

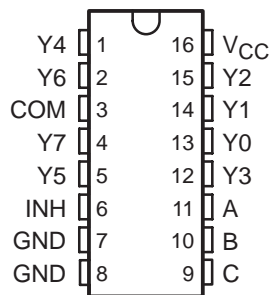
SN74LV4051A-Q1

8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

SCLS520C – AUGUST 2003 – REVISED APRIL 2008

- Qualified for Automotive Applications
- 2-V to 5.5-V V_{CC} Operation
- Supports 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

D, DW, OR PW PACKAGE
(TOP VIEW)



description/ordering information

This 8-channel CMOS analog multiplexer/demultiplexer is designed for 2-V to 5.5-V V_{CC} operation.

The SN74LV4051A handles 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.

ORDERING INFORMATION†

| T _A | PACKAGE‡ | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|------------|---------------|-----------------------|------------------|
| –40°C to 105°C | SOIC – D | Tape and reel | SN74LV4051ATDRQ1 | L4051AQ |
| | SOIC – DW | Tape and reel | SN74LV4051ATDWRQ1 | L4051AQ |
| | TSSOP – PW | Tape and reel | SN74LV4051ATPWRQ1 | L4051AQ |

† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at <http://www.ti.com>.

‡ Package drawings, thermal data, and symbolization are available at <http://www.ti.com/packaging>.



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

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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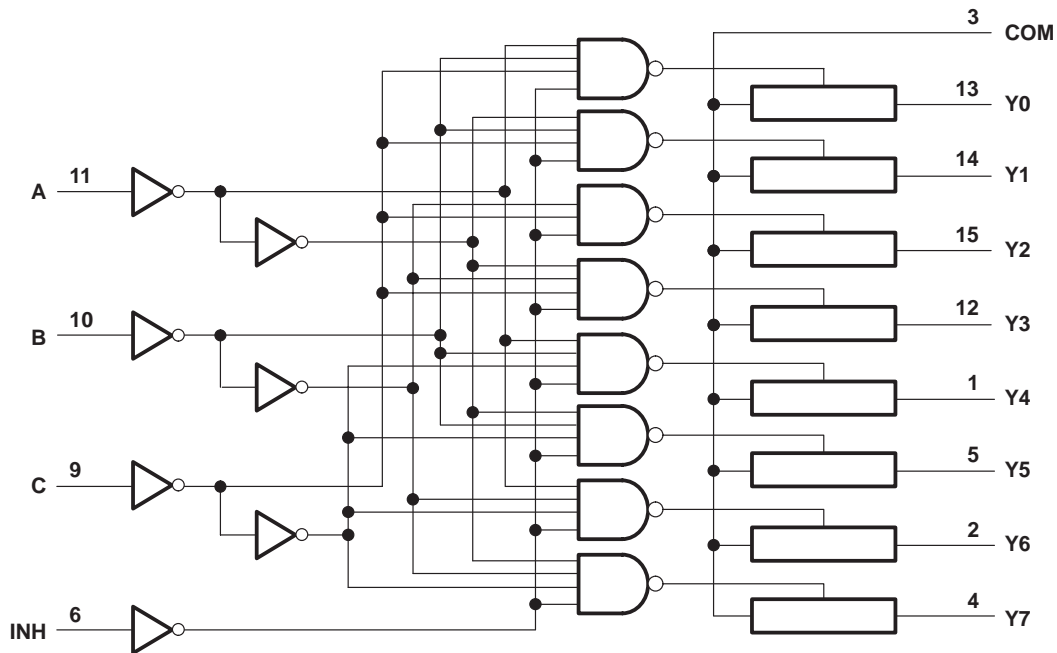
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FUNCTION TABLE

| 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 |

logic diagram (positive logic)



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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

| | |
|--|----------------------------|
| Supply voltage range, V_{CC} | –0.5 V to 7.0 V |
| Input voltage range, V_I (see Note 1) | –0.5 V to 7.0 V |
| Switch I/O voltage range, V_{IO} (see Notes 1 and 2) | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, I_{IK} ($V_I < 0$) | –20 mA |
| I/O diode current, I_{IOK} ($V_{IO} < 0$) | –50 mA |
| Switch through current, I_T ($V_{IO} = 0$ to V_{CC}) | ±25 mA |
| Continuous current through V_{CC} or GND | ±50 mA |
| Package thermal impedance, θ_{JA} (see Note 3): D package | 95°C/W |
| DW package | 75°C/W |
| PW package | 108°C/W |
| Storage temperature range, T_{stg} | –65°C to 150°C |

† 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.

- NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
 2. This value is limited to 5.5 V maximum.
 3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 4)

| | | MIN | MAX | UNIT |
|---------------------|--|---------------------------|---------------------|------|
| V_{CC} | Supply voltage | 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 | $V_{CC} \times 0.7$ | |
| | | $V_{CC} = 3$ V to 3.6 V | $V_{CC} \times 0.7$ | |
| | | $V_{CC} = 4.5$ V to 5.5 V | $V_{CC} \times 0.7$ | |
| V_{IL} | Low-level input voltage, control inputs | $V_{CC} = 2$ V | 0.5 | V |
| | | $V_{CC} = 2.3$ V to 2.7 V | $V_{CC} \times 0.3$ | |
| | | $V_{CC} = 3$ V to 3.6 V | $V_{CC} \times 0.3$ | |
| | | $V_{CC} = 4.5$ V to 5.5 V | $V_{CC} \times 0.3$ | |
| V_I | Control input voltage | 0 | 5.5 | V |
| V_{IO} | Input/output voltage | 0 | V_{CC} | V |
| $\Delta t/\Delta v$ | 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 | 105 | °C |

‡ 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.

NOTE 4: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



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8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

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

| PARAMETER | TEST CONDITIONS | V _{CC} | T _A = 25°C | | | MIN | MAX | UNIT |
|---|--|-----------------|-----------------------|------|-----|------|-----|------|
| | | | MIN | TYP | MAX | | | |
| r _{on} On-state switch resistance | I _T = 2 mA, V _I = V _{CC} or GND, V _{INH} = V _{IL} (see Figure 1) | 2.3 V | | 38 | 180 | | 225 | Ω |
| | | 3 V | | 30 | 150 | | 190 | |
| | | 4.5 V | | 22 | 75 | | 100 | |
| r _{on(p)} Peak on-state resistance | I _T = 2 mA, V _I = V _{CC} to GND, V _{INH} = V _{IL} | 2.3 V | | 113 | 500 | | 600 | Ω |
| | | 3 V | | 54 | 180 | | 225 | |
| | | 4.5 V | | 31 | 100 | | 125 | |
| Δr _{on} Difference in on-state resistance between switches | I _T = 2 mA, V _I = V _{CC} to GND, V _{INH} = V _{IL} | 2.3 V | | 2.1 | 30 | | 40 | Ω |
| | | 3 V | | 1.4 | 20 | | 30 | |
| | | 4.5 V | | 1.3 | 15 | | 20 | |
| I _I Control input current | V _I = 5.5 V or GND | 0 to 5.5 V | | | | ±0.1 | ±1 | μA |
| 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 2) | 5.5 V | | | | ±0.1 | ±1 | μA |
| I _{S(on)} On-state switch leakage current | V _I = V _{CC} or GND, V _{INH} = V _{IL} (see Figure 3) | 5.5 V | | | | ±0.1 | ±1 | μA |
| I _{CC} Supply current | V _I = V _{CC} or GND | 5.5 V | | | | | 20 | μA |
| C _{IC} Control input capacitance | f = 10 MHz | 3.3 V | | 2 | | | | pF |
| C _{IS} Common terminal capacitance | | 3.3 V | | 23.4 | | | | pF |
| C _{OS} Switch terminal capacitance | | 3.3 V | | 5.7 | | | | pF |
| C _F Feedthrough capacitance | | 3.3 V | | 0.5 | | | | pF |



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8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

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**switching characteristics over recommended operating free-air temperature range,
V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted)**

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | T _A = 25°C | | | MIN | MAX | UNIT |
|---|-----------------------|-----------------------|---|-----------------------|-----|-----|-----|-----|------|
| | | | | MIN | TYP | MAX | | | |
| t _{PLH} t _{PHL} Propagation delay time | COM or Y _n | Y _n or COM | C _L = 50 pF, (see Figure 4) | | 2.5 | 9 | | 12 | ns |
| t _{PZH} t _{PZL} Enable delay time | INH | COM or Y _n | C _L = 50 pF, (see Figure 5) | | 5.5 | 20 | | 25 | ns |
| t _{PHZ} t _{PLZ} Disable delay time | INH | COM or Y _n | C _L = 50 pF, (see Figure 5) | | 8.8 | 20 | | 25 | ns |

**switching characteristics over recommended operating free-air temperature range,
V_{CC} = 5 V ± 0.5 V (unless otherwise noted)**

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | T _A = 25°C | | | MIN | MAX | UNIT |
|---|-----------------------|-----------------------|---|-----------------------|-----|-----|-----|-----|------|
| | | | | MIN | TYP | MAX | | | |
| t _{PLH} t _{PHL} Propagation delay time | COM or Y _n | Y _n or COM | C _L = 50 pF, (see Figure 4) | | 1.5 | 6 | | 8 | ns |
| t _{PZH} t _{PZL} Enable delay time | INH | COM or Y _n | C _L = 50 pF, (see Figure 5) | | 4 | 14 | | 18 | ns |
| t _{PHZ} t _{PLZ} Disable delay time | INH | COM or Y _n | C _L = 50 pF, (see Figure 5) | | 6.2 | 14 | | 18 | ns |

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8-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

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

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | V _{CC} | T _A = 25°C | | | UNIT |
|--|-----------------------|-----------------------|--|---------------------------------------|-----------------------|-----|-----|------|
| | | | | | MIN | TYP | MAX | |
| Frequency response (switch on) | COM or Y _n | Y _n or COM | C _L = 50 pF, R _L = 600 Ω, f _{in} = 1 MHz (sine wave) (see Note 5 and Figure 6) | 2.3 V | 20 | | MHz | |
| | | | | 3 V | 25 | | | |
| | | | | 4.5 V | 35 | | | |
| Crosstalk (control input to signal output) | INH | COM or Y _n | C _L = 50 pF, R _L = 600 Ω, f _{in} = 1 MHz (square wave) (see Figure 7) | 2.3 V | 20 | | mV | |
| | | | | 3 V | 35 | | | |
| | | | | 4.5 V | 60 | | | |
| Feedthrough attenuation (switch off) | COM or Y _n | Y _n or COM | C _L = 50 pF, R _L = 600 Ω, f _{in} = 1 MHz (see Note 6 and Figure 8) | 2.3 V | -45 | | dB | |
| | | | | 3 V | -45 | | | |
| | | | | 4.5 V | -45 | | | |
| Sine-wave distortion | COM or Y _n | Y _n or COM | C _L = 50 pF, R _L = 10 kΩ, f _{in} = 1 kHz (sine wave) (see Figure 9) | V _I = 2 V _{p-p} | 2.3 V | 0.1 | | % |
| | | | | V _I = 2.5 V _{p-p} | 3 V | 0.1 | | |
| | | | | V _I = 4 V _{p-p} | 4.5 V | 0.1 | | |

NOTES: 5. Adjust f_{in} voltage to obtain 0-dBm output. Increase f_{in} frequency until dB meter reads -3 dB.
6. Adjust f_{in} voltage to obtain 0-dBm input.

operating characteristics, V_{CC} = 3.3 V, T_A = 25°C

| PARAMETER | TEST CONDITIONS | TYP | UNIT |
|---|------------------------------------|-----|------|
| C _{pd} Power dissipation capacitance | C _L = 50 pF, f = 10 MHz | 5.9 | pF |

PARAMETER MEASUREMENT INFORMATION

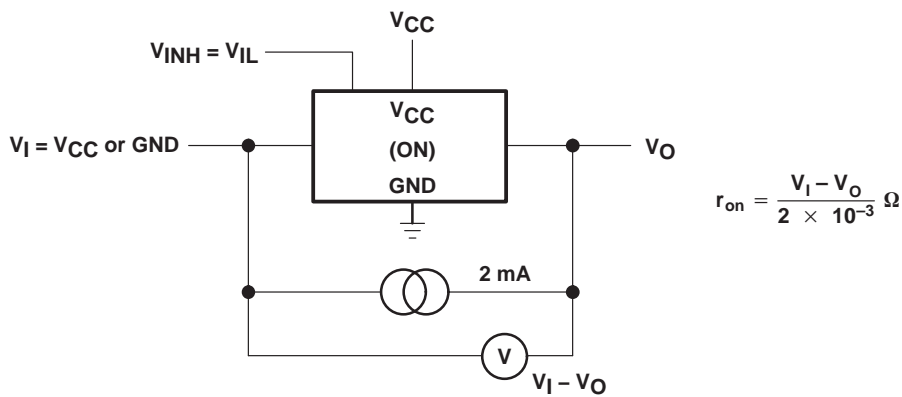
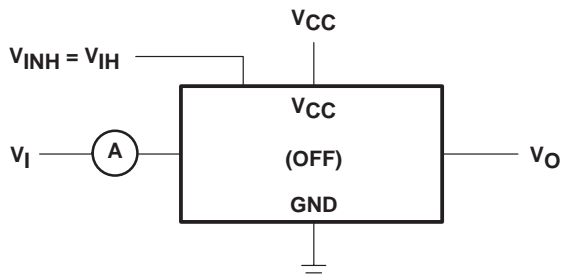


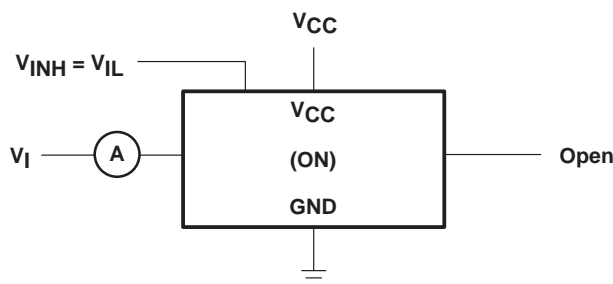
Figure 1. On-State Resistance Test Circuit

PARAMETER MEASUREMENT INFORMATION



Condition 1: $V_I = 0, V_O = V_{CC}$
 Condition 2: $V_I = V_{CC}, V_O = 0$

Figure 2. Off-State Switch Leakage-Current Test Circuit



$V_I = V_{CC} \text{ or } GND$

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

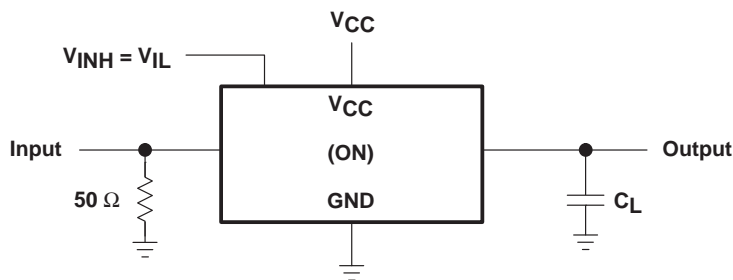


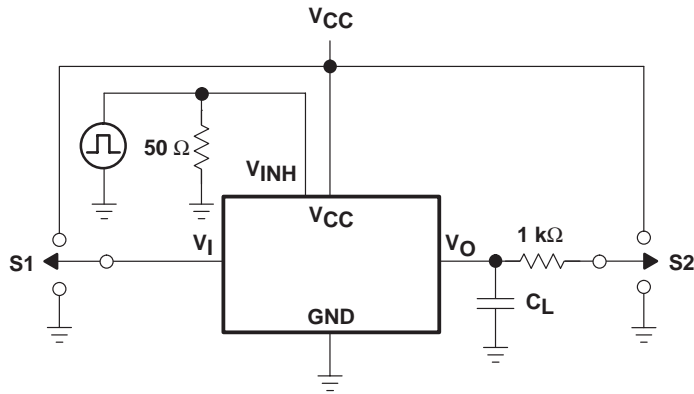
Figure 4. Propagation Delay Time, Signal Input to Signal Output

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PARAMETER MEASUREMENT INFORMATION



| TEST | S1 | S2 |
|-------------------|----------|----------|
| t_{PLZ}/t_{PZL} | GND | V_{CC} |
| t_{PHZ}/t_{PHZ} | V_{CC} | GND |

TEST CIRCUIT

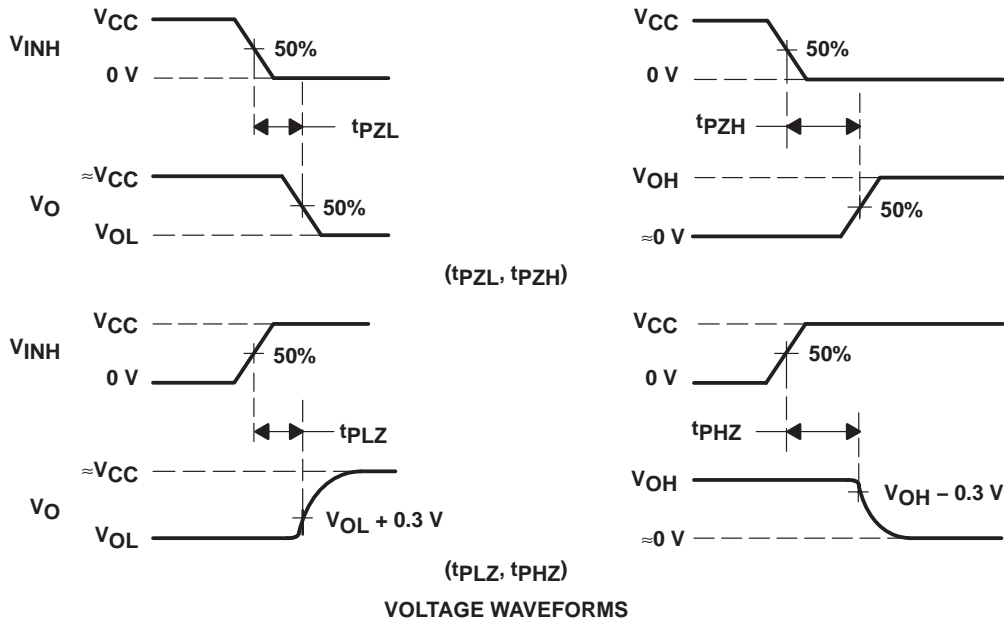
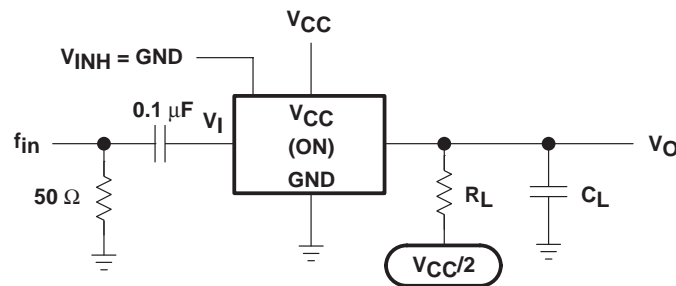


Figure 5. Switching Time (t_{PZL} , t_{PLZ} , t_{PHZ} , t_{PHZ}), Control to Signal Output



NOTE A: f_{in} is a sine wave.

Figure 6. Frequency Response (Switch On)

PARAMETER MEASUREMENT INFORMATION

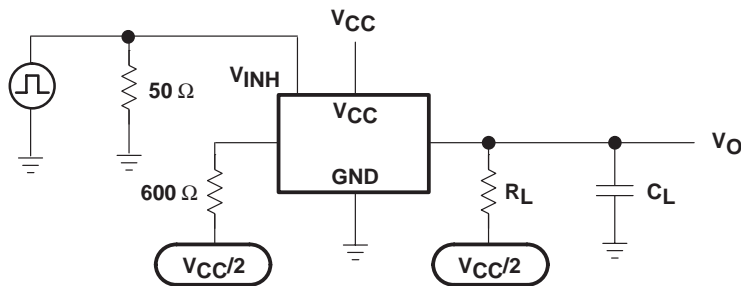


Figure 7. Crosstalk (Control Input, Switch Output)

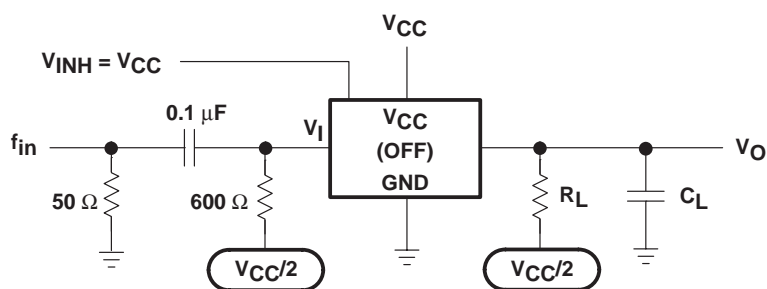


Figure 8. Feedthrough Attenuation (Switch Off)

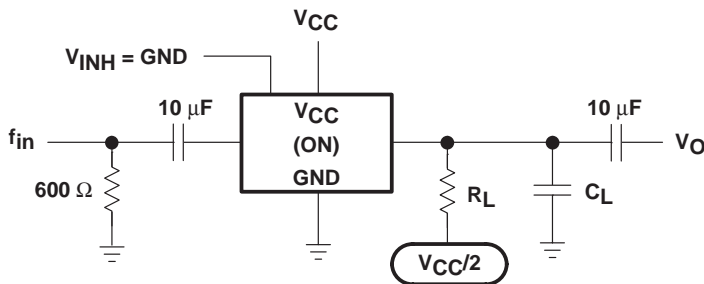


Figure 9. Sine-Wave Distortion

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--|
| CLV4051ATDWRG4Q1 | ACTIVE | SOIC | DW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CLV4051ATPWRG4Q1 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LV4051ATDRQ1 | ACTIVE | SOIC | D | 16 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LV4051ATDWRQ1 | ACTIVE | SOIC | DW | 16 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LV4051ATPWRQ1 | ACTIVE | TSSOP | PW | 16 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-1-250C-UNLIM |

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

ACTIVE: Product device recommended for new designs.

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

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

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

OBSOLETE: TI has discontinued the production of the device.

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

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

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

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

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

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

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OTHER QUALIFIED VERSIONS OF SN74LV4051A-Q1 :

- Catalog: [SN74LV4051A](#)
- Enhanced Product: [SN74LV4051A-EP](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

D (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



- 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 .006 (0,15) per end.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
 - E. Reference JEDEC MS-012 variation AC.

D(R-PDSO-G16)

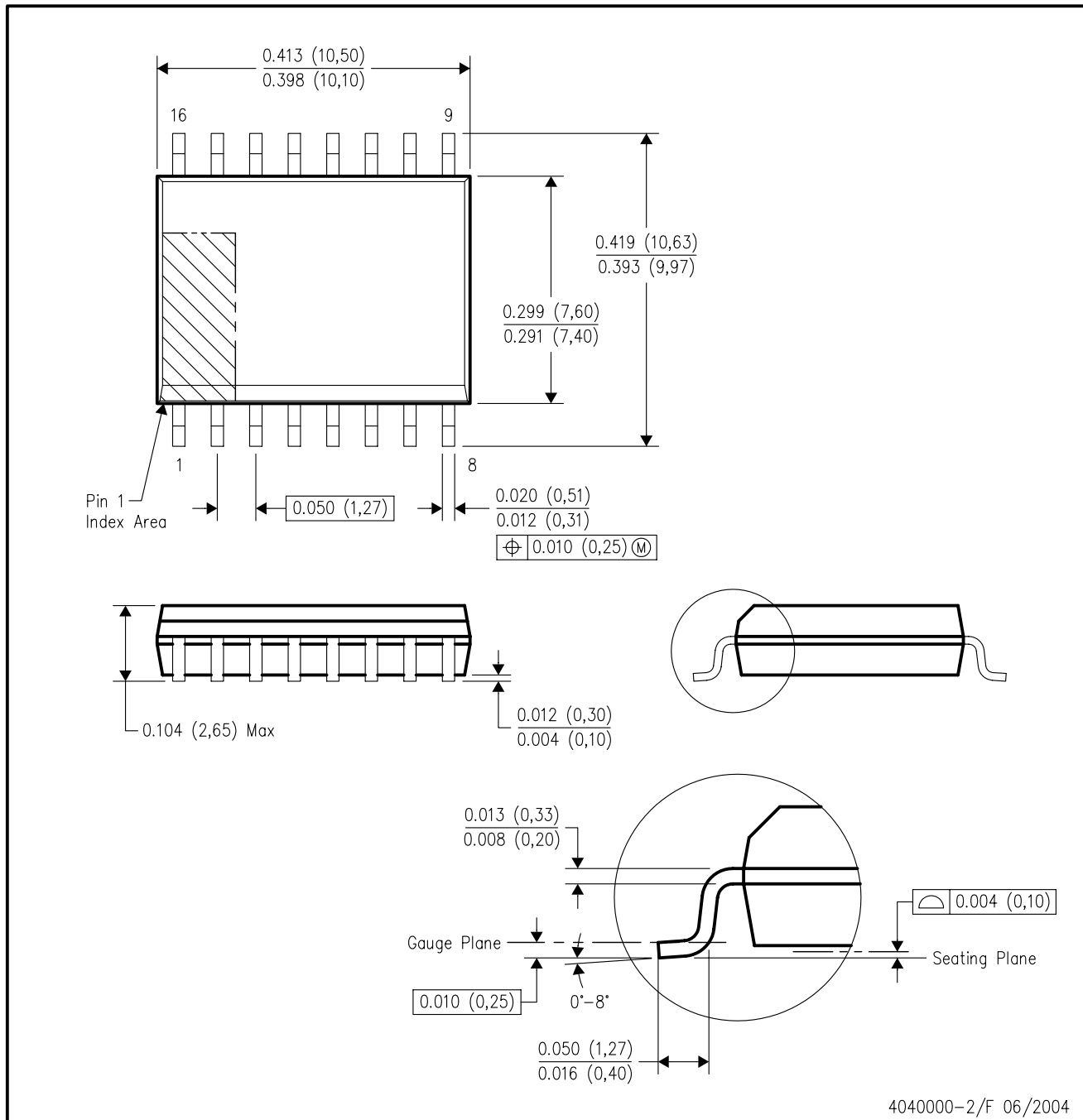


4209373/A 03/08

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

DW (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



4040000-2/F 06/2004

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

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