



SN74LV4051A 8-Channel Analog Multiplexers and Demultiplexers

1 Features

- 2-V to 5.5-V V_{CC} Operation
- Support Mixed-Mode Voltage Operation on All Ports
- High On-Off Output-Voltage Ratio
- Low Crosstalk Between Switches
- Individual Switch Controls
- Extremely Low Input Current
- 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 Applications

- Telecommunications
- eCall
- Infotainment

3 Description

The SN74LV4051A 8-channel CMOS analog multiplexers and demultiplexers are designed for 2-V to 5.5-V V_{CC} operation.

The SN74LV4051A devices handle both analog and digital signals. Each channel permits signals with amplitudes up to 5.5-V (peak) to be transmitted in either direction.

Applications include: signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.

Device Information⁽¹⁾

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|------------|--------------------|
| SN74LV4051A | TSSOP (16) | 5.00 mm × 6.30 mm |
| | SOIC (16) | 9.90 mm × 6.00 mm |
| | SSOP (16) | 6.20 mm × 7.80 mm |
| | TVSOP (16) | 3.60 mm × 6.40 mm |
| | PDIP (16) | 19.30 mm × 6.35 mm |
| | SO (16) | 3.60 mm × 6.40 mm |
| | VQFN (16) | 3.50 mm × 4.00 mm |

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

Logic Diagram (Positive Logic)

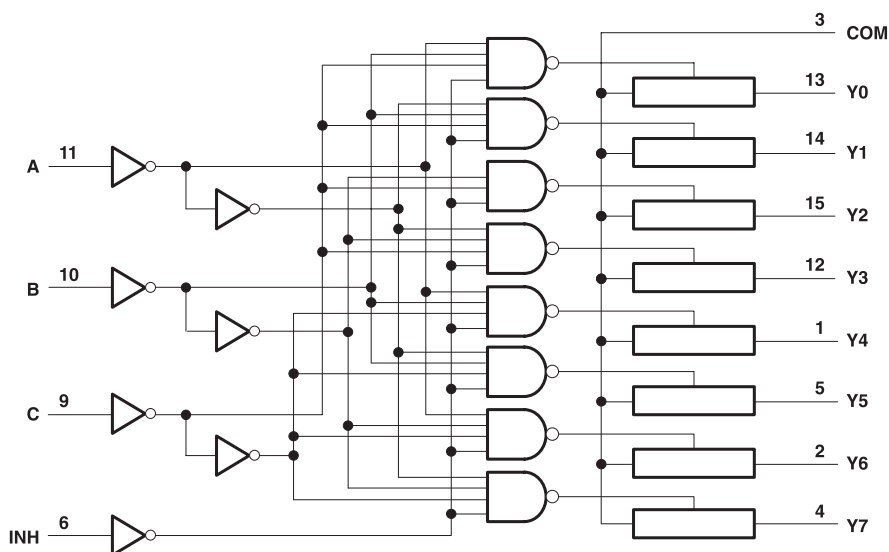


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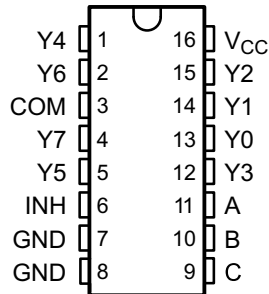
4 Revision History

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

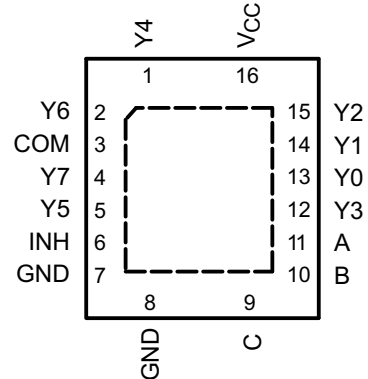
| Changes from Revision H (April 2005) to Revision I | Page |
|--|------|
| • Added <i>Device Information</i> table, <i>Pin Functions</i> table, <i>ESD Ratings</i> table, <i>Thermal Information</i> table, <i>Detailed Description</i> section, <i>Applications and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section | 1 |
| • Deleted SN54LV4051A part number from the data sheet | 1 |
| • Removed <i>Ordering Information</i> table. | 1 |
| • Deleted θ_{JA} from the <i>Absolute Maximum Ratings</i> table | 4 |

5 Pin Configuration and Functions

D, DB, DGB, N, NS, PW Package
16-Pin SOIC, SSOP, TVSOP, PDIP, SO, TSSOP
Top View



RGY Package
16-Pin VQFN With Exposed Thermal Pad
Top View



Pin Functions

| PIN | | I/O | DESCRIPTION |
|-----------------|------|--------------------|---|
| NAME | NO. | | |
| A | 11 | I | Selector line A for outputs (see Device Functional Modes for specific information) |
| B | 10 | I | Selector line B for outputs (see Device Functional Modes for specific information) |
| C | 9 | I | Selector line C for outputs (see Device Functional Modes for specific information) |
| COM | 3 | O/I ⁽¹⁾ | Output/Input of mux |
| GND | 7, 8 | — | Ground |
| INH | 6 | I ⁽¹⁾ | Enables the outputs of the device. Logic low level will turn the outputs on, high level will turn them off. |
| Y0 | 13 | I/O ⁽¹⁾ | Input/Output to mux |
| Y1 | 14 | I/O ⁽¹⁾ | Input/Output to mux |
| Y2 | 15 | I/O ⁽¹⁾ | Input/Output to mux |
| Y3 | 12 | I/O ⁽¹⁾ | Input/Output to mux |
| Y4 | 1 | I/O ⁽¹⁾ | Input/Output of mux |
| Y5 | 5 | I/O ⁽¹⁾ | Input/Output to mux |
| Y6 | 2 | I/O ⁽¹⁾ | Input/Output to mux |
| Y7 | 4 | I/O ⁽¹⁾ | Input/Output to mux |
| V _{CC} | 16 | — | Device power |

- (1) These I/O descriptions represent the device when used as a multiplexer, when this device is operated as a demultiplexer pins Y0-Y7 may be considered outputs (O) and the COM pin may be considered inputs (I).

6 Specifications

6.1 Absolute Maximum Ratings

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

| | | MIN | MAX | UNIT |
|------------------|---|--|-----------------------|------|
| V _{CC} | Supply voltage range | −0.5 | 7.0 | V |
| V _I | Input voltage range ⁽²⁾ | −0.5 | 7.0 | V |
| V _{IO} | Switch I/O voltage range ⁽²⁾⁽³⁾ | −0.5 | V _{CC} + 0.5 | V |
| I _{IK} | Input clamp current | V _I < 0 | −20 | mA |
| I _{IOK} | I/O diode current | V _{IO} < 0 | −50 | mA |
| I _T | Switch through current | V _{IO} = 0 to V _{CC} | ±25 | mA |
| | Continuous current through V _{CC} or GND | | ±50 | mA |
| T _J | Max 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 negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) This value is limited to 5.5-V maximum.

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 JEDEC specification JESD22-C101 ⁽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⁾

| | | MIN | NOM | MAX | UNIT |
|-----------------|--|----------------------------------|-----------------------|-----------------------|------|
| V _{CC} | Supply voltage | 2 ⁽²⁾ | | 5.5 | V |
| V _{IH} | High-level input voltage, control inputs | V _{CC} = 2 V | 1.5 | | V |
| | | V _{CC} = 2.3 V to 2.7 V | V _{CC} × 0.7 | | |
| | | V _{CC} = 3 V to 3.6 V | V _{CC} × 0.7 | | |
| | | V _{CC} = 4.5 V to 5.5 V | V _{CC} × 0.7 | | |
| V _{IL} | Low-level input voltage, control inputs | V _{CC} = 2 V | | 0.5 | V |
| | | V _{CC} = 2.3 V to 2.7 V | | V _{CC} × 0.3 | |
| | | V _{CC} = 3 V to 3.6 V | | V _{CC} × 0.3 | |
| | | V _{CC} = 4.5 V to 5.5 V | | V _{CC} × 0.3 | |
| V _I | Control input voltage | 0 | | 5.5 | V |
| V _{IO} | Input or output voltage | 0 | | V _{CC} | V |
| Δt/Δv | Input transition rise or fall rate | V _{CC} = 2.3 V to 2.7 V | | 200 | ns/V |
| | | V _{CC} = 3 V to 3.6 V | | 100 | |
| | | V _{CC} = 4.5 V to 5.5 V | | 20 | |
| T _A | Operating free-air temperature | −40 | | 85 | °C |

- (1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to TI application report *Implications of Slow or Floating CMOS Inputs*, [SCBA004](#).
- (2) With supply voltages at or near 2 V, the analog switch ON-state resistance becomes very nonlinear. It is recommended that only digital signals be transmitted at these low supply voltages.

6.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | SN74LV4051A | | UNIT |
|-------------------------------|--|-------------|------------|------|
| | | N (PDIP) | PW (TSSOP) | |
| | | 16 PINS | 16 PINS | |
| R _{θJA} | Junction-to-ambient thermal resistance | 54.8 | 111.3 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 42.1 | 45.3 | °C/W |
| R _{θJB} | Junction-to-board thermal resistance | 34.8 | 56.9 | °C/W |
| ψ _{JT} | Junction-to-top characterization parameter | 26.9 | 5.4 | °C/W |
| ψ _{JB} | Junction-to-board characterization parameter | 34.7 | 56.3 | °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} | MIN | TYP | MAX | UNIT |
|---|--|--------------------------------|-----------------|-----|------|------|------|
| r _{on} ON-state switch resistance | I _T = 2 mA, V _I = V _{CC} or GND, V _{INH} = V _{IL} (see Figure 2) | T _A = 25°C | 2.3 V | | 38 | 180 | Ω |
| | | T _A = –40°C to 85°C | | | | 225 | |
| | | T _A = 25°C | 3 V | | 30 | 150 | |
| | | T _A = –40°C to 85°C | | | | 190 | |
| | | T _A = 25°C | 4.5 V | | 22 | 75 | |
| | | T _A = –40°C to 85°C | | | | 100 | |
| r _{on(p)} Peak ON-state resistance | I _T = 2 mA, V _I = V _{CC} to GND, V _{INH} = V _{IL} | T _A = 25°C | 2.3 V | | 113 | 500 | Ω |
| | | T _A = –40°C to 85°C | | | | 600 | |
| | | T _A = 25°C | 3 V | | 54 | 180 | |
| | | T _A = –40°C to 85°C | | | | 225 | |
| | | T _A = 25°C | 4.5 V | | 31 | 100 | |
| | | T _A = –40°C to 85°C | | | | 125 | |
| Δr _{on} Difference in ON-state resistance between switches | I _T = 2 mA, V _I = V _{CC} to GND, V _{INH} = V _{IL} | T _A = 25°C | 2.3 V | | 2.1 | 30 | Ω |
| | | T _A = –40°C to 85°C | | | | 40 | |
| | | T _A = 25°C | 3 V | | 1.4 | 20 | |
| | | T _A = –40°C to 85°C | | | | 30 | |
| | | T _A = 25°C | 4.5 V | | 1.3 | 15 | |
| | | T _A = –40°C to 85°C | | | | 20 | |
| I _I Control input current | V _I = 5.5 V or GND | T _A = 25°C | 0 to 5.5 V | | | ±0.1 | μA |
| | | T _A = –40°C to 85°C | | | | ±1 | |
| I _{S(off)} OFF-state switch leakage current | V _I = V _{CC} and V _O = GND, or V _I = GND and V _O = V _{CC} , V _{INH} = V _{IH} (see Figure 3) | T _A = 25°C | 5.5 V | | | ±0.1 | μA |
| | | T _A = –40°C to 85°C | | | | ±1 | |
| I _{S(on)} ON-state switch leakage current | V _I = V _{CC} or GND, V _{INH} = V _{IL} (see Figure 4) | T _A = 25°C | 5.5 V | | | ±0.1 | μA |
| | | T _A = –40°C to 85°C | | | | ±1 | |
| I _{CC} Supply current | V _I = V _{CC} or GND | T _A = –40°C to 85°C | 5.5 V | | | 20 | μA |
| C _{IC} Control input capacitance | f = 10 MHz | T _A = 25°C | 3.3 V | | 2 | | pF |
| C _{IS} Common terminal capacitance | T _A = 25°C | | 3.3 V | | 23.4 | | pF |
| C _{OS} Switch terminal capacitance | T _A = 25°C | | 3.3 V | | 5.7 | | pF |
| C _F Feedthrough capacitance | T _A = 25°C | | 3.3 V | | 0.5 | | pF |

6.6 Operating Characteristics

 $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$

| PARAMETER | TEST CONDITIONS | TYP | UNIT |
|--|--|-----|------|
| C_{pd} Power dissipation capacitance | $C_L = 50\text{ pF}$, $f = 10\text{ MHz}$ | 5.9 | pF |

6.7 Switching Characteristics: $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$

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

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|--------------|-------------|---|-----|------|----------|------|
| t_{PLH} t_{PHL} Propagation delay time | COM or Yn | Yn or COM | $C_L = 15\text{ pF}$ (see Figure 5) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 1.9 | 10 16 | ns |
| t_{PZH} t_{PZL} Enable delay time | INH | COM or Yn | $C_L = 15\text{ pF}$ (see Figure 6) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 6.6 | 18 23 | ns |
| t_{PHZ} t_{PLZ} Disable delay time | INH | COM or Yn | $C_L = 15\text{ pF}$ (see Figure 6) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 7.4 | 18 23 | ns |
| t_{PLH} t_{PHL} Propagation delay time | COM or Yn | Yn or COM | $C_L = 50\text{ pF}$ (see Figure 6) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 3.8 | 12 18 | ns |
| t_{PZH} t_{PZL} Enable delay time | INH | COM or Yn | $C_L = 50\text{ pF}$ (see Figure 6) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 7.8 | 28 35 | ns |
| t_{PHZ} t_{PLZ} Disable delay time | INH | COM or Yn | $C_L = 50\text{ pF}$ (see Figure 6) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 11.5 | 28 35 | ns |

6.8 Switching Characteristics: $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$

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

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|--------------|-------------|---|-----|-----|----------|------|
| t_{PLH} t_{PHL} Propagation delay time | COM or Yn | Yn or COM | $C_L = 15\text{ pF}$ (see Figure 5) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 1.2 | 6 10 | ns |
| t_{PZH} t_{PZL} Enable delay time | INH | COM or Yn | $C_L = 15\text{ pF}$ (see Figure 6) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 4.7 | 12 15 | ns |
| t_{PHZ} t_{PLZ} Disable delay time | INH | COM or Yn | $C_L = 15\text{ pF}$ (see Figure 6) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 5.7 | 12 15 | ns |
| t_{PLH} t_{PHL} Propagation delay time | COM or Yn | Yn or COM | $C_L = 50\text{ pF}$ (see Figure 5) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 2.5 | 9 12 | ns |
| t_{PZH} t_{PZL} Enable delay time | INH | COM or Yn | $C_L = 50\text{ pF}$ (see Figure 6) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 5.5 | 20 25 | ns |
| t_{PHZ} t_{PLZ} Disable delay time | INH | COM or Yn | $C_L = 50\text{ pF}$ (see Figure 6) $T_A = 25^\circ\text{C}$ $T_A = -40^\circ\text{C to } 85^\circ\text{C}$ | | 8.8 | 20 25 | ns |

6.9 Switching Characteristics: $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$

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

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|--------------|-------------|--|---|-----|-----|------|
| t_{PLH} t_{PHL} Propagation delay time | COM or Yn | Yn or COM | $C_L = 15\text{ pF}$ (see Figure 5) | $T_A = 25^\circ\text{C}$ | 0.6 | 4 | ns |
| | | | | $T_A = -40^\circ\text{C}$ to 85°C | | 7 | |
| t_{PZH} t_{PZL} Enable delay time | INH | COM or Yn | $C_L = 15\text{ pF}$ (see Figure 6) | $T_A = 25^\circ\text{C}$ | 3.5 | 8 | ns |
| | | | | $T_A = -40^\circ\text{C}$ to 85°C | | 10 | |
| t_{PHZ} t_{PLZ} Disable delay time | INH | COM or Yn | $C_L = 15\text{ pF}$ (see Figure 6) | $T_A = 25^\circ\text{C}$ | 4.4 | 8 | ns |
| | | | | $T_A = -40^\circ\text{C}$ to 85°C | | 10 | |
| t_{PLH} t_{PHL} Propagation delay time | COM or Yn | Yn or COM | $C_L = 50\text{ pF}$ (see Figure 5) | $T_A = 25^\circ\text{C}$ | 1.5 | 6 | ns |
| | | | | $T_A = -40^\circ\text{C}$ to 85°C | | 8 | |
| t_{PZH} t_{PZL} Enable delay time | INH | COM or Yn | $C_L = 50\text{ pF}$ (see Figure 6) | $T_A = 25^\circ\text{C}$ | 4 | 14 | ns |
| | | | | $T_A = -40^\circ\text{C}$ to 85°C | | 18 | |
| t_{PHZ} t_{PLZ} Disable delay time | INH | COM or Yn | $C_L = 50\text{ pF}$ (see Figure 6) | $T_A = 25^\circ\text{C}$ | 6.2 | 14 | ns |
| | | | | $T_A = -40^\circ\text{C}$ to 85°C | | 18 | |

6.10 Analog Switch Characteristics

over recommended operating free-air temperature range (unless otherwise noted), $T_A = 25^\circ\text{C}$

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | V_{CC} | MIN | TYP | MAX | UNIT |
|--|--------------|-------------|---|----------------------------|-------|------|-----|------|
| Frequency response (switch on) | COM or Yn | Yn or COM | $C_L = 50\text{ pF}$, $R_L = 600\ \Omega$, $f_{in} = 1\text{ MHz}$ (sine wave) (see ⁽¹⁾ and Figure 7) | 2.3 V | | 20 | | MHz |
| | | | | 3 V | | 25 | | |
| | | | | 4.5 V | | 35 | | |
| Crosstalk (control input to signal output) | INH | COM or Yn | $C_L = 50\text{ pF}$, $R_L = 600\ \Omega$, $f_{in} = 1\text{ MHz}$ (square wave) (see Figure 8) | 2.3 V | | 20 | | mV |
| | | | | 3 V | | 35 | | |
| | | | | 4.5 V | | 60 | | |
| Feedthrough attenuation (switch off) | COM or Yn | Yn or COM | $C_L = 50\text{ pF}$, $R_L = 600\ \Omega$, $f_{in} = 1\text{ MHz}$ (see ⁽²⁾ and Figure 9) | 2.3 V | | –45 | | dB |
| | | | | 3 V | | –45 | | |
| | | | | 4.5 V | | –45 | | |
| Sine-wave distortion | COM or Yn | Yn or COM | $C_L = 50\text{ pF}$, $R_L = 10\text{ k}\Omega$, $f_{in} = 1\text{ kHz}$ (sine wave) (see Figure 10) | $V_I = 2\text{ V}_{p-p}$ | 2.3 V | 0.1% | | |
| | | | | $V_I = 2.5\text{ V}_{p-p}$ | 3 V | 0.1% | | |
| | | | | $V_I = 4\text{ V}_{p-p}$ | 4.5 V | 0.1% | | |

(1) Adjust f_{in} voltage to obtain 0-dBm output. Increase f_{in} frequency until dB meter reads –3 dB.

(2) Adjust f_{in} voltage to obtain 0-dBm input.

6.11 Typical Characteristics

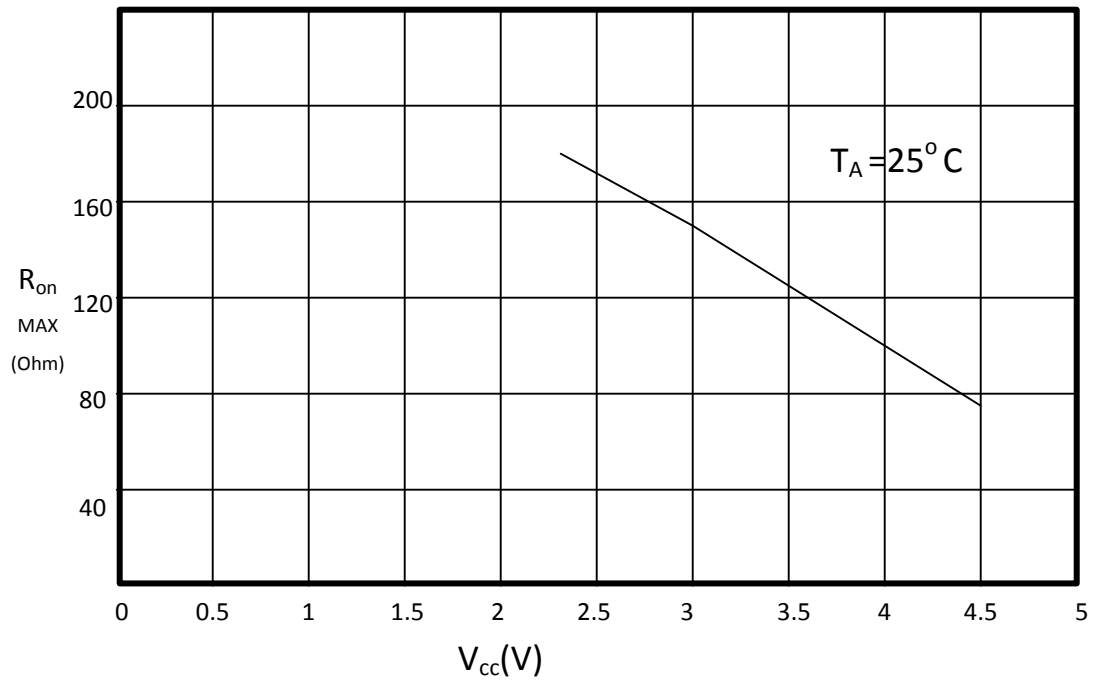


Figure 1. Plot at 25°C for V_{CC} vs Max R_{ON}

7 Parameter Measurement Information

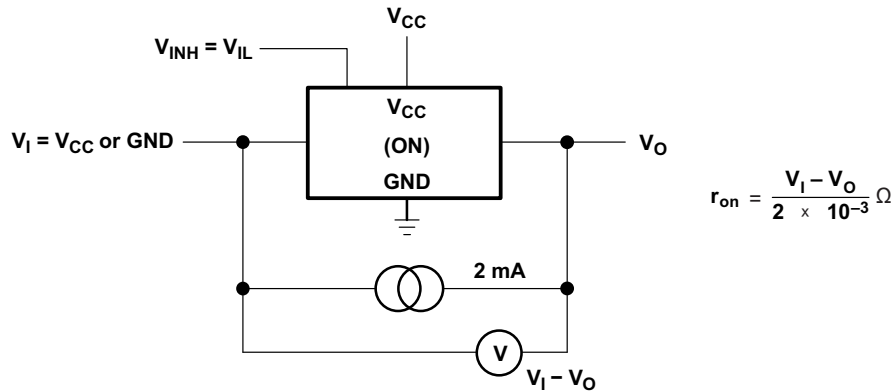


Figure 2. On-State Resistance Test Circuit

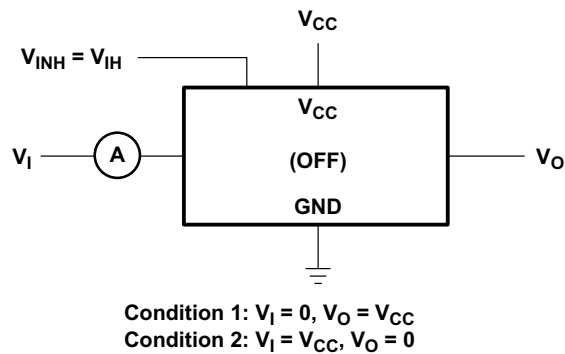


Figure 3. Off-State Switch Leakage-Current Test Circuit

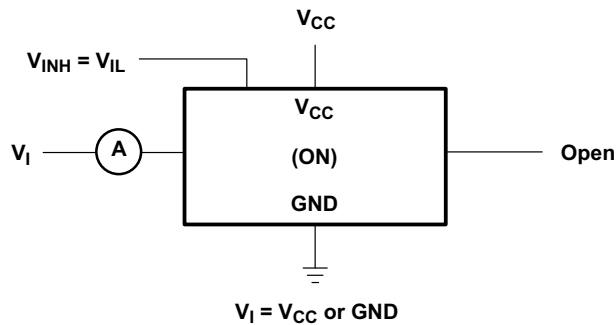


Figure 4. On-State Switch Leakage-Current Test Circuit

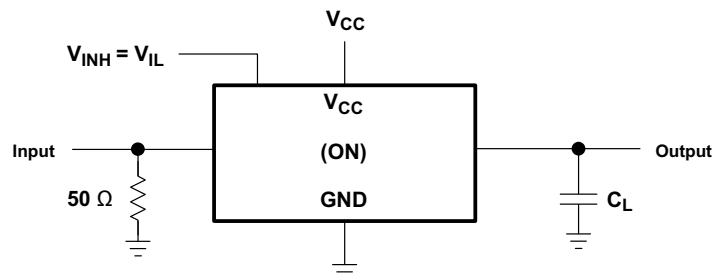


Figure 5. Propagation Delay Time, Signal Input to Signal Output

Parameter Measurement Information (continued)

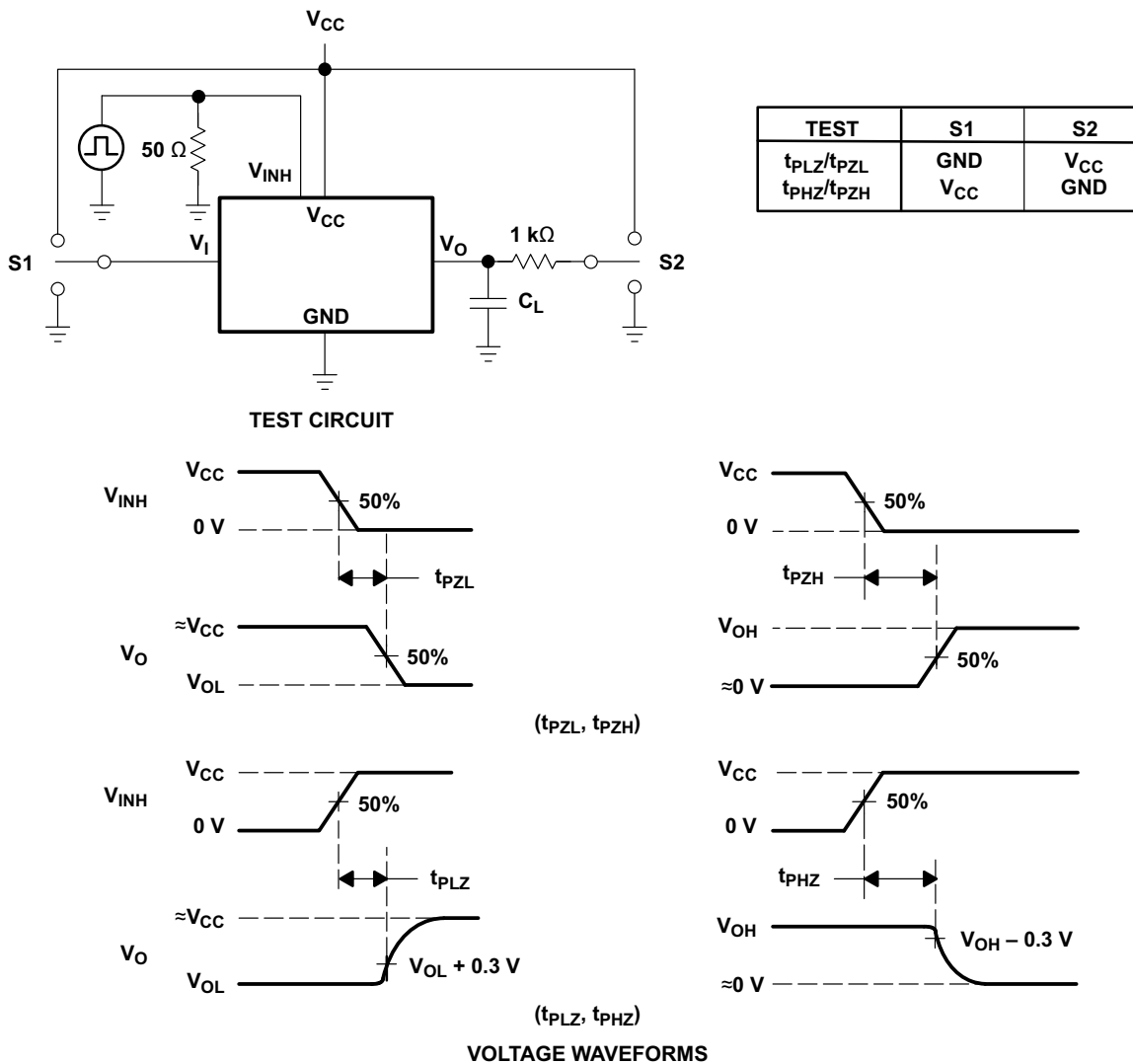
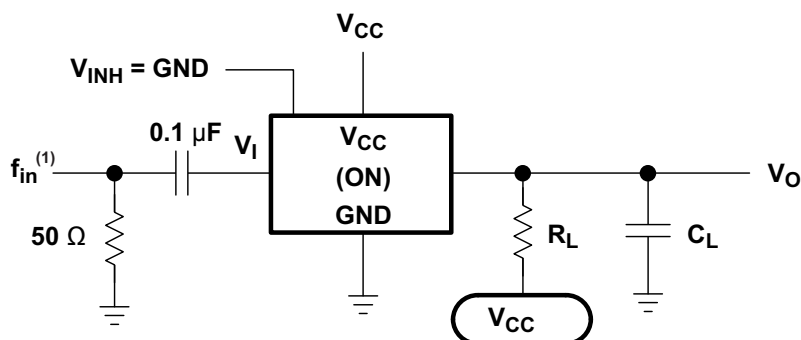


Figure 6. Switching Time (t_{PZL} , t_{PLZ} , t_{PHZ} , t_{PHZ}), Control to Signal Output



(1) f_{in} is a sine wave.

Figure 7. Frequency Response (Switch On)

Parameter Measurement Information (continued)

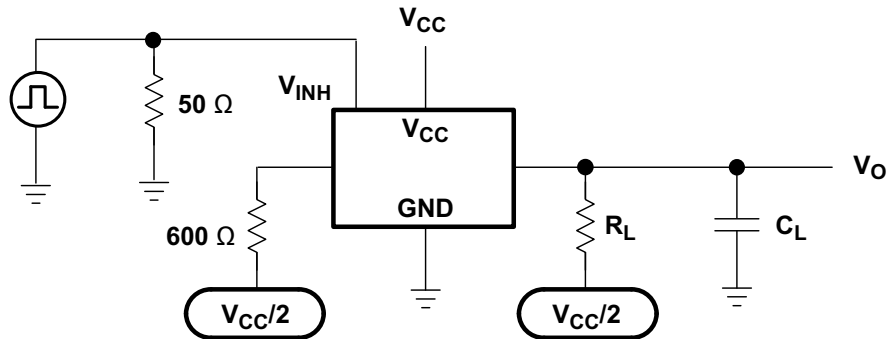


Figure 8. Crosstalk (Control Input, Switch Output)

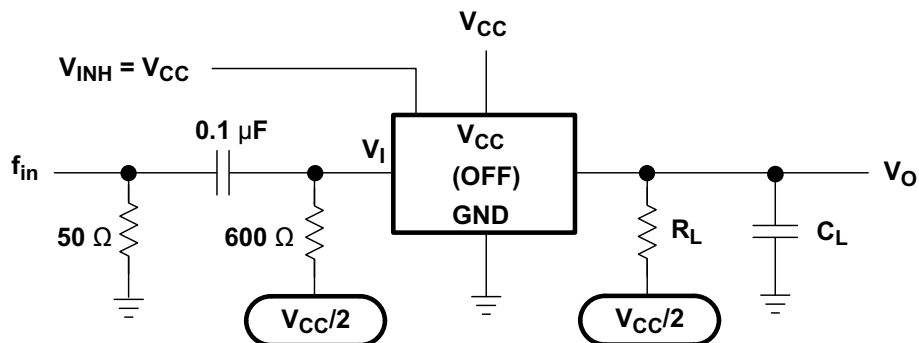


Figure 9. Feedthrough Attenuation (Switch Off)

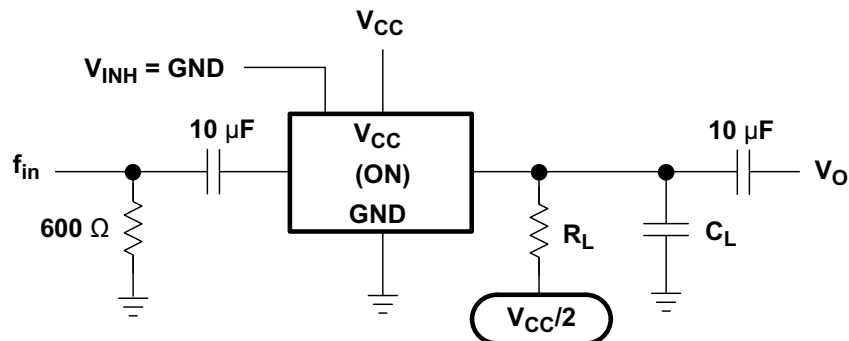


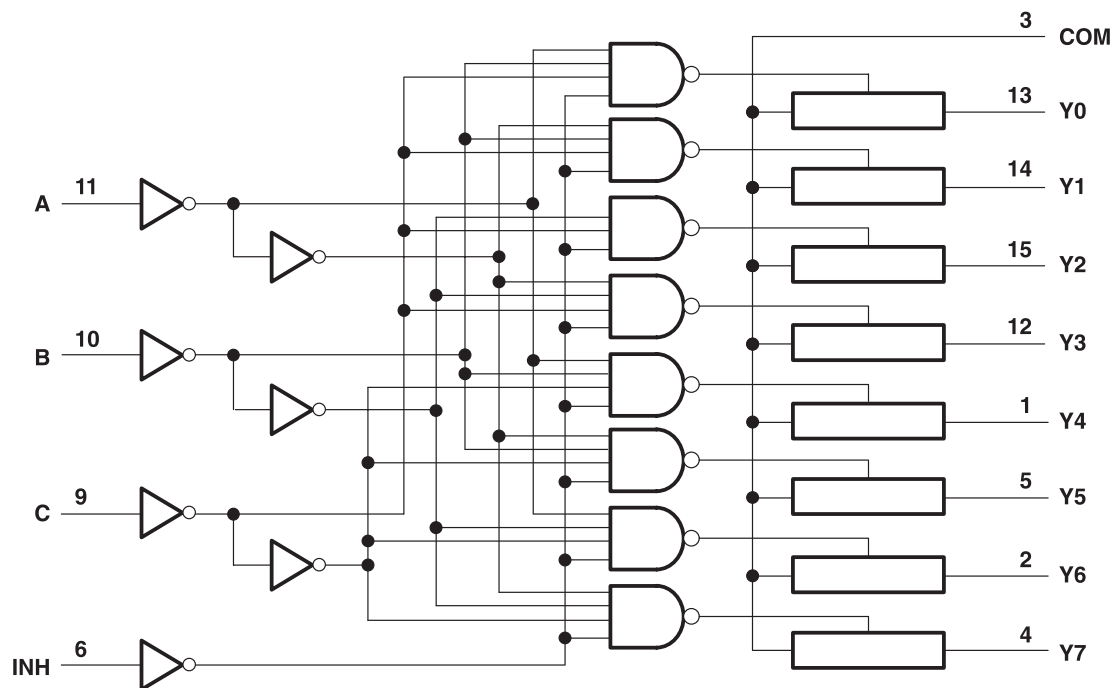
Figure 10. Sine-Wave Distortion

8 Detailed Description

8.1 Overview

The SN74LV4051A device is an 8-channel analog multiplexer. A multiplexer is used when several signals must share the same device or resource. This device allows for the selection of one of these signals at a time for analysis or propagation.

8.2 Functional Block Diagram



8.3 Feature Description

The SN74LV4051A device contains one 8-channel multiplexer for use in a variety of applications and can also be configured as demultiplexer by using the COM pin as an input and the Yn pins as outputs. This device is qualified to operate in the temperature range -40°C to $+85^{\circ}\text{C}$ (maximum depends on package type).

8.4 Device Functional Modes

Table 1. Function Table

| INPUTS | | | | ON CHANNEL |
|--------|---|---|---|---------------|
| INH | C | B | A | |
| L | L | L | L | Y0 |
| L | L | L | H | Y1 |
| L | L | H | L | Y2 |
| L | L | H | H | Y3 |
| L | H | L | L | Y4 |
| L | H | L | H | Y5 |
| L | H | H | L | Y6 |
| L | H | H | H | Y7 |
| H | X | X | X | None |

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. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

A multiplexer is used in applications where multiple signals share a resource. In [Figure 11](#), several different sensors are connected to the analog-to-digital converter (ADC) of a microcontroller unit (MCU).

9.2 Typical Application

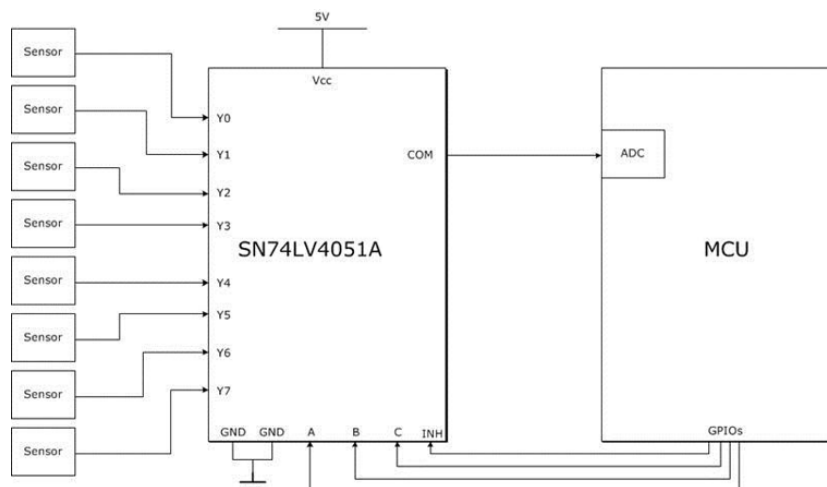


Figure 11. Example of Multiplexer Use With Analog Sensors and the ADC of an MCU

9.2.1 Design Requirements

Designing with the SN74LV4051A device requires a stable input voltage between 2 V (see [Recommended Operating Conditions](#) for details) and 5.5 V. Another important design consideration are the characteristics of the signal being multiplexed—ensure no important information is lost due to timing or incompatibility with this device.

9.2.2 Detailed Design Procedure

Normally, processing eight different analog signals requires eight separate ADCs, but [Figure 11](#) shows how to achieve this using only one ADC and four GPIOs (general-purpose input/outputs).

Typical Application (continued)

9.2.3 Application Curve

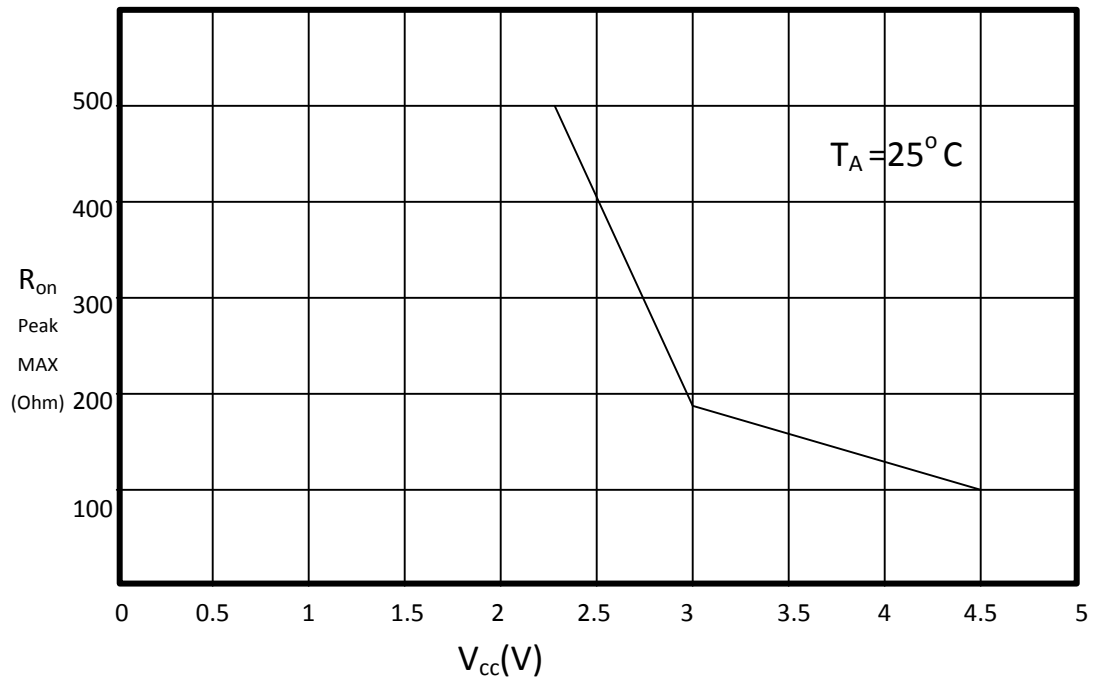


Figure 12. Plot at 25°C for V_{CC} vs Max $R_{ON(peak)}$

10 Power Supply Recommendations

Most systems have a common 3.3-V or 5-V rail that can supply the V_{CC} pin of this device. If this rail is not available, a switched-mode power supply (SMPS) or a low dropout regulator (LDO) can supply this device from a higher-voltage rail.

11 Layout

11.1 Layout Guidelines

TI recommends keeping the signal lines as short and as straight as possible (see [Figure 13](#)). Incorporation of microstrip or stripline techniques are also recommended when signal lines are more than 1" long. These traces must be designed with a characteristic impedance of either 50- Ω or 75- Ω as required by the application. Do **not** place this device too close to high-voltage switching components because they may cause interference.

11.2 Layout Example

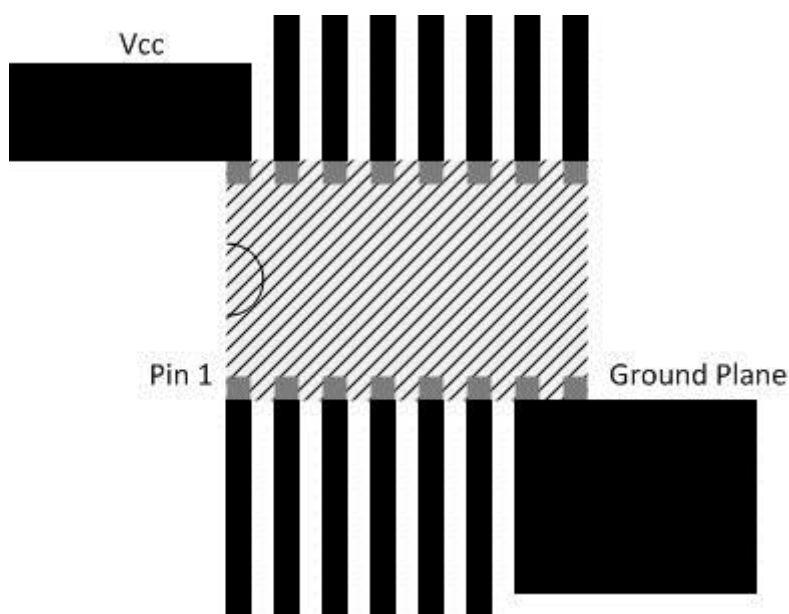


Figure 13. Layout Schematic

12 Device and Documentation Support

12.1 Documentation Support

12.1.1 Related Documentation

For related documentation, see the following:

Implications of Slow or Floating CMOS Inputs, [SCBA004](#)

12.2 Community Resources

The following links connect to TI community resources. Linked contents are 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](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

12.3 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

12.4 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.

12.5 Glossary

[SLYZ022](#) — *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 Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|-------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74LV4051AD | ACTIVE | SOIC | D | 16 | 40 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LV4051A | Samples |
| SN74LV4051ADBR | ACTIVE | SSOP | DB | 16 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LW051A | Samples |
| SN74LV4051ADGVR | ACTIVE | TVSOP | DGV | 16 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LW051A | Samples |
| SN74LV4051ADGVRG4 | ACTIVE | TVSOP | DGV | 16 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LW051A | Samples |
| SN74LV4051ADR | ACTIVE | SOIC | D | 16 | 2500 | RoHS & Green | NIPDAU SN | Level-1-260C-UNLIM | -40 to 85 | LV4051A | Samples |
| SN74LV4051AN | ACTIVE | PDIP | N | 16 | 25 | RoHS & Green | NIPDAU | N / A for Pkg Type | -40 to 85 | SN74LV4051AN | Samples |
| SN74LV4051ANSR | ACTIVE | SO | NS | 16 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 74LV4051A | Samples |
| SN74LV4051APW | ACTIVE | TSSOP | PW | 16 | 90 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LW051A | Samples |
| SN74LV4051APWG4 | ACTIVE | TSSOP | PW | 16 | 90 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LW051A | Samples |
| SN74LV4051APWR | ACTIVE | TSSOP | PW | 16 | 2000 | RoHS & Green | NIPDAU SN | Level-1-260C-UNLIM | -40 to 85 | LW051A | Samples |
| SN74LV4051APWRE4 | ACTIVE | TSSOP | PW | 16 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LW051A | Samples |
| SN74LV4051APWRG4 | ACTIVE | TSSOP | PW | 16 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LW051A | Samples |
| SN74LV4051APWT | ACTIVE | TSSOP | PW | 16 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | LW051A | Samples |
| SN74LV4051ARGYR | ACTIVE | VQFN | RGY | 16 | 3000 | RoHS & Green | NIPDAU | Level-2-260C-1 YEAR | -40 to 85 | LW051A | Samples |

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

ACTIVE: Product device recommended for new designs.

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

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

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

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of ≤ 1000 ppm threshold. Antimony trioxide based flame retardants must also meet the ≤ 1000 ppm threshold requirement.

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

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

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

(6) Lead finish/Ball material - Orderable Devices 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.

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 SN74LV4051A :

- Automotive : [SN74LV4051A-Q1](#)
- Enhanced Product : [SN74LV4051A-EP](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

TAPE AND REEL INFORMATION



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LV4051ADBR | SSOP | DB | 16 | 2000 | 330.0 | 16.4 | 8.35 | 6.6 | 2.4 | 12.0 | 16.0 | Q1 |
| SN74LV4051ADGVR | TVSOP | DGV | 16 | 2000 | 330.0 | 12.4 | 6.8 | 4.0 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV4051ADR | SOIC | D | 16 | 2500 | 330.0 | 16.8 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LV4051ADR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LV4051ANSR | SO | NS | 16 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| SN74LV4051APWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV4051APWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV4051APWRG4 | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV4051APWT | TSSOP | PW | 16 | 250 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| SN74LV4051ARGYR | VQFN | RGY | 16 | 3000 | 330.0 | 12.4 | 3.8 | 4.3 | 1.5 | 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) |
|------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LV4051ADBR | SSOP | DB | 16 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74LV4051ADGVR | TVSOP | DGV | 16 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74LV4051ADR | SOIC | D | 16 | 2500 | 364.0 | 364.0 | 27.0 |
| SN74LV4051ADR | SOIC | D | 16 | 2500 | 340.5 | 336.1 | 32.0 |
| SN74LV4051ANSR | SO | NS | 16 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74LV4051APWR | TSSOP | PW | 16 | 2000 | 364.0 | 364.0 | 27.0 |
| SN74LV4051APWR | TSSOP | PW | 16 | 2000 | 356.0 | 356.0 | 35.0 |
| SN74LV4051APWRG4 | TSSOP | PW | 16 | 2000 | 367.0 | 367.0 | 35.0 |
| SN74LV4051APWT | TSSOP | PW | 16 | 250 | 356.0 | 356.0 | 35.0 |
| SN74LV4051ARGYR | VQFN | RGY | 16 | 3000 | 367.0 | 367.0 | 35.0 |

TUBE



*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| SN74LV4051AD | D | SOIC | 16 | 40 | 507 | 8 | 3940 | 4.32 |
| SN74LV4051AN | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74LV4051AN | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74LV4051APW | PW | TSSOP | 16 | 90 | 530 | 10.2 | 3600 | 3.5 |
| SN74LV4051APWG4 | PW | TSSOP | 16 | 90 | 530 | 10.2 | 3600 | 3.5 |

D (R-PDSO-G16)

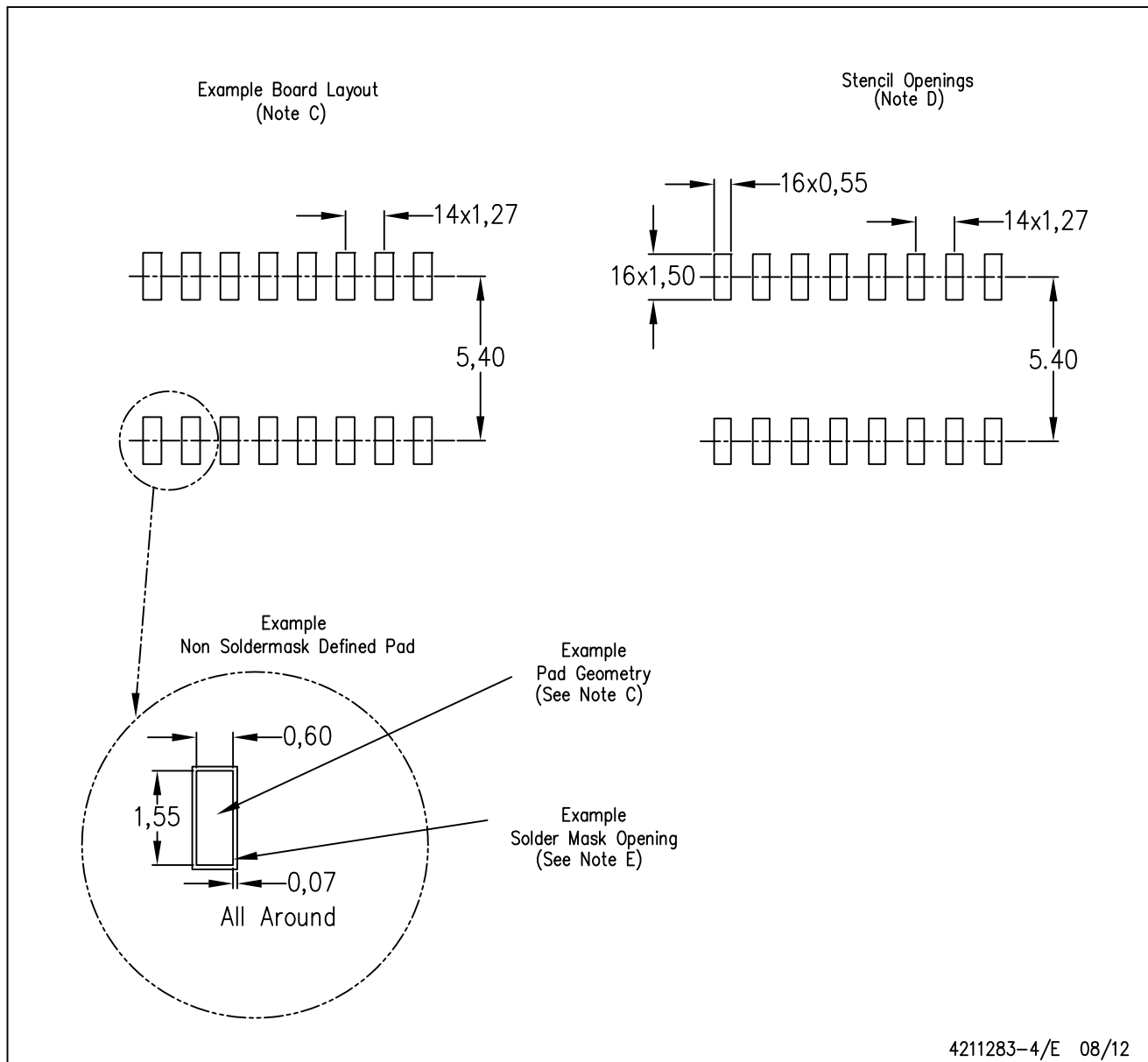
PLASTIC SMALL OUTLINE



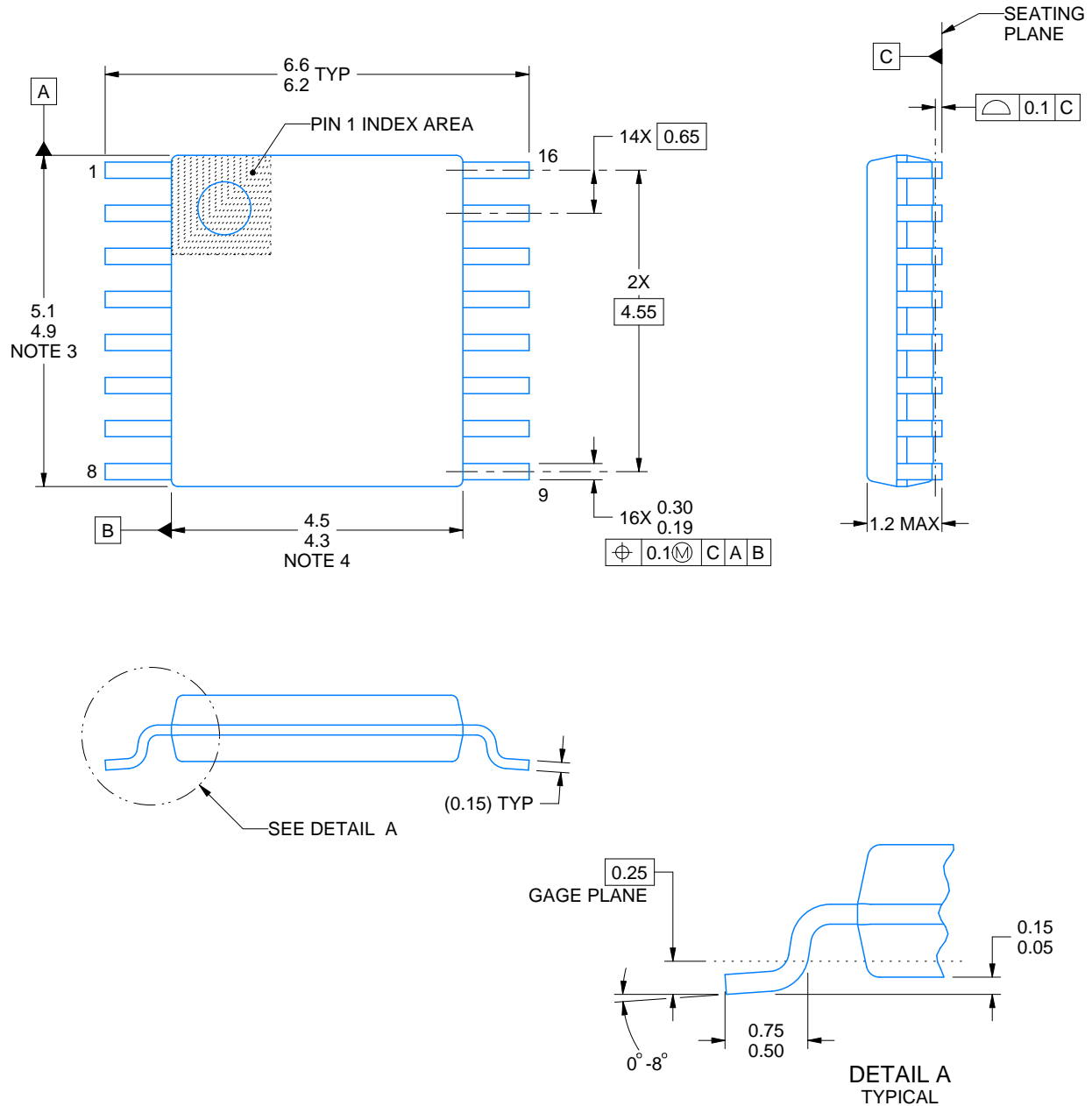
- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



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



4220204/A 02/2017

NOTES:

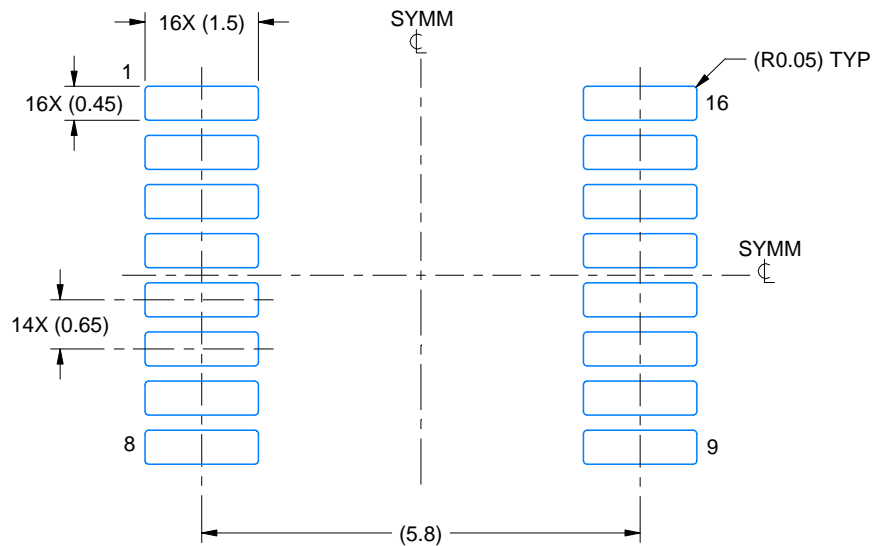
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

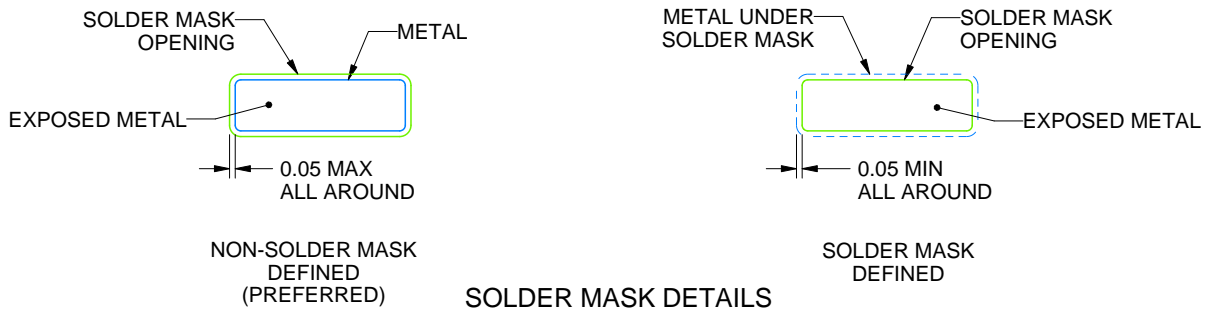
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



4220204/A 02/2017

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

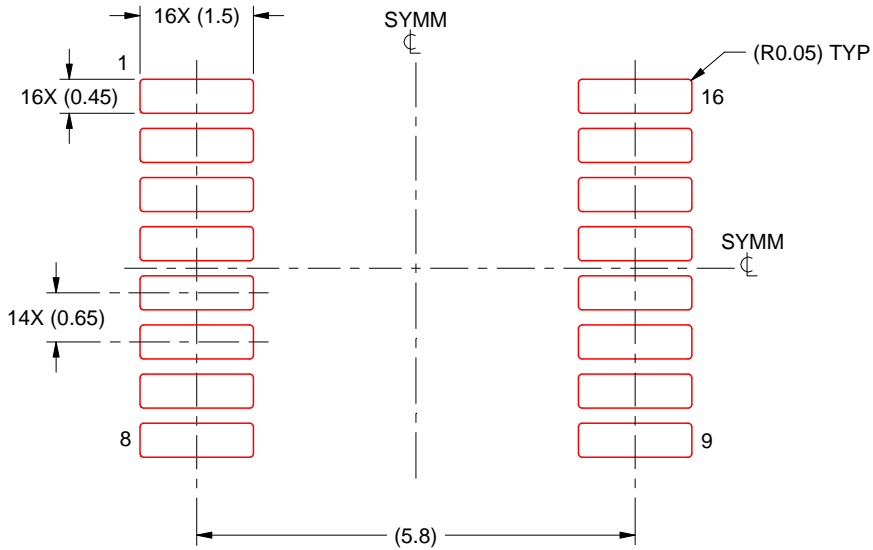
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

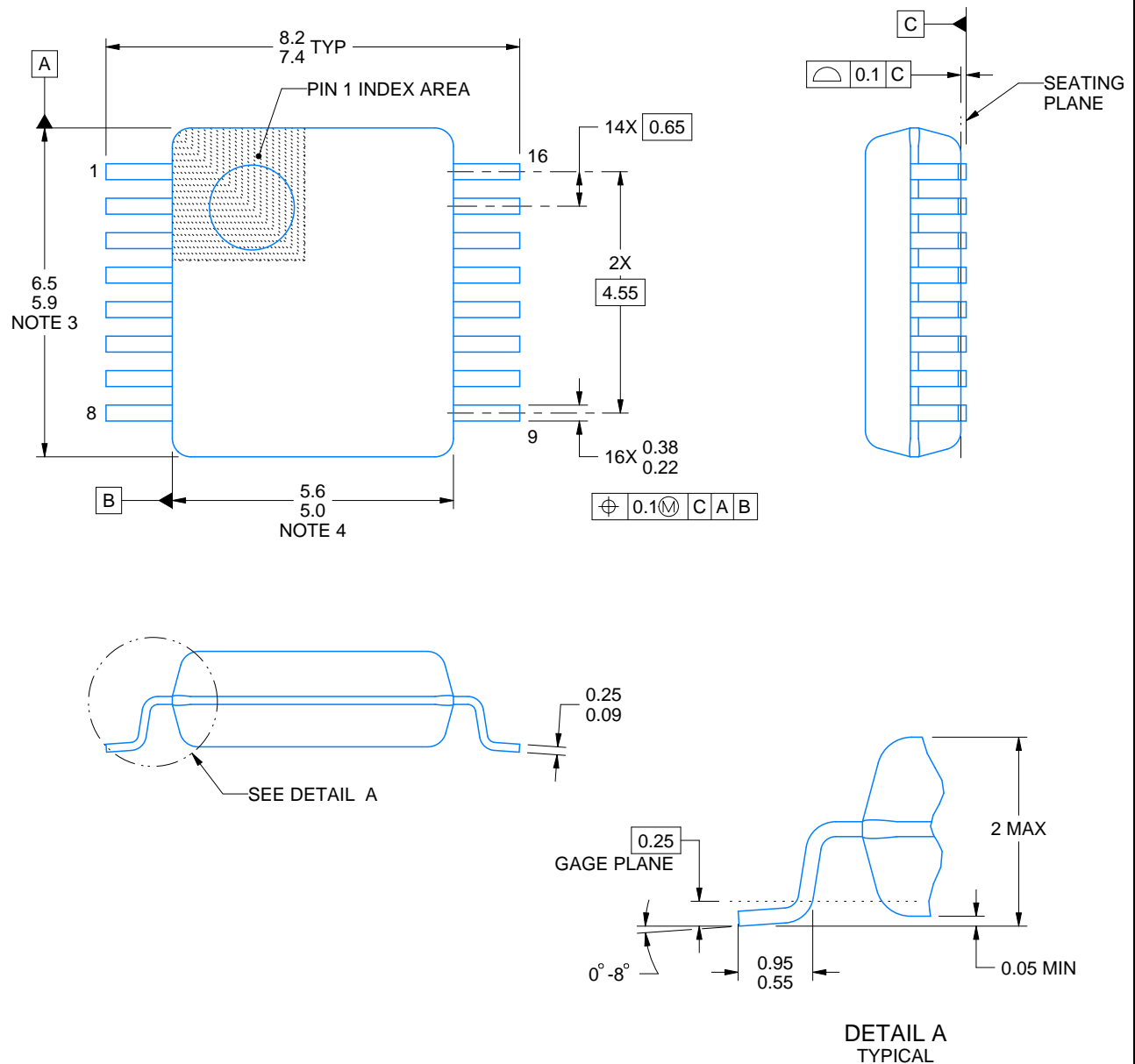


SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220204/A 02/2017

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.



4220763/A 05/2022

NOTES:

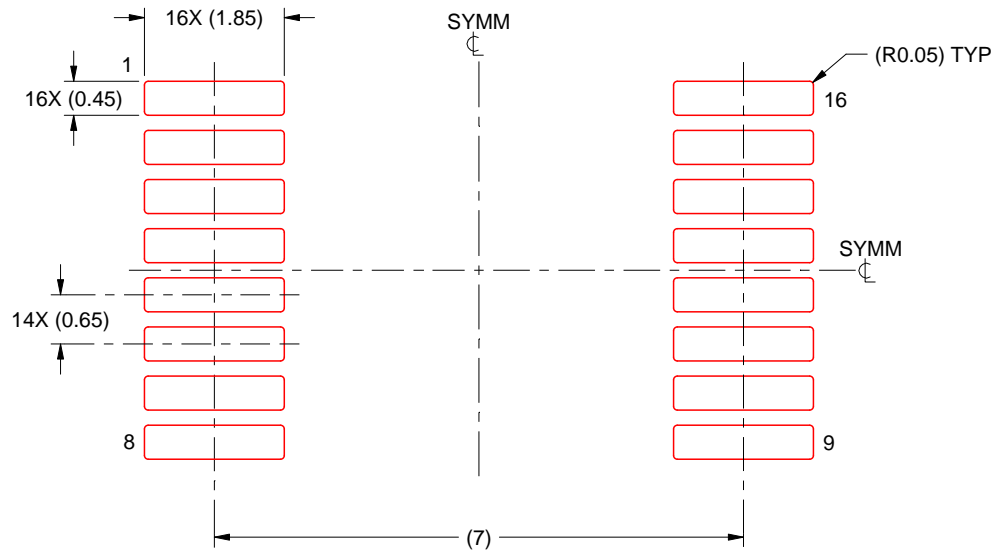
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

EXAMPLE 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)

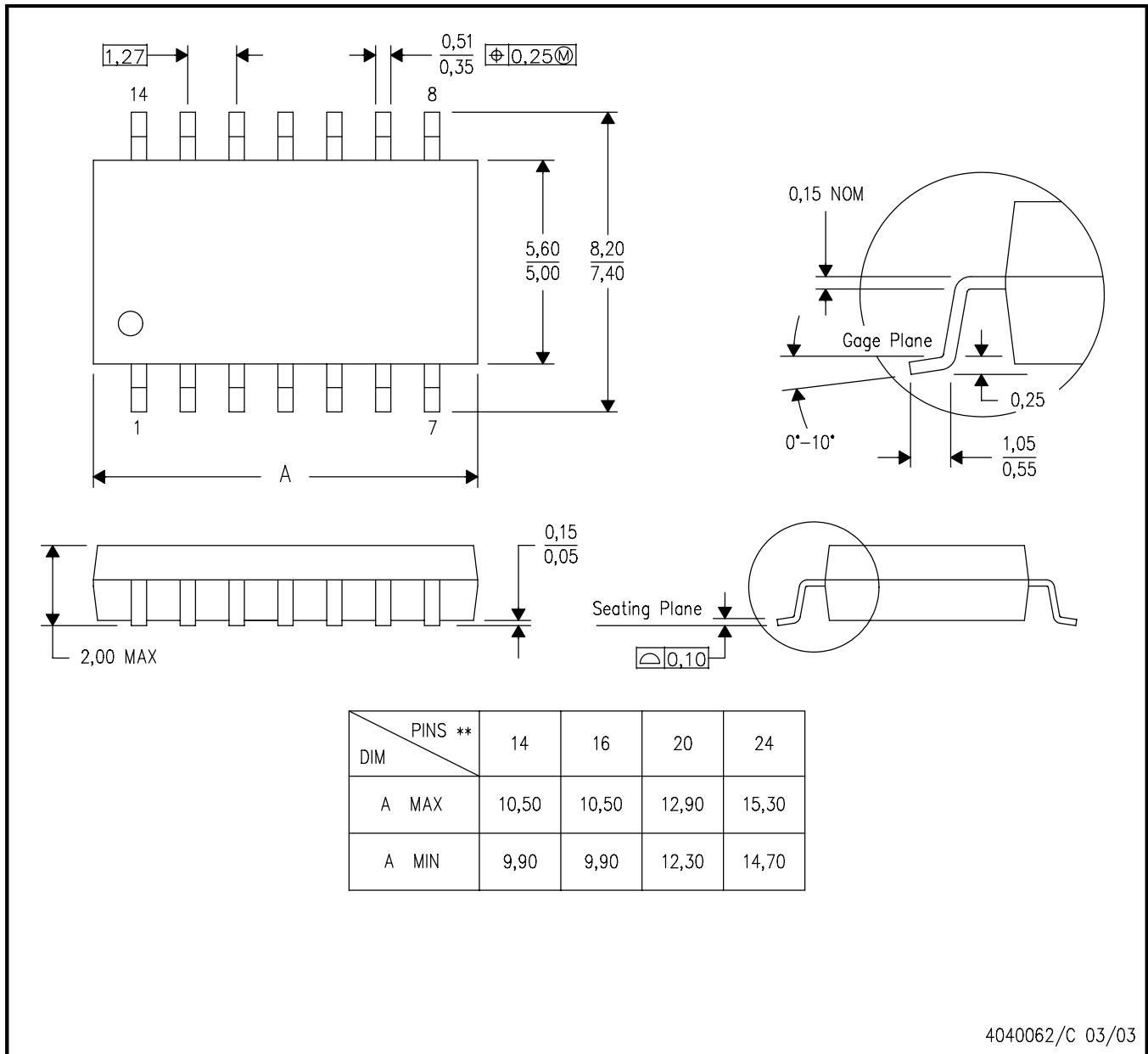
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

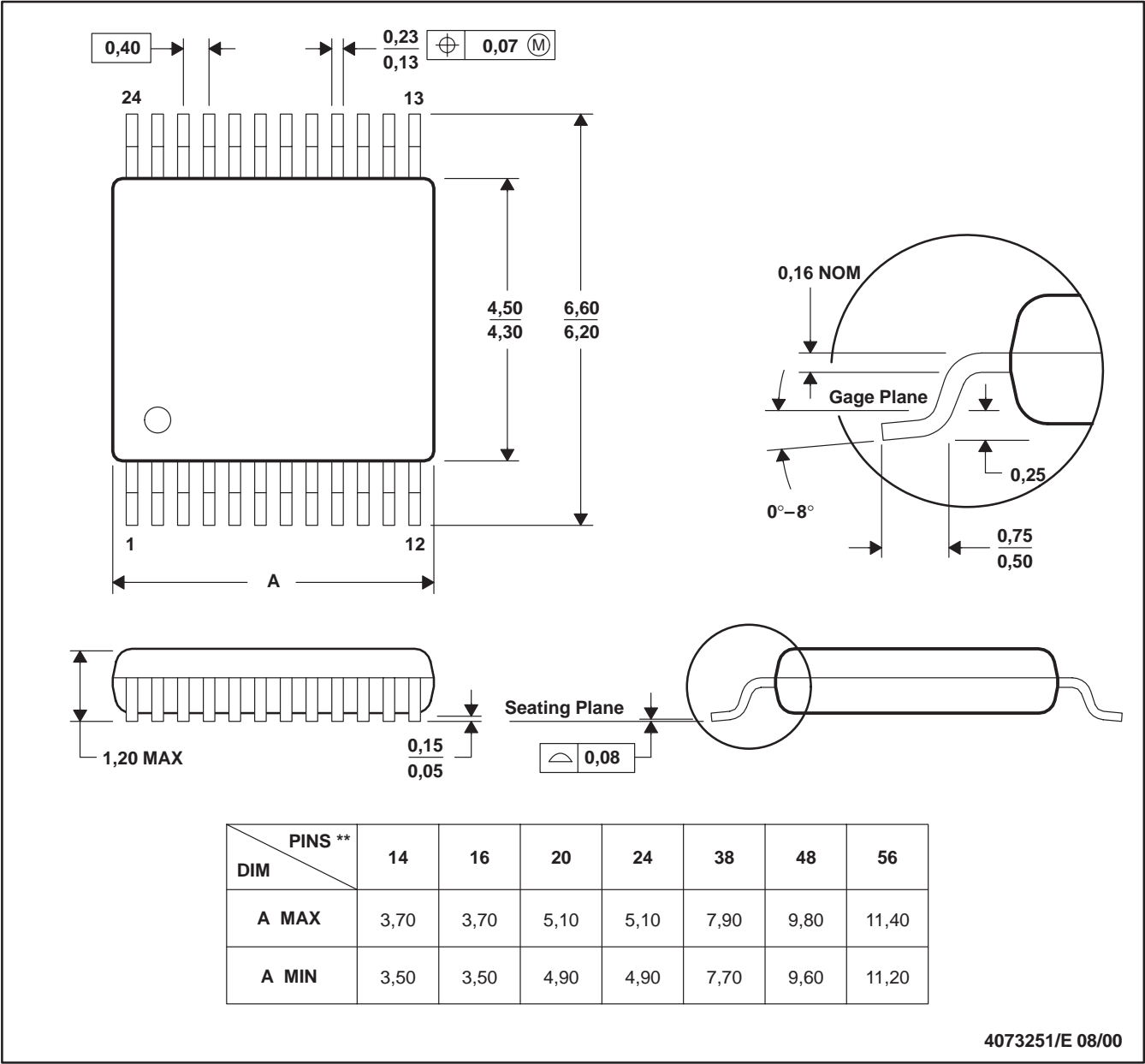
14-PINS SHOWN



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

DGV (R-PDSO-G)**
 24 PINS SHOWN

PLASTIC SMALL-OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 - D. Falls within JEDEC: 24/48 Pins – MO-153
14/16/20/56 Pins – MO-194

N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



| PINS ** | 14 | 16 | 18 | 20 |
|---------------------|------------------|------------------|------------------|------------------|
| DIM | | | | |
| A MAX | 0.775 (19,69) | 0.775 (19,69) | 0.920 (23,37) | 1.060 (26,92) |
| A MIN | 0.745 (18,92) | 0.745 (18,92) | 0.850 (21,59) | 0.940 (23,88) |
| MS-001 VARIATION | AA | BB | AC | AD |



4040049/E 12/2002

- 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.

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



4203539-3/I 06/2011

- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - This drawing is subject to change without notice.
 - QFN (Quad Flatpack No-Lead) package configuration.
 - The package thermal pad must be soldered to the board for thermal and mechanical performance.
 - See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
 - Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
 - Package complies to JEDEC MO-241 variation BA.

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD

THERMAL INFORMATION

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

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

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



Bottom View

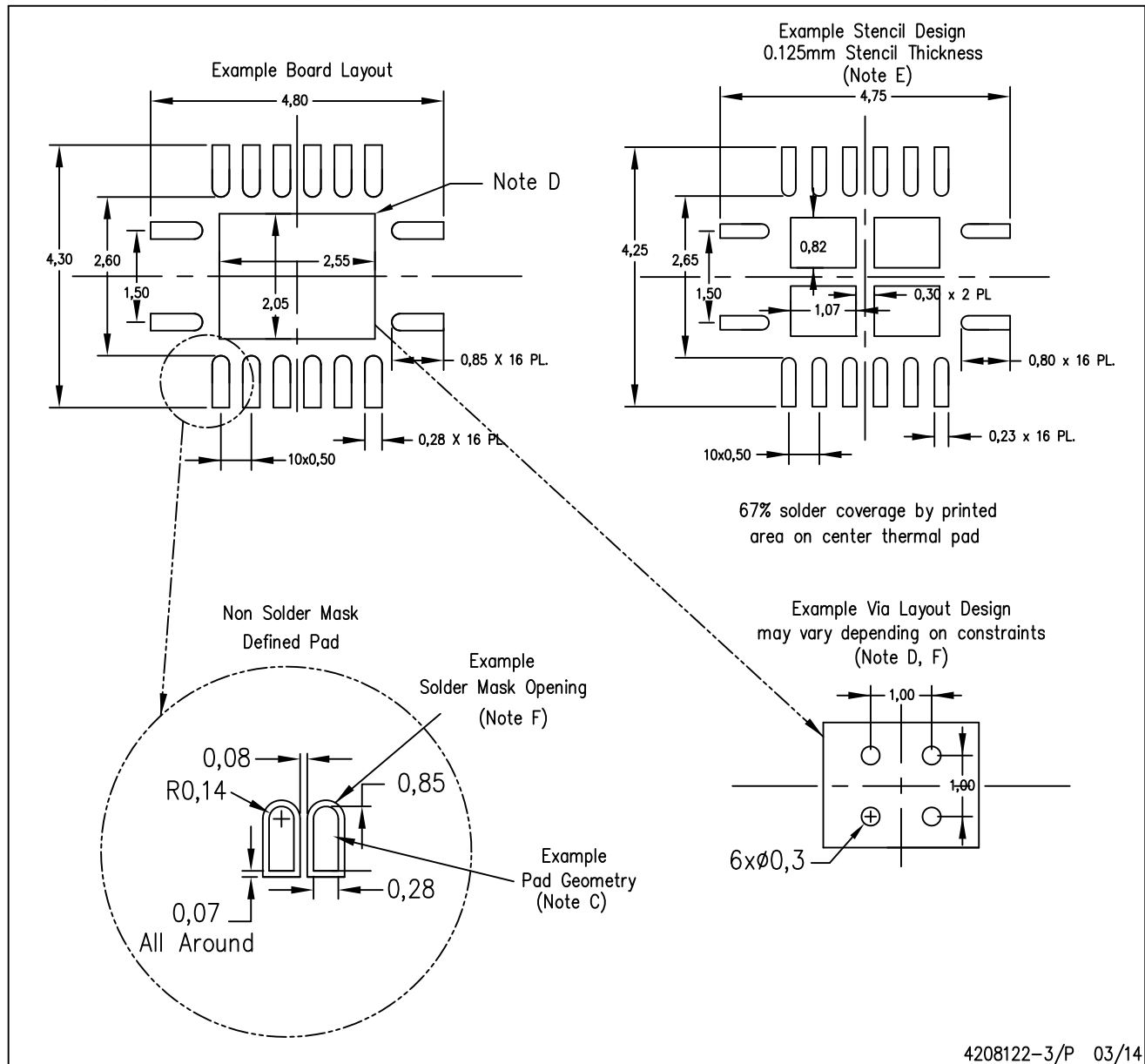
Exposed Thermal Pad Dimensions

4206353-3/P 03/14

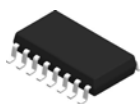
NOTE: All linear dimensions are in millimeters

RGY (R-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



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



PACKAGE OUTLINE

NS0016A

SOP - 2.00 mm max height

SOP



4220735/A 12/2021

NOTES:

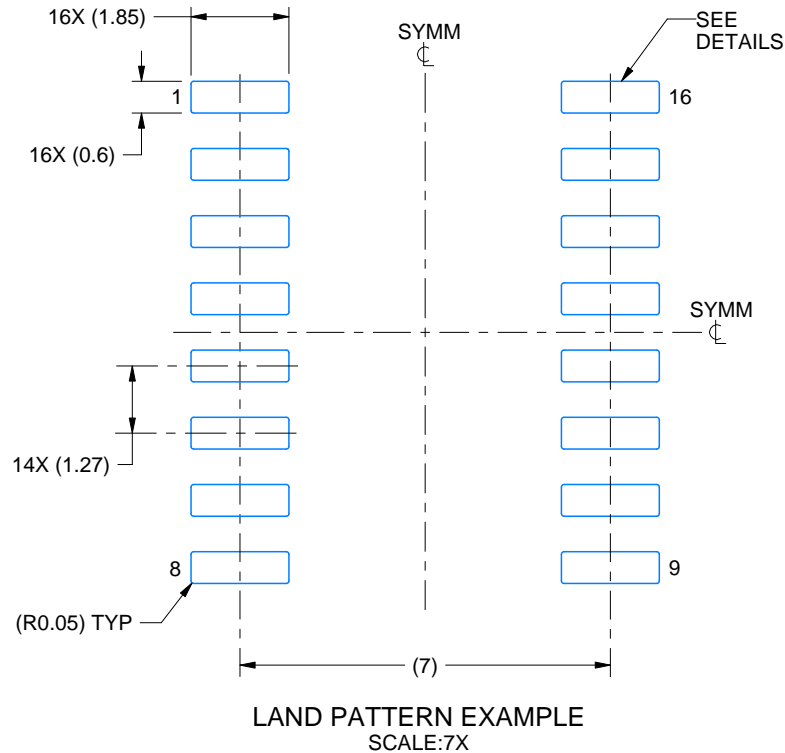
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate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



SOLDER MASK DETAILS

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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