

CD4051B-Q1 Automotive CMOS Single 8-Channel Analog Multiplexer or Demultiplexer with Logic-Level Conversion

1 Features

- AEC-Q100 qualified for automotive applications:
 - Temperature grade 1: -45°C to $+125^{\circ}\text{C}$, T_A
- Wide range of digital and analog signal levels:
 - Digital: 3V to 20V
 - Analog: $\leq 20V_{P-P}$
- Single supply range : 3V to 20V (performance degrades for $V_{DD} < 3V$)
- Dual Supply range: $\pm 3V$ to $\pm 10V$
- Low ON resistance, 125 Ω (typical) over input range for $V_{DD} = 15V$
- Low channel leakage of $\pm 10pA$ (typical) at $V_{DD} = 15V$
- Low quiescent power dissipation : 0.2 μW (typical)
- Bidirectional signal path
- ESD protection HBM: 3000V, CDM: 2000V
- Pin compatible with industry standard 4051

2 Applications

- Analog and digital multiplexing and demultiplexing
- Analog to digital and digital to analog conversion
- Signal gating
- [Factory automation](#)
- [Televisions](#)
- [Appliances](#)
- [Consumer audio](#)
- Programmable logic circuits
- [Sensors](#)

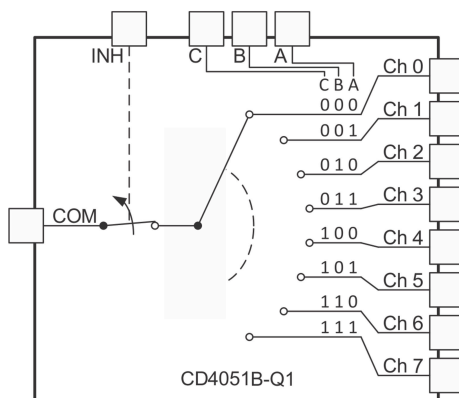
3 Description

The CD4051B-Q1 analog multiplexers and demultiplexers are digitally-controlled analog switches having low ON impedance and very low OFF leakage current. These multiplexer circuits dissipate extremely low quiescent power over the full $V_{DD} - V_{SS}$ and $V_{DD} - V_{EE}$ supply-voltage ranges, independent of the logic state of the control signals.

Package Information

| PART NUMBER | PACKAGE ⁽¹⁾ | PACKAGE SIZE ⁽²⁾ |
|-------------|------------------------|-----------------------------|
| CD4051B-Q1 | PW (TSSOP, 16) | 5mm × 6.4mm |

- (1) For all available packages, see the orderable addendum at the end of the data sheet.
- (2) The package size (length × width) is a nominal value and includes pins, where applicable.



Functional Diagram of CD4051B-Q1



Table of Contents

| | | | |
|--|-----------|--|-----------|
| 1 Features | 1 | 7.4 Device Functional Modes..... | 17 |
| 2 Applications | 1 | 8 Application and Implementation | 18 |
| 3 Description | 1 | 8.1 Application Information..... | 18 |
| 4 Pin Configuration and Functions | 3 | 8.2 Typical Application..... | 18 |
| 5 Specifications | 4 | 8.3 Power Supply Recommendations..... | 19 |
| 5.1 Absolute Maximum Ratings..... | 4 | 8.4 Layout..... | 20 |
| 5.2 ESD Ratings..... | 4 | 9 Device and Documentation Support | 21 |
| 5.3 Recommended Operating Conditions..... | 4 | 9.1 Documentation Support..... | 21 |
| 5.4 Thermal Information..... | 5 | 9.2 Receiving Notification of Documentation Updates.... | 21 |
| 5.5 Electrical Characteristics - CD4051B-Q1..... | 6 | 9.3 Support Resources..... | 21 |
| 5.6 AC Performance Characteristics - CD4051B-Q1..... | 10 | 9.4 Trademarks..... | 21 |
| 5.7 Typical Characteristics..... | 11 | 9.5 Electrostatic Discharge Caution..... | 21 |
| 6 Parameter Measurement Information | 12 | 9.6 Glossary..... | 21 |
| 7 Detailed Description | 15 | 10 Revision History | 22 |
| 7.1 Overview..... | 15 | 11 Mechanical, Packaging, and Orderable Information | 22 |
| 7.2 Functional Block Diagrams..... | 16 | | |
| 7.3 Feature Description..... | 17 | | |

4 Pin Configuration and Functions

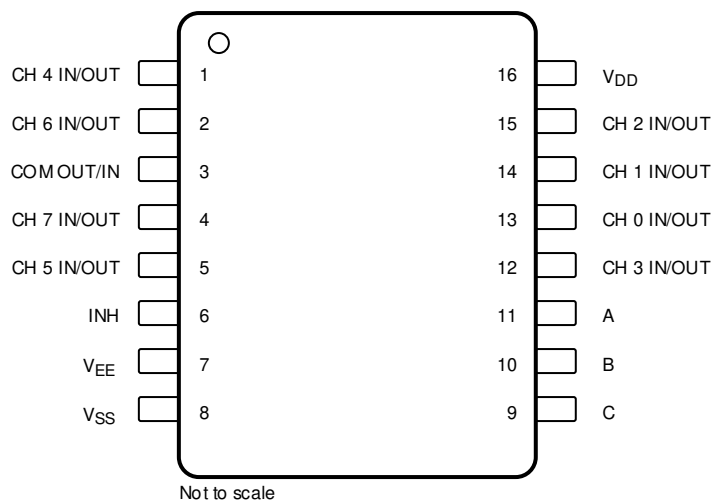


Figure 4-1. CD4051B-Q1 PW Package, (Top View)

Table 4-1. Pin Functions CD4051B-Q1

| PIN | | TYPE ⁽¹⁾ | DESCRIPTION |
|-----|-------------|---------------------|--|
| NO. | NAME | | |
| 1 | CH 4 IN/OUT | I/O | Channel 4 in/out |
| 2 | CH 6 IN/OUT | I/O | Channel 6 in/out |
| 3 | COM OUT/IN | I/O | Common out/in |
| 4 | CH 7 IN/OUT | I/O | Channel 7 in/out |
| 5 | CH 5 IN/OUT | I/O | Channel 5 in/out |
| 6 | INH | I | Disables all channels. See Table 7-1 . |
| 7 | VEE | — | Negative power input |
| 8 | VSS | — | Ground |
| 9 | C | I | Channel select C. See Table 7-1 . |
| 10 | B | I | Channel select B. See Table 7-1 . |
| 11 | A | I | Channel select A. See Table 7-1 . |
| 12 | CH 3 IN/OUT | I/O | Channel 3 in/out |
| 13 | CH 0 IN/OUT | I/O | Channel 0 in/out |
| 14 | CH 1 IN/OUT | I/O | Channel 1 in/out |
| 15 | CH 2 IN/OUT | I/O | Channel 2 in/out |
| 16 | VDD | — | Positive power input |

(1) I = input, O = output

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)^{(1) (2)}

| | | | MIN | MAX | UNIT |
|--------------------|---|---|------|----------------------|------|
| | Supply Voltage | V+ to V-, Voltages Referenced to V _{SS} Terminal | −0.5 | 20 | V |
| | DC Input Voltage | | −0.5 | V _{DD} +0.5 | V |
| | DC Input Current | Any One Input | −10 | 10 | mA |
| T _{JMAX1} | Maximum junction temperature, ceramic package | | | 175 | °C |
| T _{JMAX2} | Maximum junction temperature, plastic package | | | 150 | °C |
| T _{stg} | Storage temperature | | −65 | 150 | °C |

- (1) Stresses beyond those listed under *Absolute Maximum Rating* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Condition*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltages are with respect to ground, unless otherwise specified.

5.2 ESD Ratings

| | | | VALUE | UNIT |
|--------------------|-------------------------|--|-------|------|
| V _(ESD) | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾ | ±3000 | V |
| | | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾ | ±2000 | |

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

5.3 Recommended Operating Conditions

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

| | MIN | NOM | MAX | UNIT |
|-------------------|-----|-----|-----|------|
| Temperature Range | −55 | | 125 | °C |

5.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | CD4051B-Q1 | | UNIT |
|-------------------------------|--|------------|------------|------|
| | | D (SOIC) | PW (TSSOP) | |
| | | 16 PINS | 16 PINS | |
| R _{θJA} | Junction-to-ambient thermal resistance | 86.7 | 116.5 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 47.3 | 47.2 | °C/W |
| R _{θJB} | Junction-to-board thermal resistance | 45.3 | 63.0 | °C/W |
| Ψ _{JT} | Junction-to-top characterization parameter | 12.1 | 6.4 | °C/W |
| Ψ _{JB} | Junction-to-board characterization parameter | 44.9 | 62.1 | °C/W |
| R _{θJC(bot)} | Junction-to-case (bottom) thermal resistance | N/A | N/A | °C/W |

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

5.5 Electrical Characteristics - CD4051B-Q1

Over operating free-air temperature range, $V_{\text{SUPPLY}} = \pm 5\text{V}$, and $R_L = 100\Omega$, (unless otherwise noted)⁽¹⁾

| PARAMETER | TEST CONDITIONS | | | | | MIN | TYP | MAX | UNIT |
|--|---------------------|---------------------|---------------------|---------------------|-------|-----|-----|------|------|
| SIGNAL INPUTS (V _{IS}) AND OUTPUTS (V _{OS}) - CD4051B-Q1 | | | | | | | | | |
| | V _{IS} (V) | V _{EE} (V) | V _{SS} (V) | V _{DD} (V) | TEMP | | | | |
| Quiescent Device Current, I _{DD} (Max) | | 0V | 0V | 5V | –55°C | | | 60 | μA |
| | | | | | –40°C | | | 60 | |
| | | | | | 25°C | | 17 | 60 | |
| | | | | | 85°C | | | 150 | |
| | | | | | 125°C | | | 150 | |
| | | 0V | 0V | 10V | –55°C | | | 60 | |
| | | | | | –40°C | | | 60 | |
| | | | | | 25°C | | 18 | 60 | |
| | | | | | 85°C | | | 300 | |
| | | | | | 125°C | | | 300 | |
| | | 0V | 0V | 15V | –55°C | | | 60 | |
| | | | | | –40°C | | | 60 | |
| | | | | | 25°C | | 18 | 60 | |
| | | | | | 85°C | | | 600 | |
| | | | | | 125°C | | | 600 | |
| | | 0V | 0V | 20V | –55°C | | | 100 | |
| | | | | | –40°C | | | 100 | |
| | | | | | 25°C | | 18 | 100 | |
| | | | | | 85°C | | | 3000 | |
| | | | | | 125°C | | | 3000 | |
| Drain to Source ON Resistance r _{ON} (Max) 0 ≤ V _{IS} ≤ V _{DD} | | 0V | 0V | 5V | –55°C | | | 800 | Ω |
| | | | | | –40°C | | | 850 | |
| | | | | | 25°C | | 470 | 1050 | |
| | | | | | 85°C | | | 1200 | |
| | | | | | 125°C | | | 1300 | |
| | | 0V | 0V | 10V | –55°C | | | 310 | |
| | | | | | –40°C | | | 300 | |
| | | | | | 25°C | | 180 | 400 | |
| | | | | | 85°C | | | 520 | |
| | | | | | 125°C | | | 550 | |
| | | 0V | 0 | 15V | –55°C | | | 200 | |
| | | | | | –40°C | | | 210 | |
| | | | | | 25°C | | 125 | 240 | |
| | | | | | 85°C | | | 300 | |
| | | | | | 125°C | | | 300 | |

5.5 Electrical Characteristics - CD4051B-Q1 (continued)

Over operating free-air temperature range, $V_{\text{SUPPLY}} = \pm 5\text{V}$, and $R_L = 100\Omega$, (unless otherwise noted)⁽¹⁾

| PARAMETER | | | TEST CONDITIONS | | | | MIN | TYP | MAX | UNIT | |
|---|--------------------------------|--|-----------------|--|----|-------|-------|-----------|------------|----------|--------------------------|
| Change in ON Resistance (Between Any Two Channels), ΔR_{ON} | | | | 0V | 0V | 5V | 25°C | | 15 | Ω | |
| | | | | 0V | 0V | 10V | | | 10 | | |
| | | | | 0V | 0V | 15V | | | 5 | | |
| OFF Channel Leakage Current: Any Channel OFF (Max) or ALL Channels OFF (COMMON OUT/IN) (Max) | | | | 0V | 0V | 18V | -55°C | | ± 100 | nA | |
| | | | | | | | -40°C | | | | |
| | | | | | | | 25°C | | ± 0.01 | | ± 100 ⁽²⁾ |
| | | | | | | | 85°C | | | | ± 100 ⁽²⁾ |
| | | | | | | | 125°C | | | | |
| ON Channel Leakage Current: Any Channel ON (Max) or ALL Channels ON (COMMON OUT/IN) (Max) | | | 5 or 0 | -5V | 0V | 10.5V | 85°C | | ± 300 | nA | |
| | | | 5 | 0V | 0V | 18V | 85°C | | ± 300 | | |
| Capacitance | Input, C _{IS} | | | 0V | 0V | 10V | 25°C | | 5 | pF | |
| | Output, C _{OS} | | | | | | | CD4051-Q1 | | | 30 |
| | Feed through, C _{IOS} | | | | | | | | | | 0.2 |
| Prop Delay | | | V _{DD} | R _L = 200k Ω | | 5V | 25°C | | 30 60 | ns | |
| | | | | C _L = 50pF | | 10V | | | 15 30 | | |
| | | | | t _r , t _f = 20ns | | 15V | | | 10 20 | | |

5.5 Electrical Characteristics - CD4051B-Q1 (continued)

Over operating free-air temperature range, $V_{\text{SUPPLY}} = \pm 5\text{V}$, and $R_L = 100\Omega$, (unless otherwise noted)⁽¹⁾

| PARAMETER | | TEST CONDITIONS | | | | MIN | TYP | MAX | UNIT |
|---|--|-------------------------|--|-----|-----|-------|-------|-----|------|
| CONTROL (ADDRESS OR INHIBIT), V _C - CD4051B-Q1 | | | | | | | | | |
| Input Low Voltage, V _{IL} , (Max) | | | | | | 5V | –55°C | 0.8 | V |
| | | | | | | | –40°C | 0.8 | |
| | | | | | | | 25°C | 0.8 | |
| | | | | | | | 85°C | 0.8 | |
| | | | | | | | 125°C | 0.8 | |
| | | | | | | 10V | –55°C | 0.8 | |
| | | | | | | | –40°C | 0.8 | |
| | | | | | | | 25°C | 0.8 | |
| | | | | | | | 85°C | 0.8 | |
| | | | | | | | 125°C | 0.8 | |
| | | | | | | 15V | –55°C | 0.8 | |
| | | | | | | | –40°C | 0.8 | |
| | | | | | | | 25°C | 0.8 | |
| | | | | | | | 85°C | 0.8 | |
| | | | | | | | 125°C | 0.8 | |
| Input High Voltage, V _{IH} , (Min) | | | | | | 5V | –55°C | 3.5 | V |
| | | | | | | | –40°C | 3.5 | |
| | | | | | | | 25°C | 3.5 | |
| | | | | | | | 85°C | 3.5 | |
| | | | | | | | 125°C | 3.5 | |
| | | | | | | 10V | –55°C | 7 | |
| | | | | | | | –40°C | 7 | |
| | | | | | | | 25°C | 7 | |
| | | | | | | | 85°C | 7 | |
| | | | | | | | 125°C | 7 | |
| | | | | | | 15V | –55°C | 11 | |
| | | | | | | | –40°C | 11 | |
| | | | | | | | 25°C | 11 | |
| | | | | | | | 85°C | 11 | |
| | | | | | | | 125°C | 11 | |
| Input current, I _{IN} (Max) | | V _{IN} = 0, 18 | | 18V | | –55°C | ±1 | μA | |
| | | | | | | –40°C | ±1 | | |
| | | | | | | 25°C | ±0.6 | | |
| | | | | | | 85°C | ±1 | | |
| | | | | | | 125°C | ±1 | | |
| Prop agati on Delay Time | Address-to-Signal OUT (Channels ON or OFF) (See Figure 10, Figure 11, and Figure 15) | | t _r , t _f = 20ns, C _L = 50pF, R _L = 10kΩ | | 0V | 0V | 5V | 450 | ns |
| | | | | | 0V | 0V | 10V | 160 | |
| | | | | | 0V | 0V | 15V | 120 | |
| | | | | | –5V | 0V | 5V | 225 | |

5.5 Electrical Characteristics - CD4051B-Q1 (continued)

Over operating free-air temperature range, $V_{\text{SUPPLY}} = \pm 5\text{V}$, and $R_L = 100\Omega$, (unless otherwise noted)⁽¹⁾

| PARAMETER | | | TEST CONDITIONS | | | | MIN | TYP | MAX | UNIT |
|--|---|---|-----------------|----|-----|------|-----|-----|-----|------|
| Propagation Delay Time | Inhibit-to-Signal OUT (Channel Turning ON) (See Figure 11) | t_r , t_f = 20 ns, C_L = 50pF, R_L = 1k Ω | 0V | 0V | 5V | | 400 | 720 | ns | |
| | | | 0V | 0V | 10V | | 160 | 320 | | |
| | | | 0V | 0V | 15V | | 120 | 240 | | |
| | | | −10V | 0V | 5V | | 200 | 400 | | |
| Propagation Delay Time | Inhibit-to-Signal OUT (Channel Turning OFF) (See Figure 17) | t_r , t_f = 20 ns, C_L = 50pF, R_L = 10k Ω | 0V | 0V | 5V | | 200 | 450 | ns | |
| | | | 0V | 0V | 10V | | 90 | 210 | | |
| | | | 0V | 0V | 15V | | 70 | 160 | | |
| | | | −10V | 0V | 5V | | 130 | 300 | | |
| Input Capacitance, C_{IN} (Any Address or Inhibit Input) | | | −5V | 0V | 5V | 25°C | 5 | 7.5 | pF | |

(1) Peak-to-Peak voltage symmetrical about $(V_{\text{DD}} - V_{\text{EE}}) / 2$.

(2) Determined by minimum feasible leakage measurement for automatic testing.

5.6 AC Performance Characteristics - CD4051B-Q1

 $V_{DD} = +15\text{ V}$, $V_{SS} = V_{EE} = 0\text{ V}$,

 $T_A = 25^\circ\text{C}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | | | | | TYP | UNIT |
|---|---|---------------------|---------------------|----------------------------------|-----------|-------|--------------------|
| | V _{IS} (V) | V _{DD} (V) | R _L (kΩ) | | | | |
| Cutoff (–3dB) Frequency Channel ON (Sine Wave Input) | 5 ⁽¹⁾ | 10 | 1 | V _{OS} at Common OUT/IN | CD4051-Q1 | 20 | MHz |
| | V _{EE} = V _{SS} , 20Log(V _{OS} /V _{IS}) = –3dB | | | V _{OS} at Any Channel | | 60 | |
| Total Harmonic Distortion, THD | 2 ⁽¹⁾ | 5 | 10 | | | 0.3% | % |
| | 3 ⁽¹⁾ | 10 | 10 | | | 0.2% | |
| | 5 ⁽¹⁾ | 15 | 10 | | | 0.12% | |
| | V _{EE} = V _{SS} , f _{IS} = 1kHz Sine Wave | | | | | | |
| –40dB Feedthrough Frequency (All Channels OFF) | 5 ⁽¹⁾ | 10 | 1 | V _{OS} at Common OUT/IN | CD4051-Q1 | 12 | MHz |
| | V _{EE} = V _{SS} , 20Log(V _{OS} /V _{IS}) = –40dB | | | V _{OS} at Any Channel | | 8 | MHz |
| –40dB Signal Crosstalk Frequency | 5 ⁽¹⁾ | 10 | 1 | | | 3 | MHz |
| Address-or-Inhibit-to- Signal Crosstalk | | 10 | 10 ⁽²⁾ | | | 65 | mV _{PEAK} |
| | V _{EE} = 0, V _{SS} = 0, t _r , t _f = 20ns, mV _{PEAK} V _{CC} = V _{DD} – V _{SS} (Square Wave) | | | | | 65 | mV _{PEAK} |

(1) Peak-to-Peak voltage symmetrical about $(V_{DD} - V_{EE}) / 2$.

(2) Both ends of channel.

5.7 Typical Characteristics

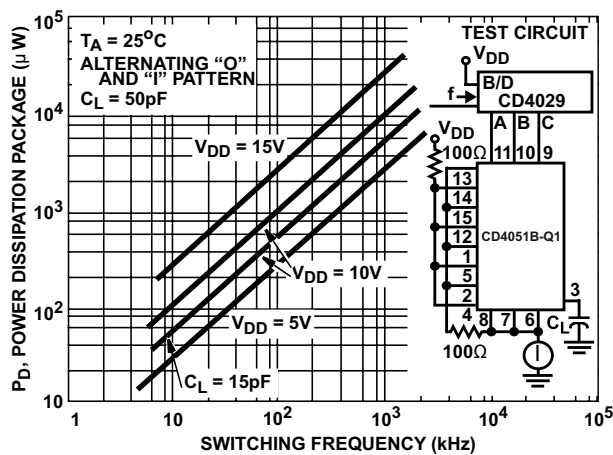


Figure 5-1. Dynamic Power Dissipation vs Switching Frequency (CD4051B-Q1)

6 Parameter Measurement Information

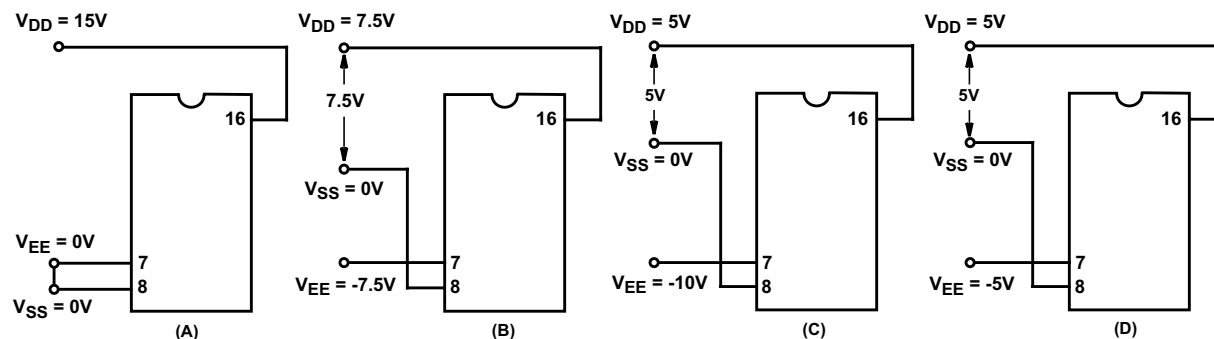


Figure 6-1. Typical Bias Voltages

Note

The ADDRESS (digital-control inputs) and INHIBIT logic levels are: 0 = V_{SS} and 1 = V_{DD} . The analog signal (through the TG) may swing from V_{EE} to V_{DD} .

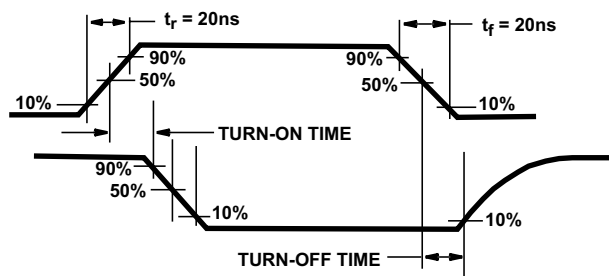


Figure 6-2. Waveforms, Channel Being Turned ON ($R_L = 1\text{ k}\Omega$)

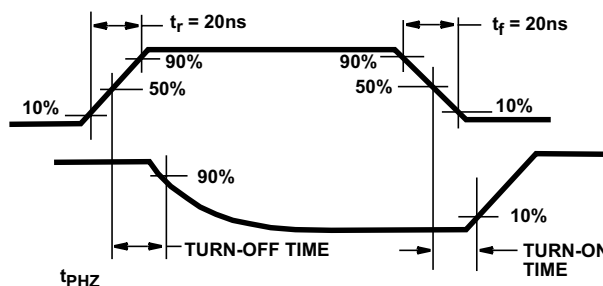


Figure 6-3. Waveforms, Channel Being Turned OFF ($R_L = 1\text{ k}\Omega$)

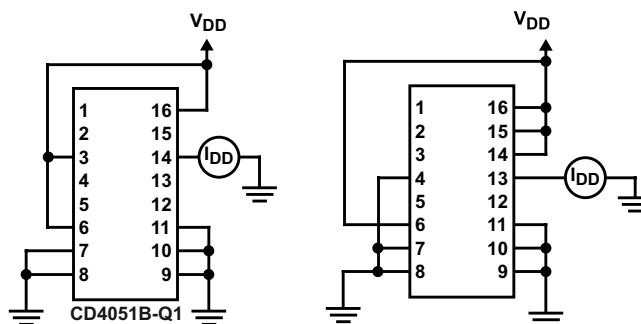


Figure 6-4. OFF Channel Leakage Current – Any Channel OFF

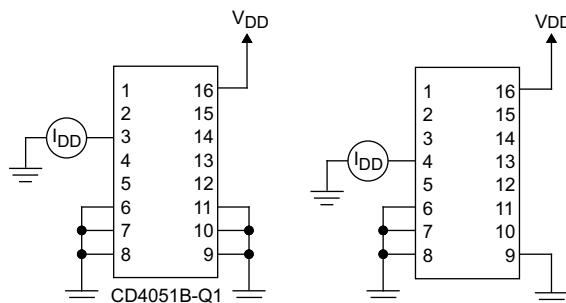


Figure 6-5. On Channel Leakage Current – Any Channel On

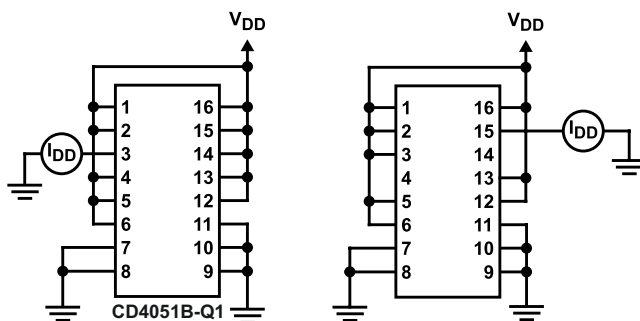


Figure 6-6. OFF Channel Leakage Current – All Channels OFF

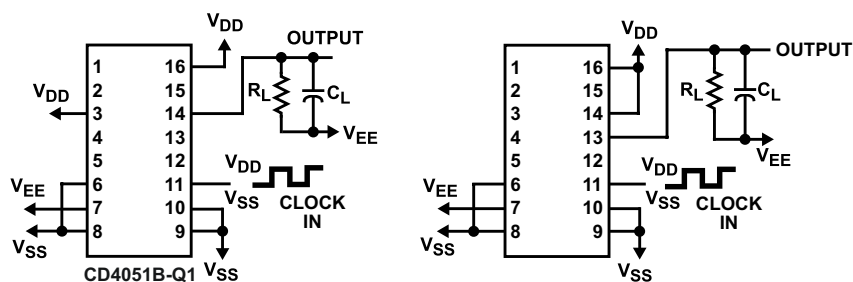


Figure 6-7. Propagation Delay – Address Input to Signal Output

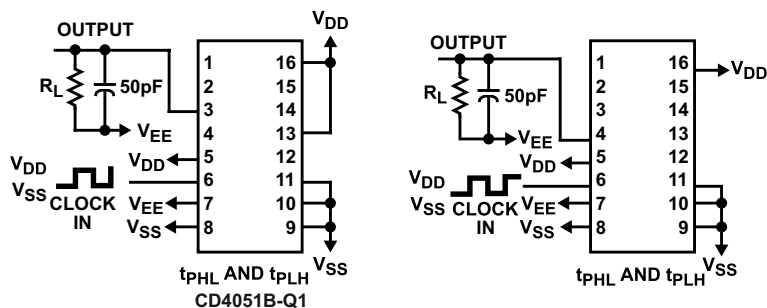
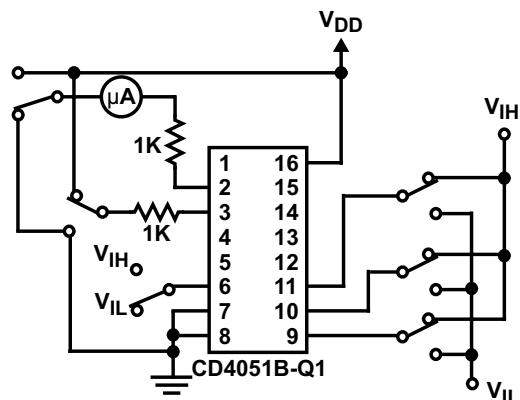
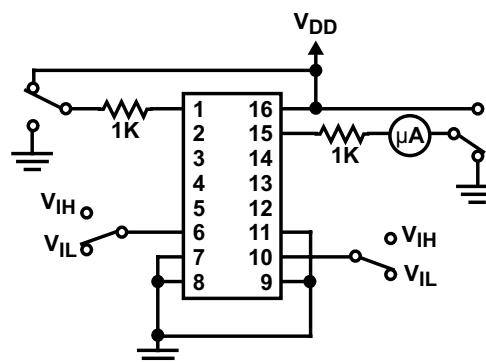


Figure 6-8. Propagation Delay – Inhibit Input to Signal Output



MEASURE $< 2\mu\text{A}$ ON ALL
"OFF" CHANNELS (e.g., CHANNEL 6)



MEASURE $< 2\mu\text{A}$ ON ALL
"OFF" CHANNELS (e.g., CHANNEL 6)

Figure 6-9. Input Voltage Test Circuits (Noise Immunity)

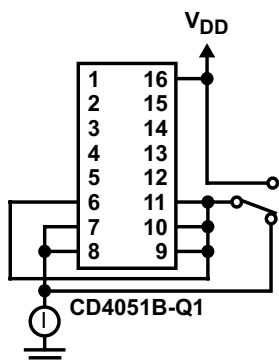


Figure 6-10. Quiescent Device Current

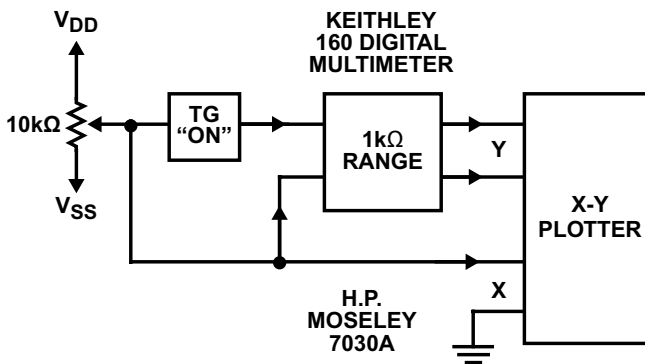
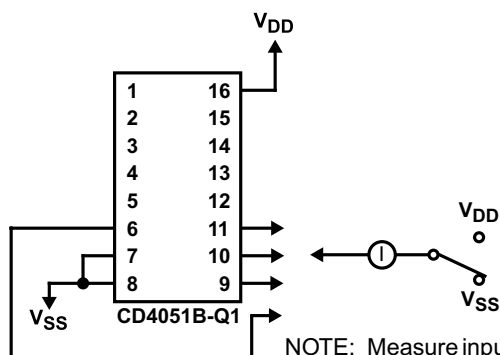


Figure 6-11. Channel ON Resistance Measurement Circuit



NOTE: Measure inputs sequentially,
to both V_{DD} and V_{SS} connect all
unused inputs to either V_{DD} or V_{SS} .

Figure 6-12. Input Current

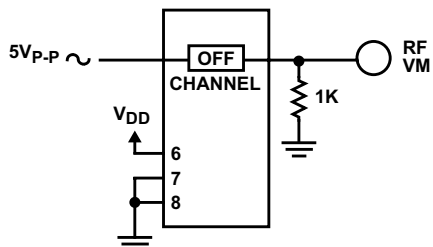


Figure 6-13. Feed-Through (All Types)

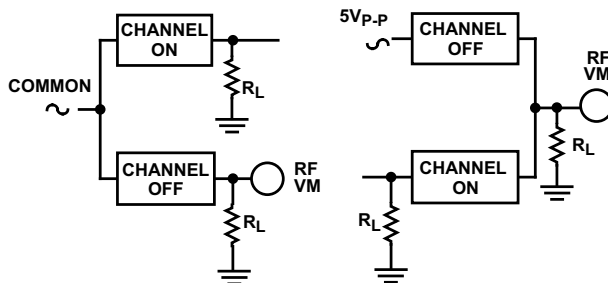


Figure 6-14. Crosstalk Between Any Two Channels (All Types)

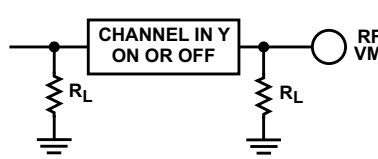
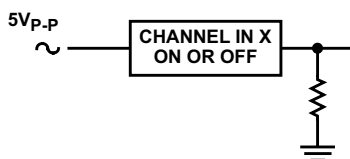


Figure 6-15. Crosstalk Between Duals or Triplets ()

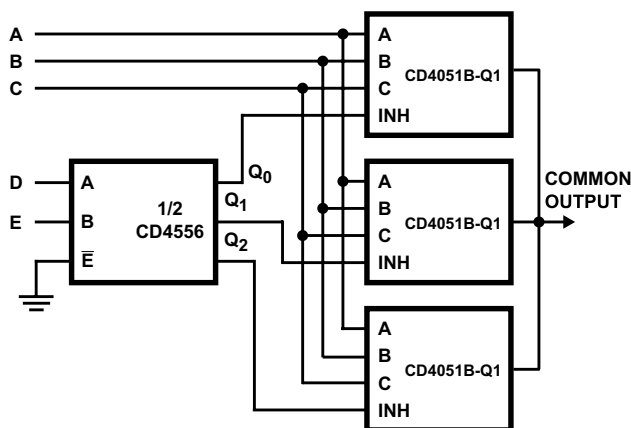


Figure 6-16. 24-to-1 MUX Addressing

7 Detailed Description

7.1 Overview

The CD4051B-Q1 device is a single 8-channel multiplexer having three binary control inputs, A, B, and C, and an inhibit input. The three binary signals select 1 of 8 channels to be turned on, and connect one of the 8 inputs to the output.

When these devices are used as demultiplexers, the CHANNEL IN/OUT terminals are the outputs and the COMMON OUT/IN terminals are the inputs.

7.2 Functional Block Diagrams

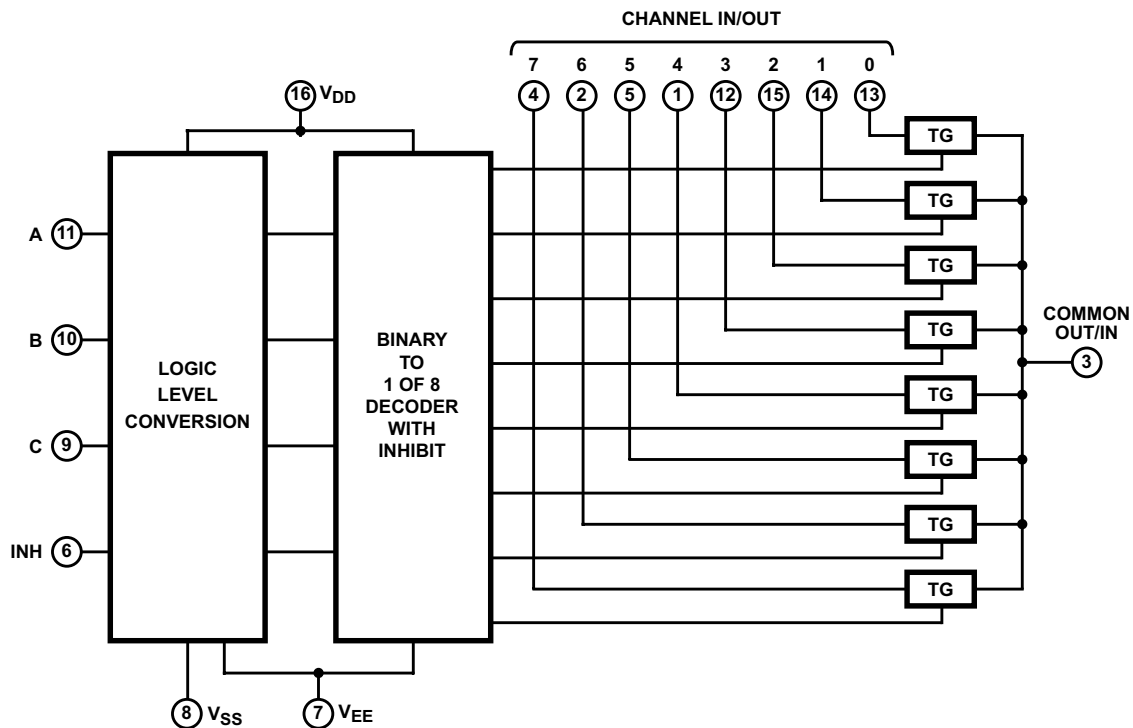


Figure 7-1. Functional Block Diagram, CD4051B-Q1

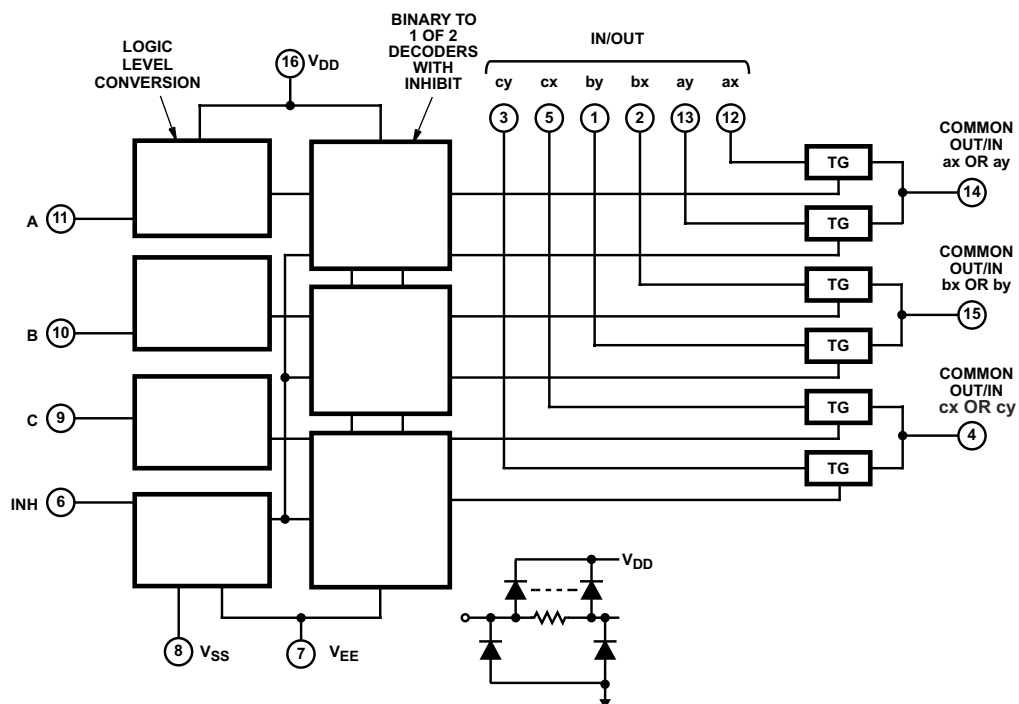


Figure 7-2. Functional Block Diagram,

7.3 Feature Description

The CD4051B-Q1 line of multiplexers and demultiplexers can accept a wide range of digital and analog signal levels. Digital signals range from 3V to 20V, and analog signals are accepted at levels $\leq 20V$. The devices have low ON resistance, typically 125Ω over $15V_{P-P}$ signal input range for $V_{DD} - V_{EE} = 18V$. This feature allows for very little signal loss through the switch.

The CD4051B-Q1 devices also have high OFF resistance, which keeps from the devices from wasting power when the switch is in the OFF position, with typical channel leakage of $\pm 100pA$ at $V_{DD} - V_{EE} = 18V$.

Binary address decoding on the chip makes channel selection simple. When channels are changed, a break-before-make system eliminates channel overlap.

7.4 Device Functional Modes

Table 7-1. Truth Table

| INPUT STATES | | | | ON CHANNEL(S) |
|--------------|---|---|---|---------------|
| INHIBIT | C | B | A | |
| CD4051B-Q1 | | | | |
| L | L | L | L | 0 |
| L | L | L | H | 1 |
| L | L | H | L | 2 |
| L | L | H | H | 3 |
| L | H | L | L | 4 |
| L | H | L | H | 5 |
| L | H | H | L | 6 |
| L | H | H | H | 7 |
| H | X | X | X | None |

8 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.

8.1 Application Information

The CD4051B-Q1 multiplexers and demultiplexers can be used for a wide variety of applications.

8.2 Typical Application

One application of the CD4051B-Q1 is to use it in conjunction with a microcontroller to poll a keypad. [Figure 8-1](#) shows the basic schematic for such a polling system. The microcontroller uses the channel select pins to cycle through the different channels while reading the input to see if a user is pressing any of the keys. This application is a very robust setup, allowing for multiple simultaneous key-presses with very little power consumption. This setup also uses very few pins on the microcontroller. The down side of polling is that the microcontroller must continually scan the keys for a press and can do little else during this process.

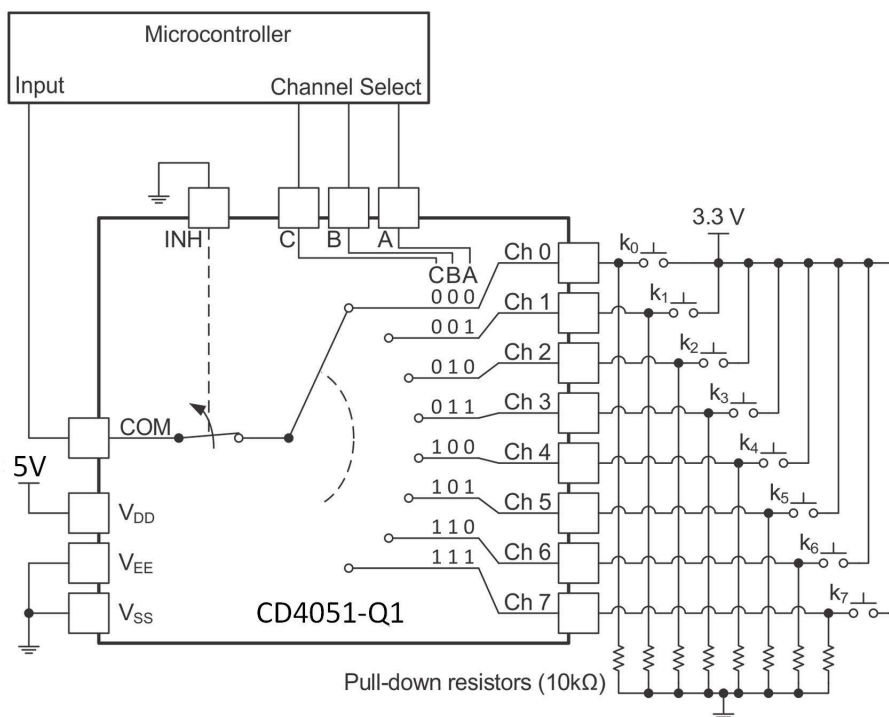


Figure 8-1. The CD4051B-Q1 Being Used to Help Read Button Presses on a Keypad

8.2.1 Design Requirements

These devices use CMOS technology and have 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.

8.2.2 Detailed Design Procedure

- Recommended Input Conditions:
 - For switch time specifications, see propagation delay times in [Section 5.5](#).
 - Inputs cannot be pushed more than 0.5V above V_{DD} or below V_{EE} .

- For input voltage level specifications for control inputs, see V_{IH} and V_{IL} in [Section 5.5](#).
- 2. Recommended Output Conditions:
 - Outputs cannot be pulled above V_{DD} or below V_{EE} .
- 3. Input or output current consideration:
 - The CD4051B-Q1 series of parts do not have internal current drive circuitry and thus cannot sink or source current. Any current will be passed through the device.

8.2.3 Application Curve

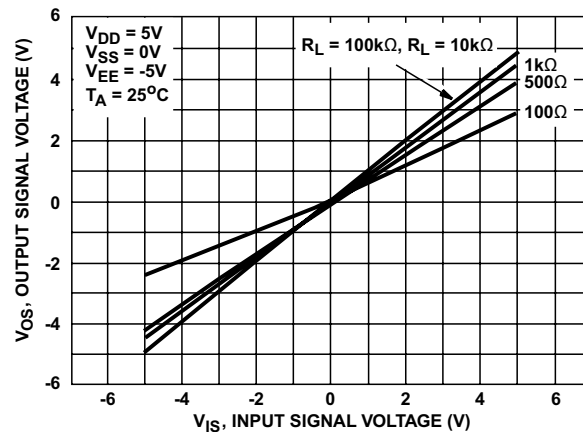


Figure 8-2. ON Characteristics for 1 of 8 Channels (CD4051B-Q1)

8.3 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the [Section 5.5](#).

Each V_{CC} terminal should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, a 0.1 μ F bypass capacitor is recommended. If there are multiple pins labeled V_{CC} , then a 0.01 μ F or 0.022 μ F capacitor is recommended for each V_{CC} because the V_{CC} pins will be tied together internally. For devices with dual supply pins operating at different voltages, for example V_{CC} and V_{DD} , a 0.1 μ F bypass capacitor is recommended for each supply pin. It is acceptable to parallel multiple bypass capacitors to reject different frequencies of noise. 0.1 μ F and 1 μ F capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results.

8.4 Layout

8.4.1 Layout Guidelines

Reflections and matching are closely related to loop antenna theory, but different enough to warrant their own discussion. When a PCB trace turns a corner at a 90° angle, a reflection can occur. This reflection is primarily due to the change of width of the trace. At the apex of the turn, the trace width is increased to 1.414 times its width. This upsets the transmission line characteristics, especially the distributed capacitance and self-inductance of the trace — resulting in the reflection. It is a given that not all PCB traces can be straight, and so they will have to turn corners. [Figure 8-3](#) shows progressively better techniques of rounding corners. Only the last example maintains constant trace width and minimizes reflections.

8.4.2 Layout Example

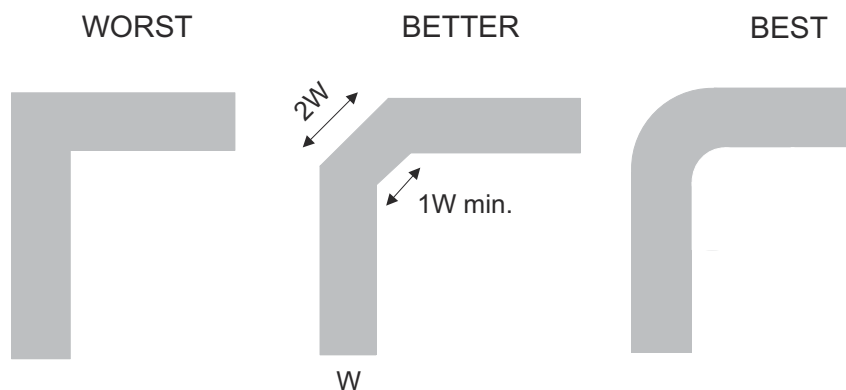


Figure 8-3. Trace Example

9 Device and Documentation Support

9.1 Documentation Support

9.1.1 Related Documentation

For related documentation, see the following:

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

9.2 Receiving Notification of Documentation Updates

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

9.3 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](#).

9.4 Trademarks

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9.5 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.

9.6 Glossary

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

10 Revision History

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

Changes from Revision D (March 2025) to Revision E (January 2026) Page

- Removed D (SOIC, 16) package type..... 1

Changes from Revision C (March 2023) to Revision D (March 2025) Page

- Updated [Section 1](#) 1
- Moved CD4053B-Q1 to SCHS469..... 1
- Updated HBM & CDM ESD values..... 4
- Updated Figure 8-1 to 5V VDD..... 18

Changes from Revision B (April 2019) to Revision C (March 2023) Page

- Updated the numbering format for tables, figures, and cross-references throughout the document..... 1
- Updated CD4051-Q1 specifications throughout the data sheet..... 1

Changes from Revision A (January 2008) to Revision B (April 2019) Page

- Added *Pin Configuration and Functions* section, *ESD Ratings* 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 part number CD4052B-Q1 from the data sheets..... 1

11 Mechanical, Packaging, and Orderable Information

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

PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| CD4051BQPWRG4Q1 | Obsolete | Production | TSSOP (PW) 16 | - | - | Call TI | Call TI | -40 to 125 | CM051BQ |
| CD4051BQPWRQ1 | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | CM051BQ |
| CD4051BQPWRQ1.A | Active | Production | TSSOP (PW) 16 | 2000 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -40 to 125 | CM051BQ |

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

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

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

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

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

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

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

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OTHER QUALIFIED VERSIONS OF CD4051B-Q1 :

- Catalog : [CD4051B](#)

- Military : [CD4051B-MIL](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION



*All dimensions are nominal

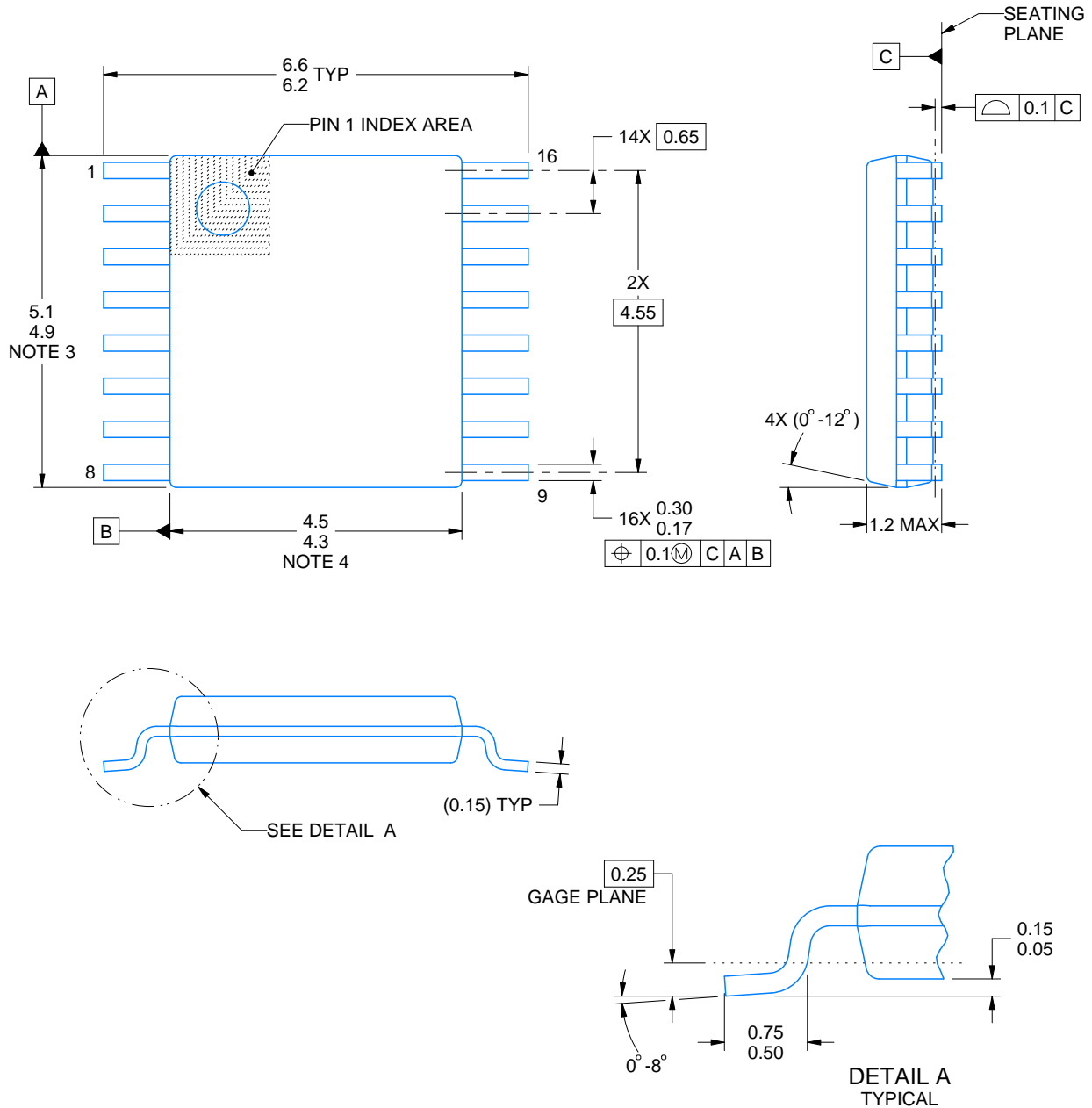
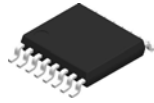
| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD4051BQPWRQ1 | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD4051BQPWRQ1 | 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) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD4051BQPWRQ1 | TSSOP | PW | 16 | 2000 | 353.0 | 353.0 | 32.0 |
| CD4051BQPWRQ1 | TSSOP | PW | 16 | 2000 | 353.0 | 353.0 | 32.0 |



4220204/B 12/2023

NOTES:

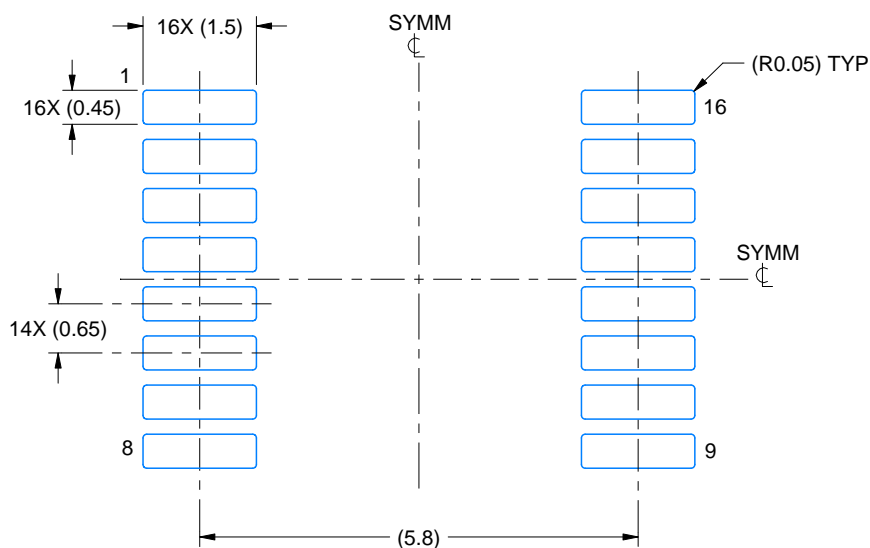
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

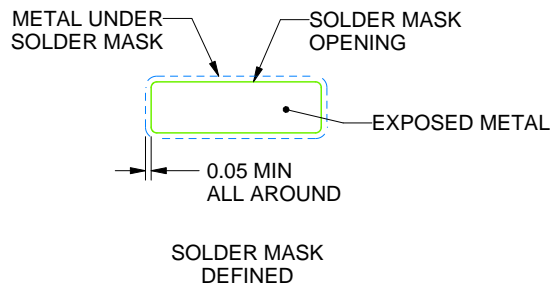
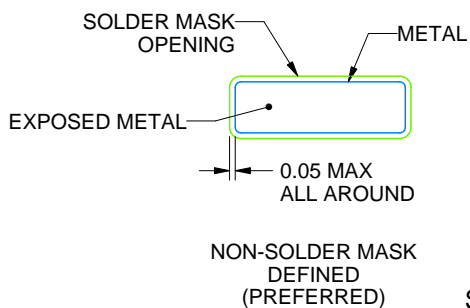
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

4220204/B 12/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

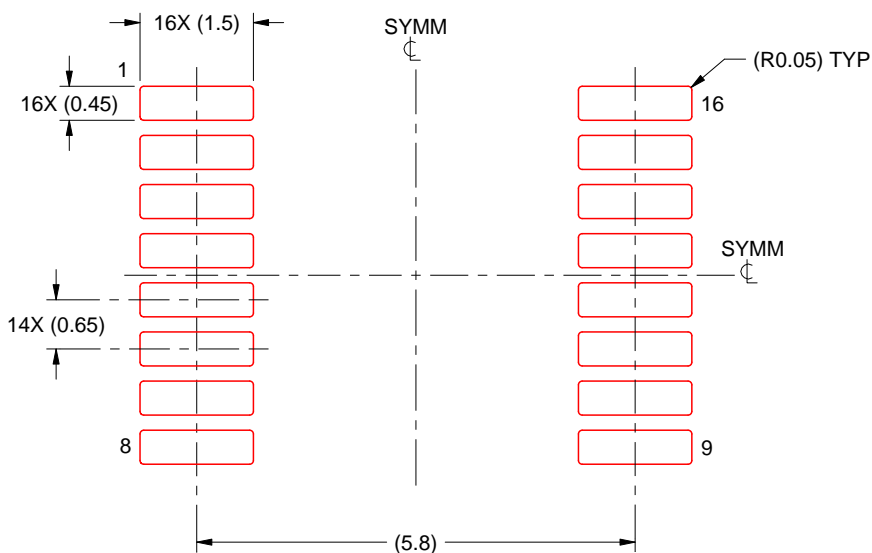
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

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.

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