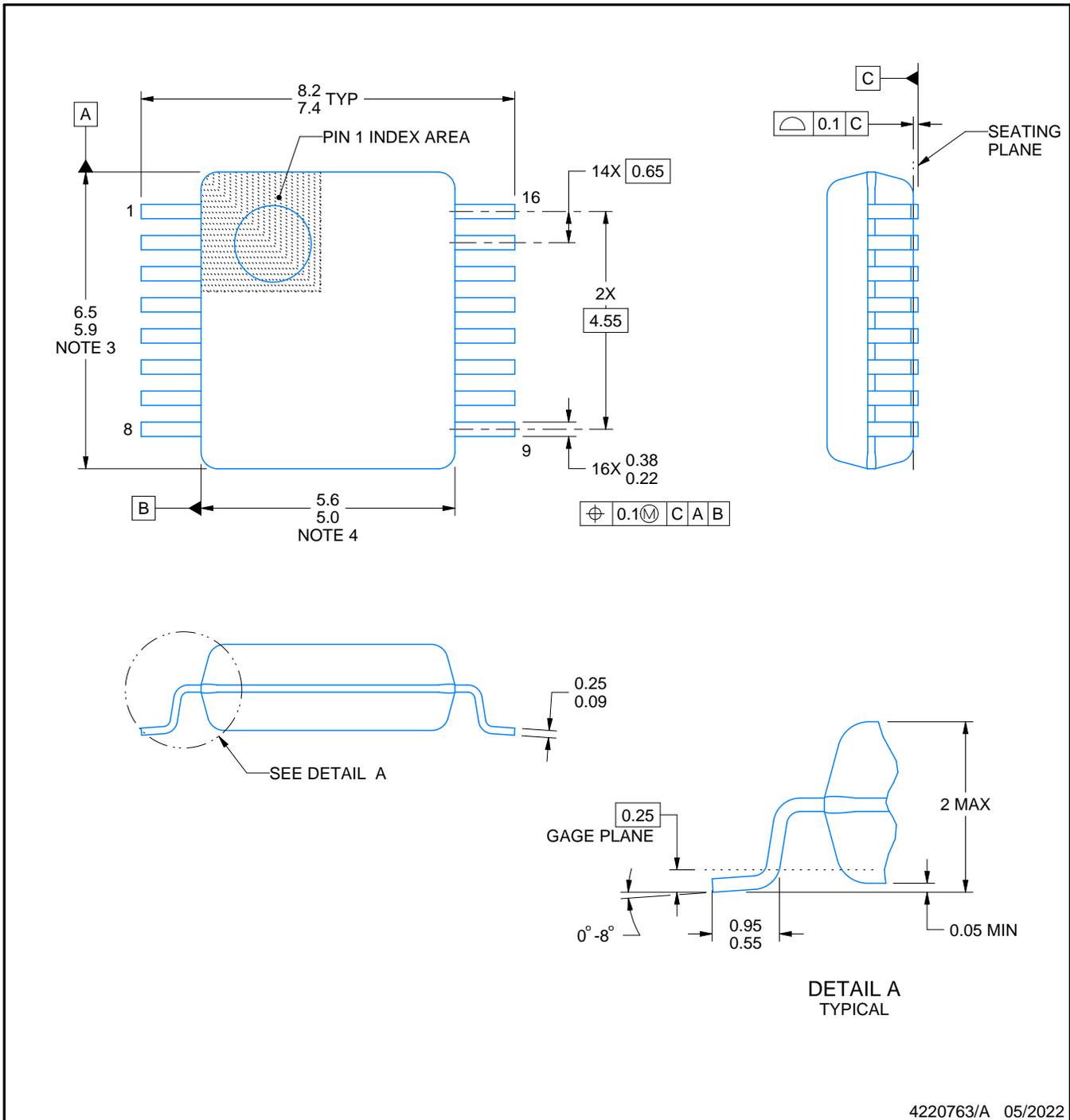
DB0016A



PACKAGE OUTLINE

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



4220763/A 05/2022

NOTES:

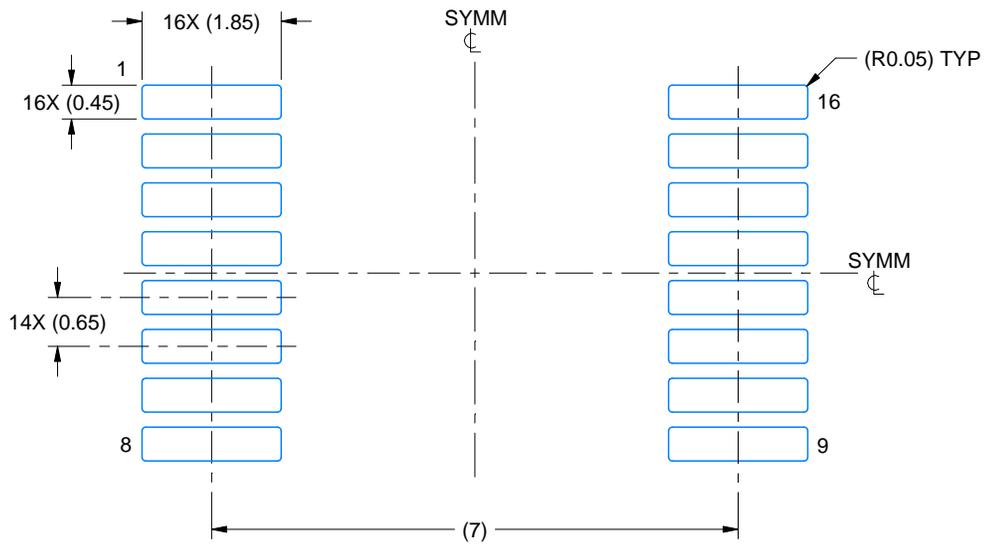
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-150.

EXAMPLE BOARD LAYOUT

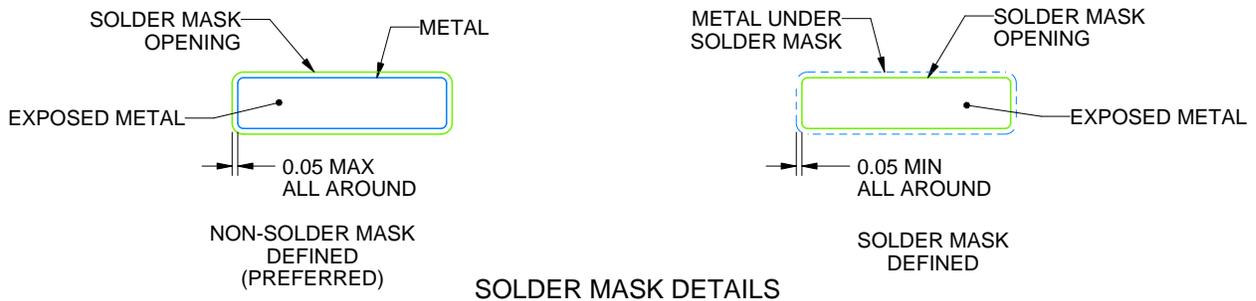
DB0016A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



4220763/A 05/2022

NOTES: (continued)

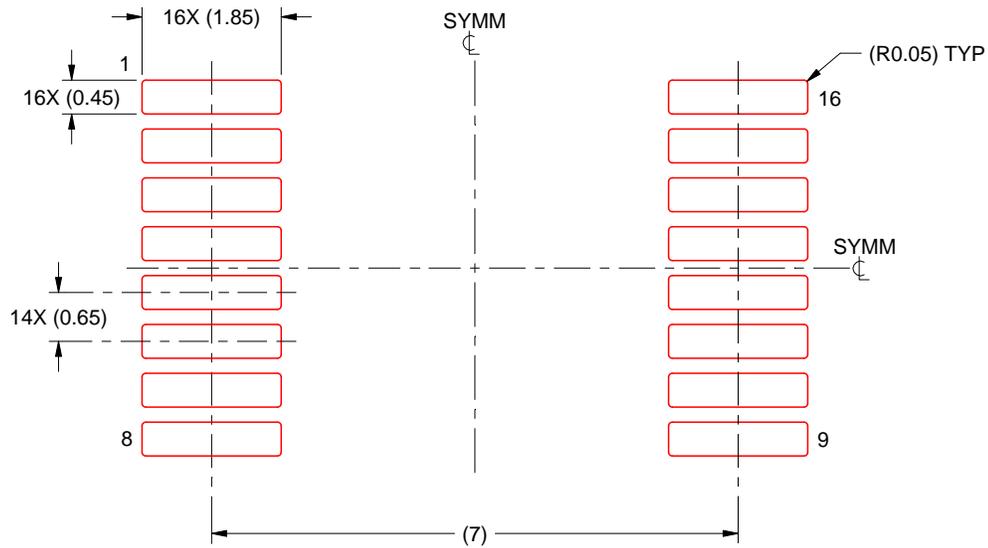
- 5. Publication IPC-7351 may have alternate designs.
- 6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DB0016A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220763/A 05/2022

NOTES: (continued)

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

GENERIC PACKAGE VIEW

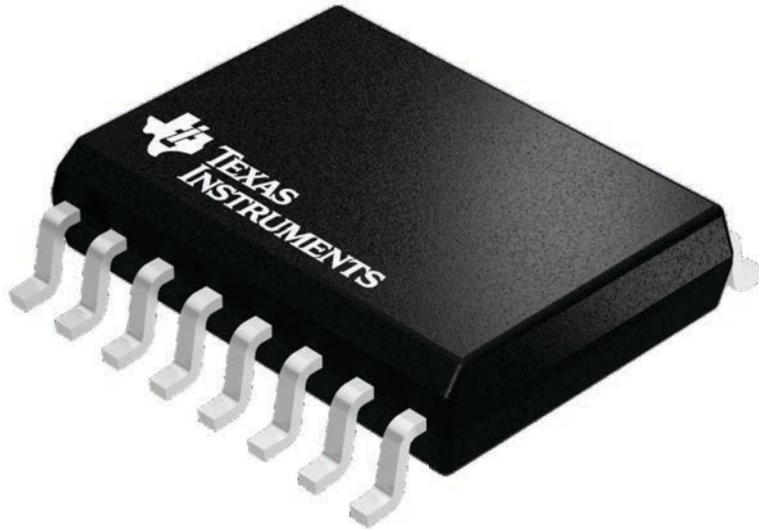
DW 16

SOIC - 2.65 mm max height

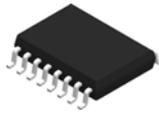
7.5 x 10.3, 1.27 mm pitch

SMALL OUTLINE INTEGRATED CIRCUIT

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



4224780/A

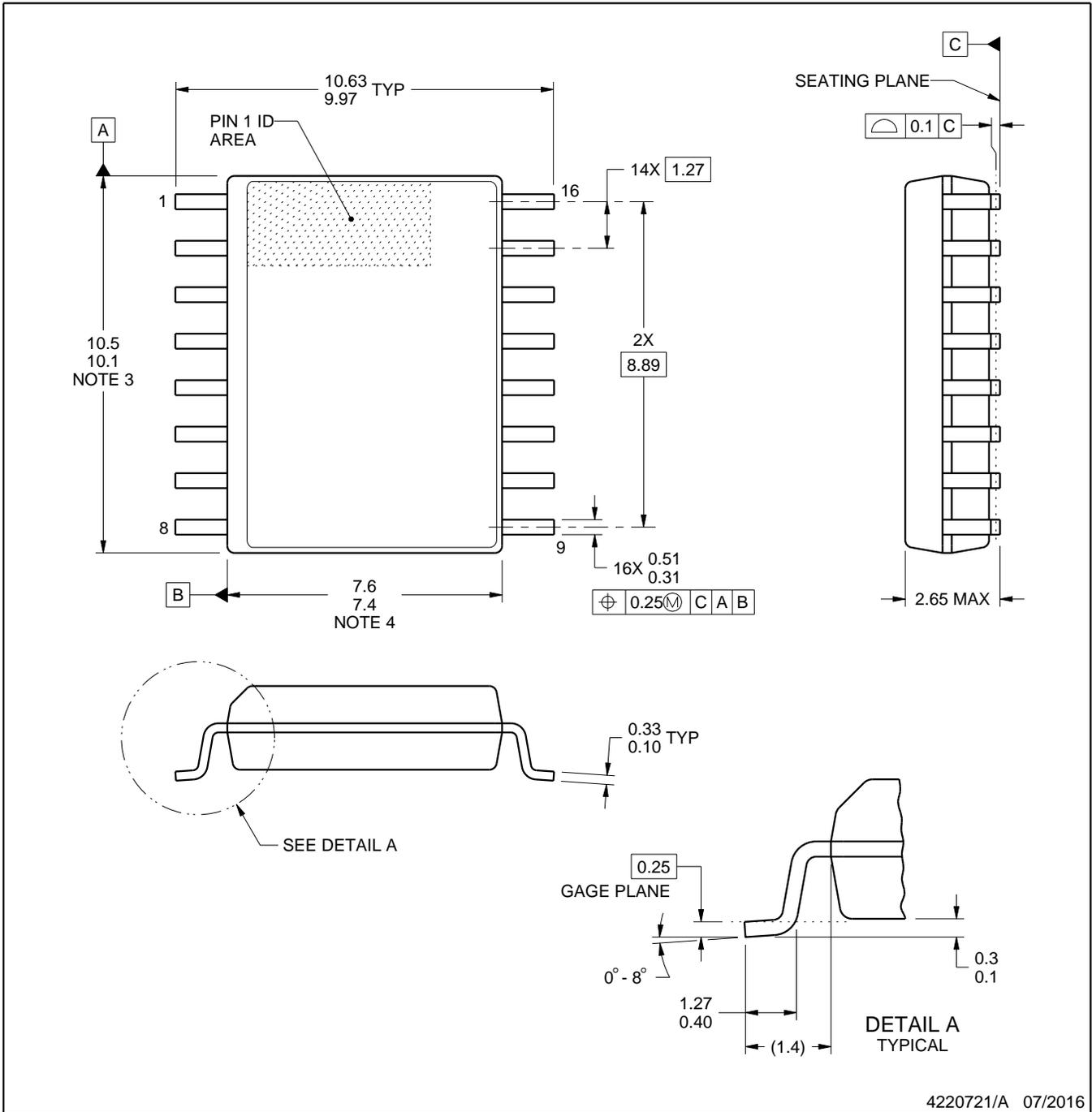


DW0016A

PACKAGE OUTLINE

SOIC - 2.65 mm max height

SOIC



4220721/A 07/2016

NOTES:

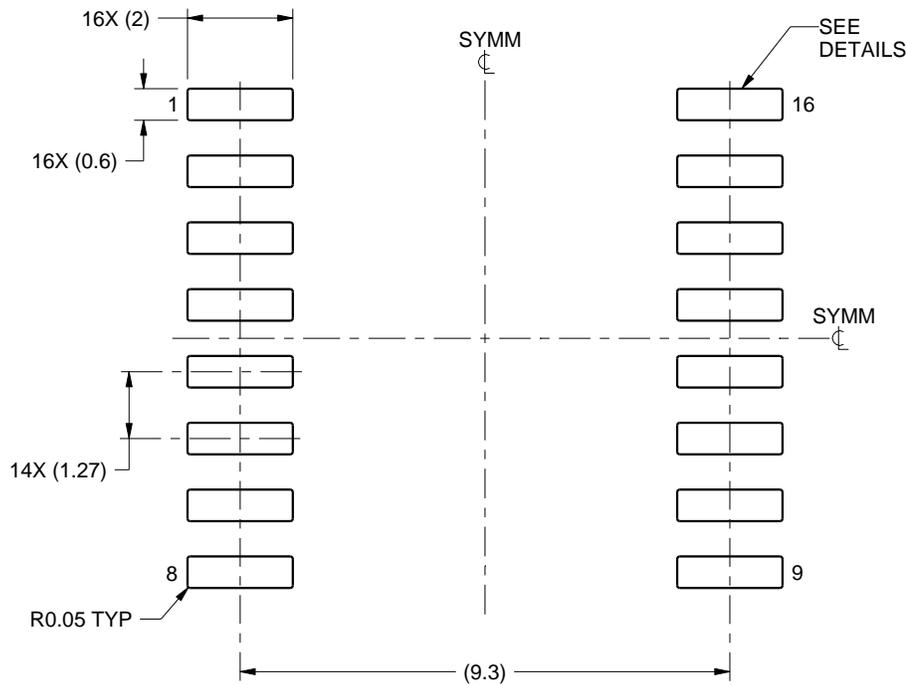
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate 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 MS-013.

EXAMPLE BOARD LAYOUT

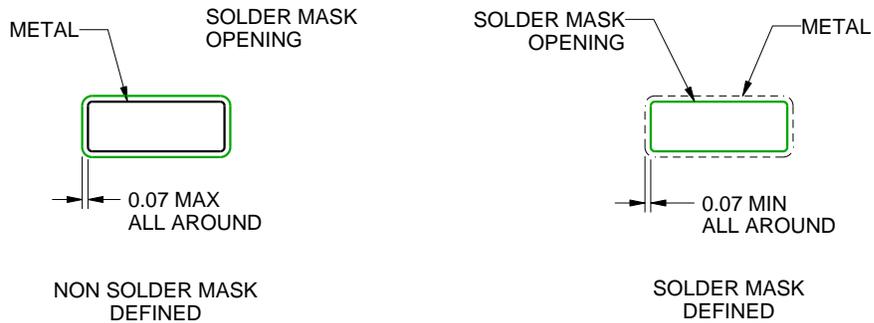
DW0016A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE
SCALE:7X



SOLDER MASK DETAILS

4220721/A 07/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

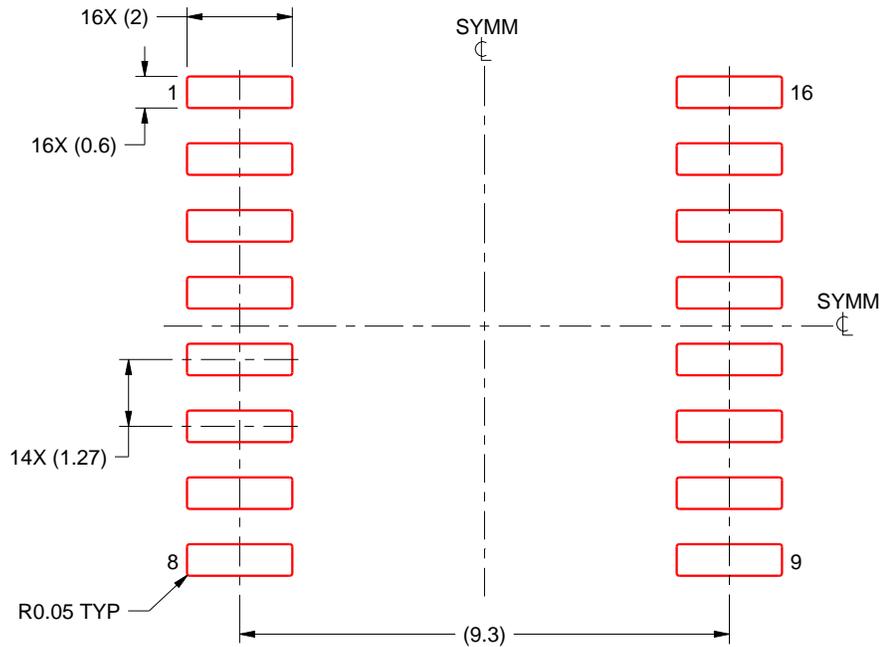
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DW0016A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:7X

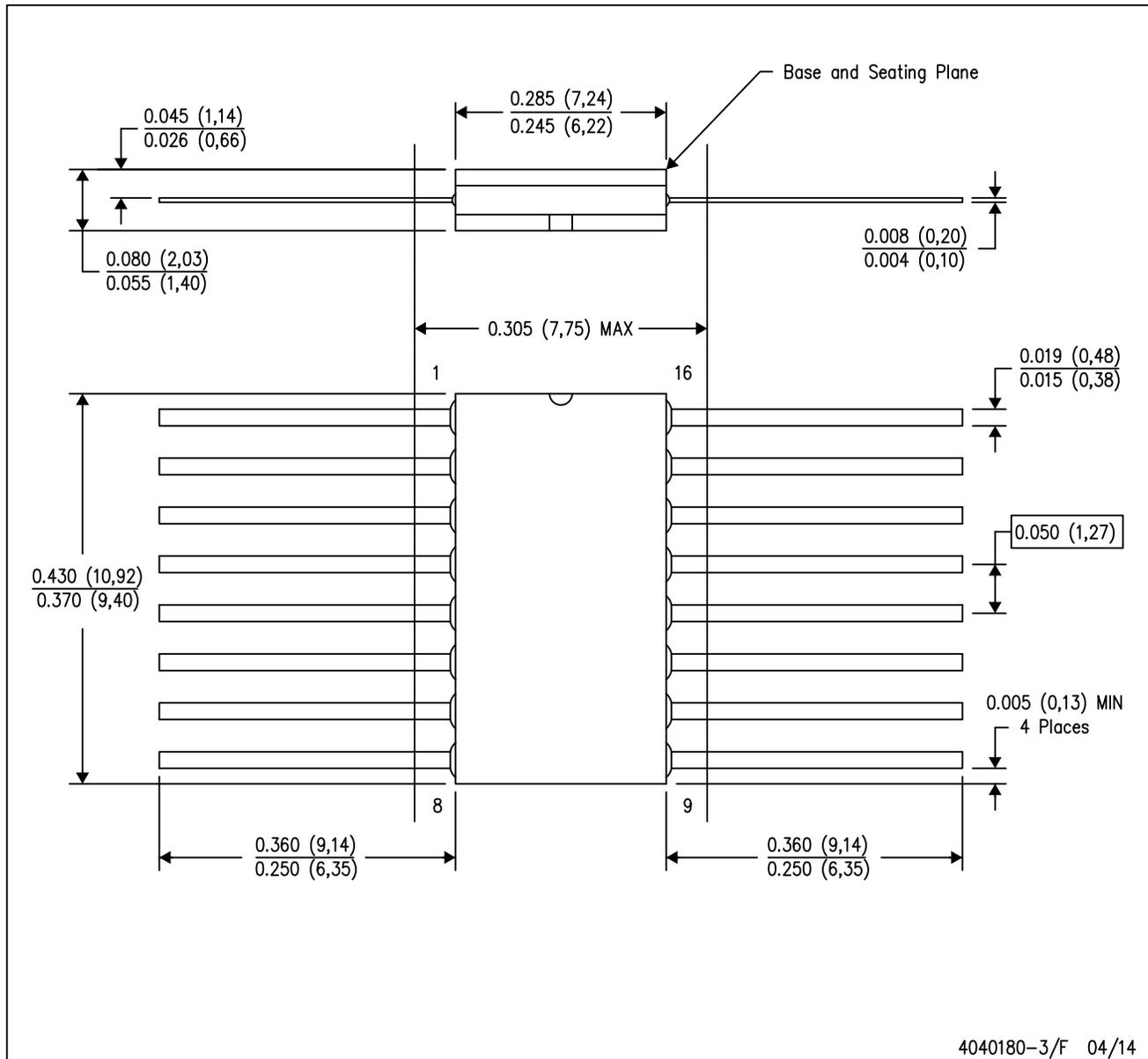
4220721/A 07/2016

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.

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only.
 - E. Falls within MIL STD 1835 GDFP2-F16

GENERIC PACKAGE VIEW

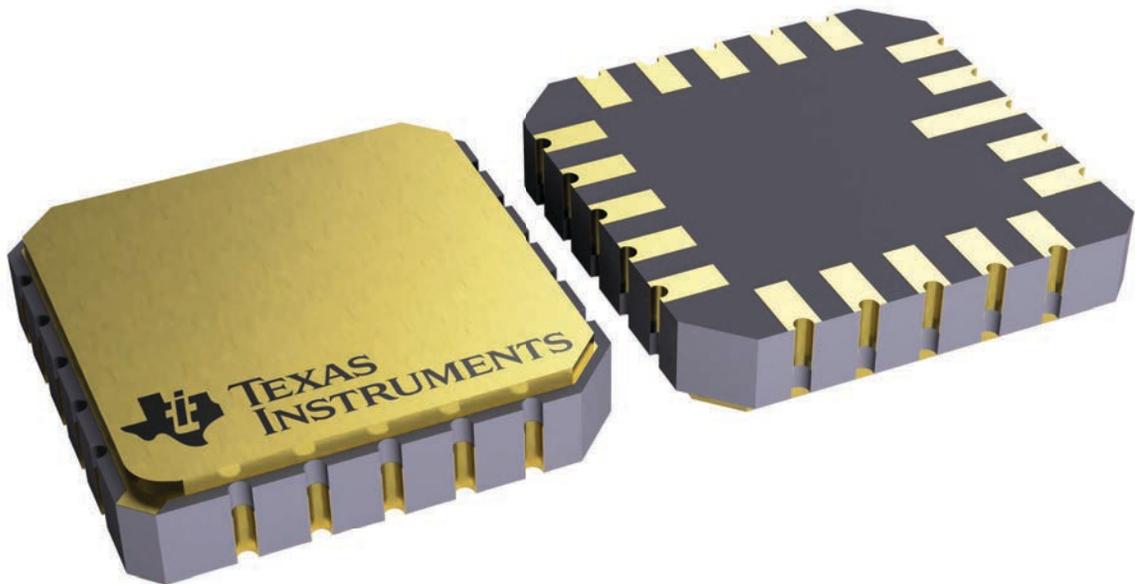
FK 20

LCCC - 2.03 mm max height

8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

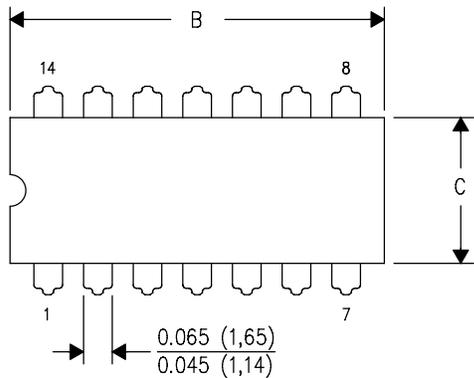


4229370VA\

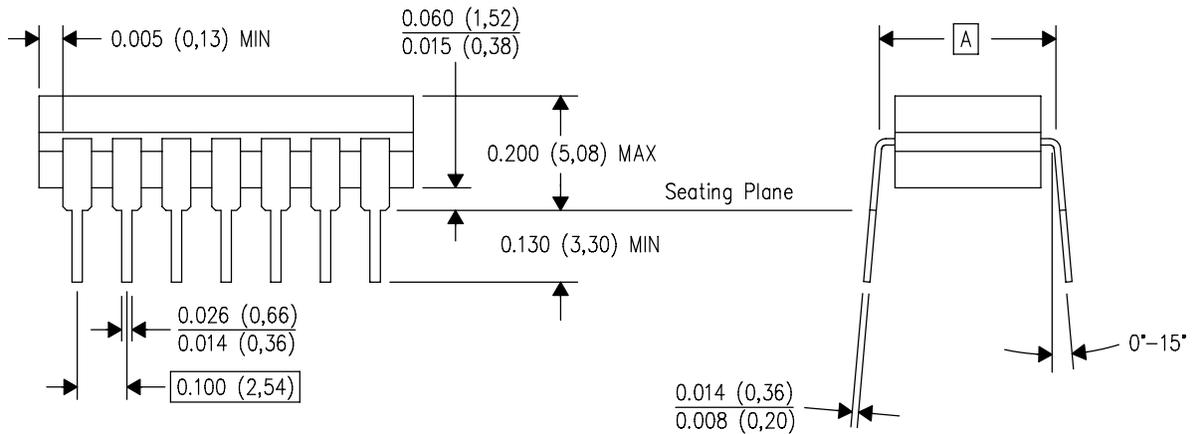
J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE

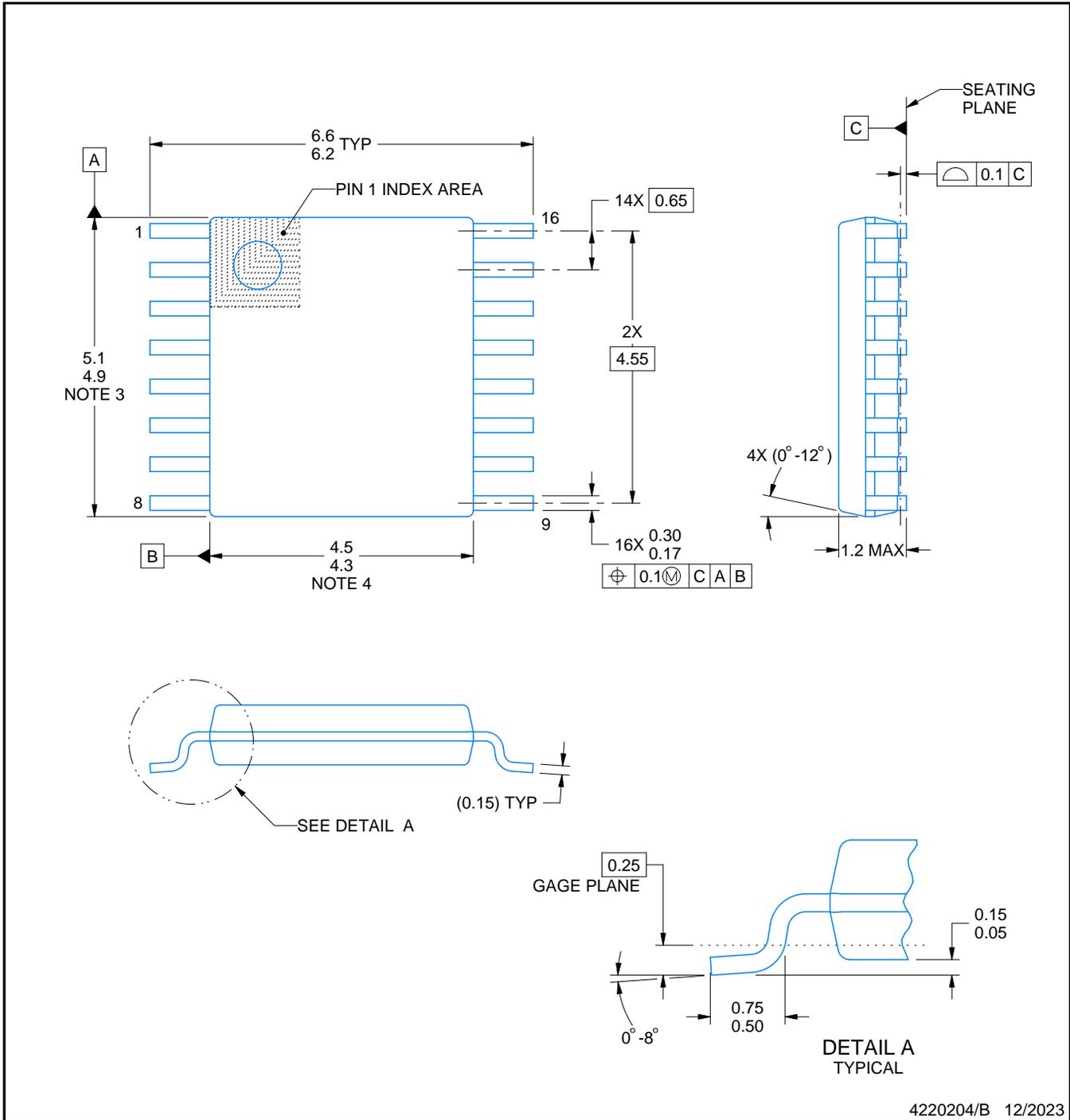


| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---------------|------------------------|------------------------|------------------------|------------------------|
| A | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC |
| B MAX | 0.785 (19,94) | .840 (21,34) | 0.960 (24,38) | 1.060 (26,92) |
| B MIN | — | — | — | — |
| C MAX | 0.300 (7,62) | 0.300 (7,62) | 0.310 (7,87) | 0.300 (7,62) |
| C MIN | 0.245 (6,22) | 0.245 (6,22) | 0.220 (5,59) | 0.245 (6,22) |



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package is hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.



NOTES:

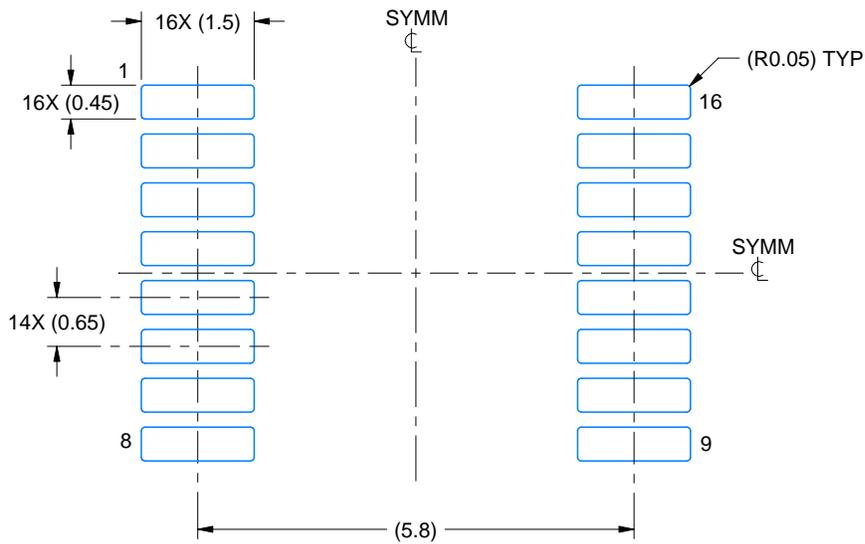
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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-153.

EXAMPLE BOARD LAYOUT

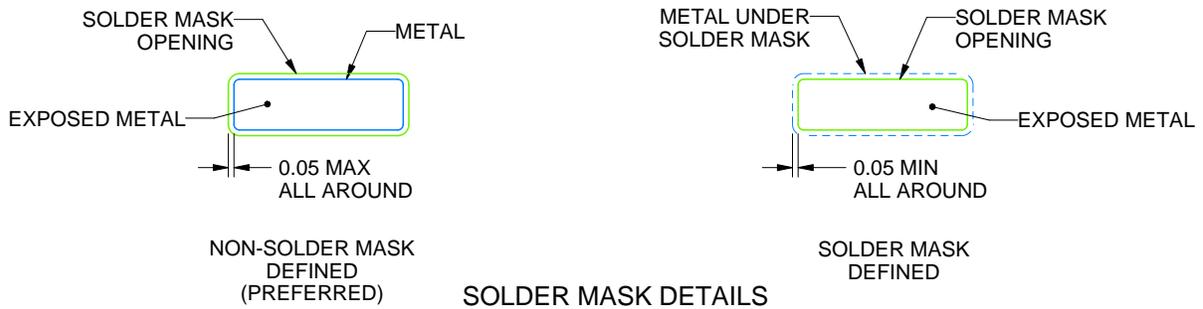
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



4220204/B 12/2023

NOTES: (continued)

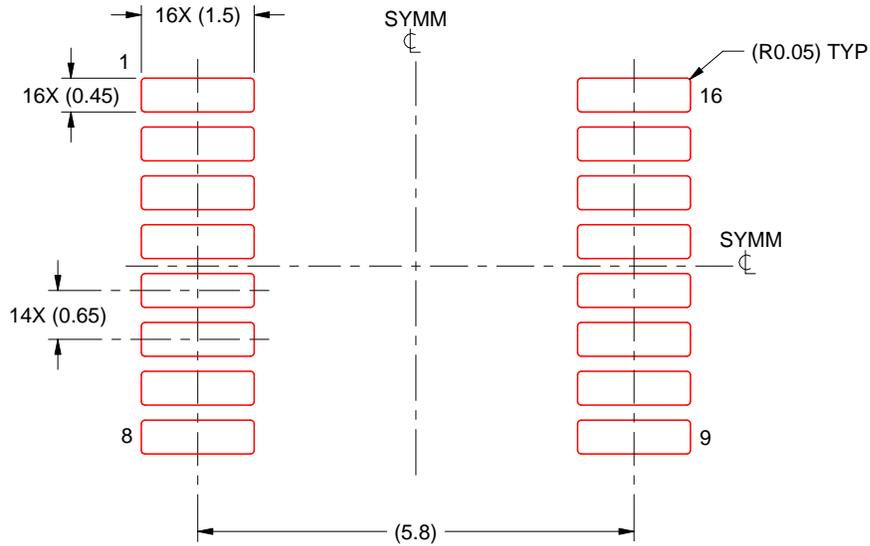
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220204/B 12/2023

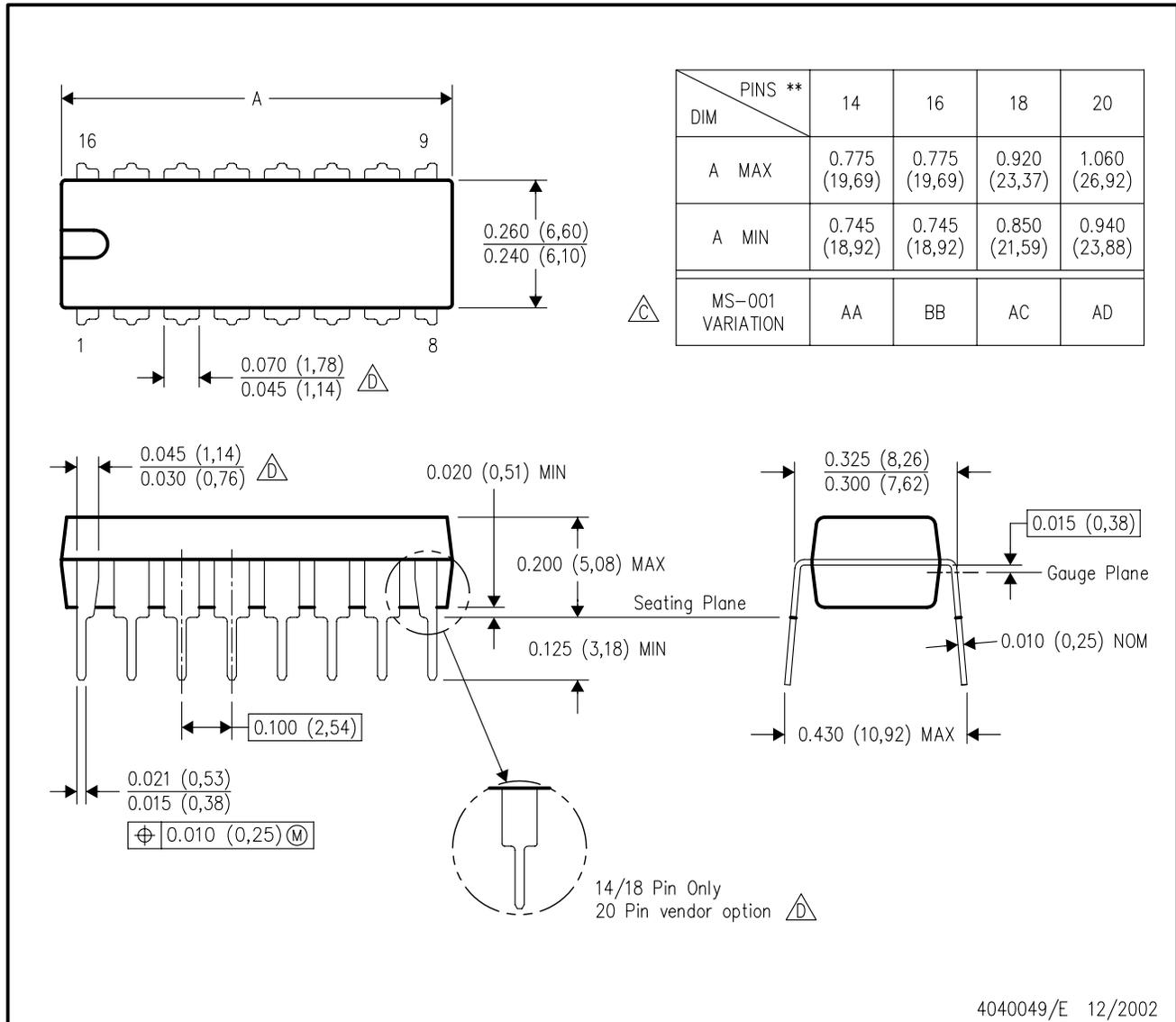
NOTES: (continued)

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.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

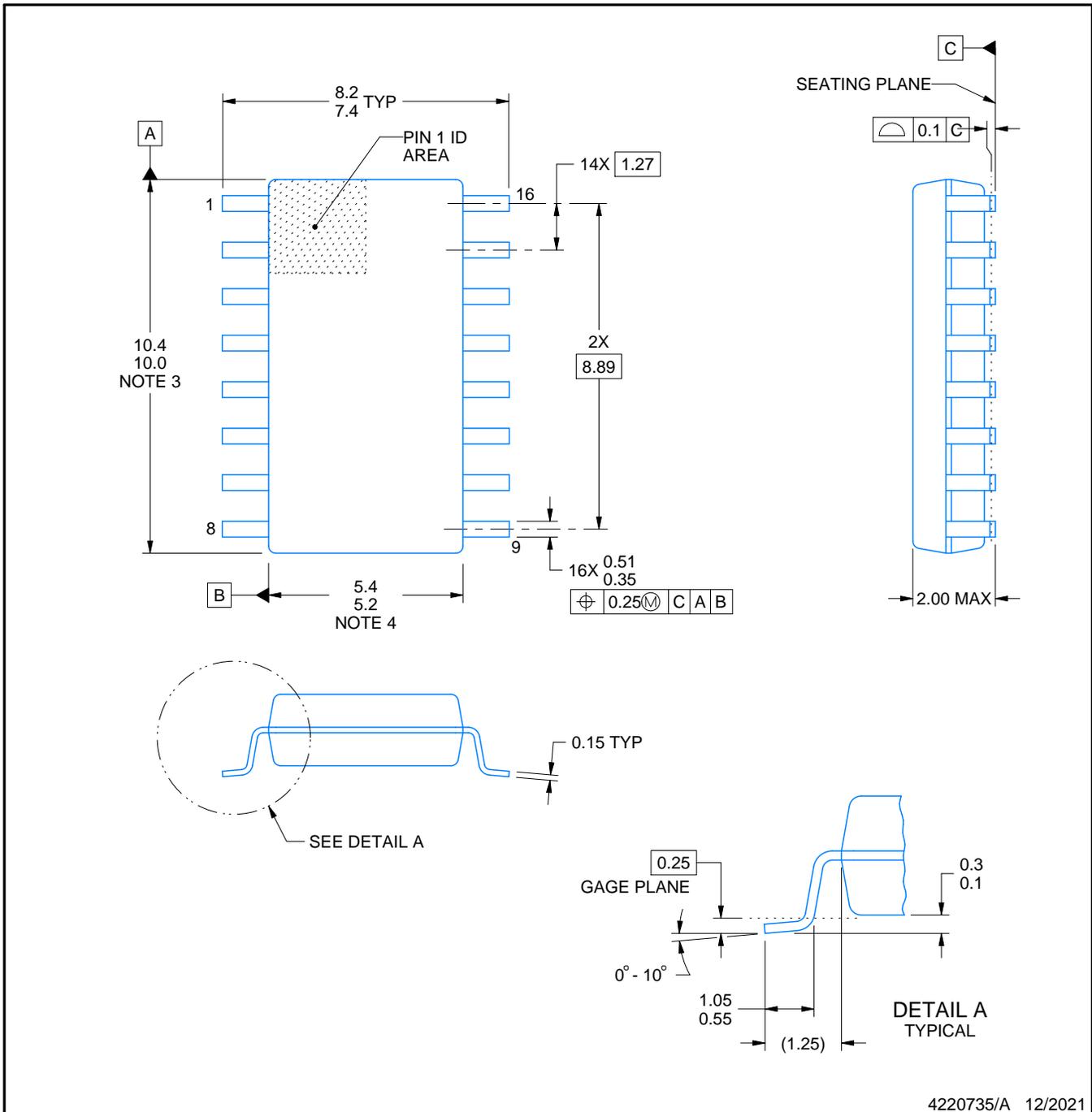


PACKAGE OUTLINE

NS0016A

SOP - 2.00 mm max height

SOP



NOTES:

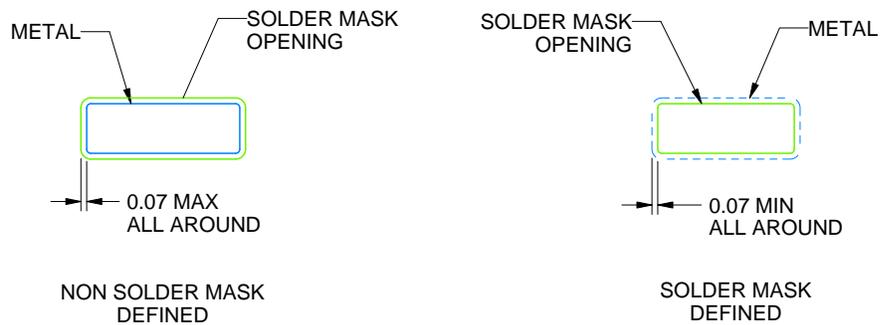
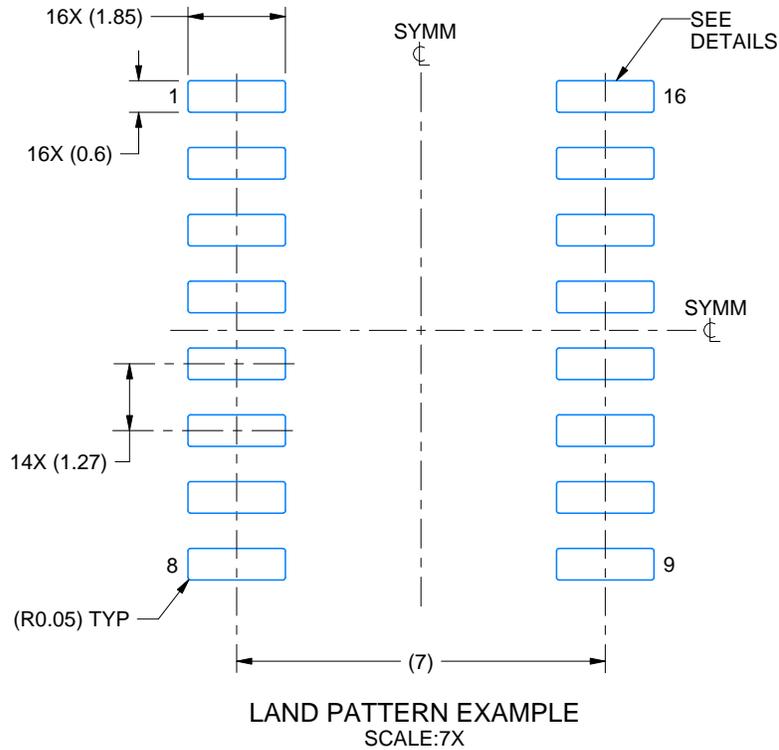
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate 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.

EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



4220735/A 12/2021

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

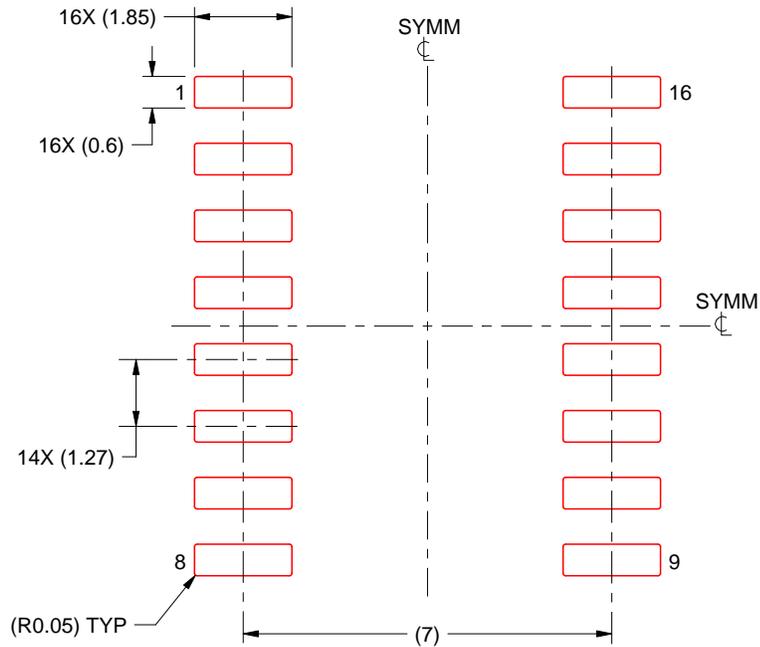
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:7X

4220735/A 12/2021

NOTES: (continued)

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

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