



CD405xB CMOS Single 8-Channel Analog Multiplexer/Demultiplexer With Logic-Level Conversion

1 Features

- Wide Range of Digital and Analog Signal Levels
 - Digital: 3 V to 20 V
 - Analog: $\leq 20 V_{P-P}$
- Low ON Resistance, 125 Ω (Typical) Over 15 V_{P-P} Signal Input Range for $V_{DD} - V_{EE} = 18 V$
- High OFF Resistance, Channel Leakage of ± 100 pA (Typical) at $V_{DD} - V_{EE} = 18 V$
- Logic-Level Conversion for Digital Addressing Signals of 3 V to 20 V ($V_{DD} - V_{SS} = 3 V$ to 20 V) to Switch Analog Signals to 20 V_{P-P} ($V_{DD} - V_{EE} = 20 V$) Matched Switch Characteristics, $r_{ON} = 5 \Omega$ (Typical) for $V_{DD} - V_{EE} = 15 V$ Very Low Quiescent Power Dissipation Under All Digital-Control Input and Supply Conditions, 0.2 μW (Typical) at $V_{DD} - V_{SS} = V_{DD} - V_{EE} = 10 V$
- Binary Address Decoding on Chip
- 5 V, 10 V, and 15 V Parametric Ratings
- 100% Tested for Quiescent Current at 20 V
- Maximum Input Current of 1 μA at 18 V Over Full Package Temperature Range, 100 nA at 18 V and 25°C
- Break-Before-Make Switching Eliminates Channel Overlap

2 Applications

- Analog and Digital Multiplexing and Demultiplexing
- A/D and D/A Conversion
- Signal Gating
- Factory Automation
- Televisions
- Appliances
- Consumer Audio
- Programmable Logic Circuits
- Sensors

3 Description

The CD405xB 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.

Device Information⁽¹⁾

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|-------------|------------|--------------------|
| CD405xB | CDIP (16) | 19.50 mm x 6.92 mm |
| | PDIP (16) | 19.30 mm x 6.35 mm |
| | SOIC (16) | 9.90 mm x 3.91 mm |
| | SOP (16) | 10.30 mm x 5.30 mm |
| | TSSOP (16) | 5.00 mm x 4.40 mm |

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

Functional Diagrams of CD405xB

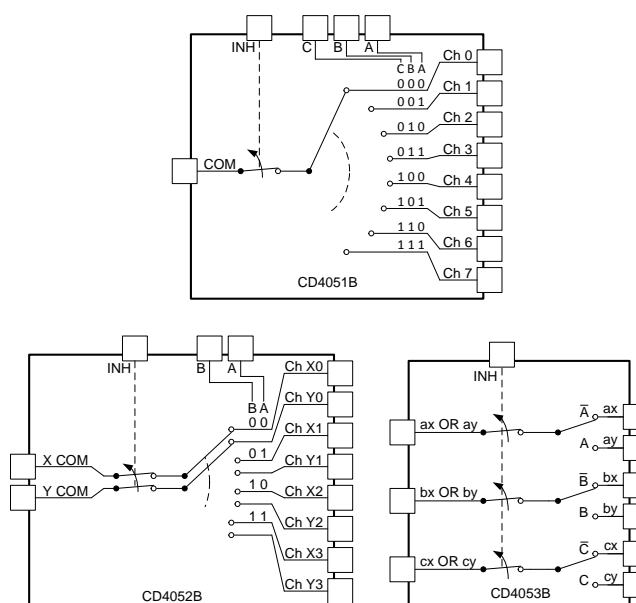


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4 Revision History

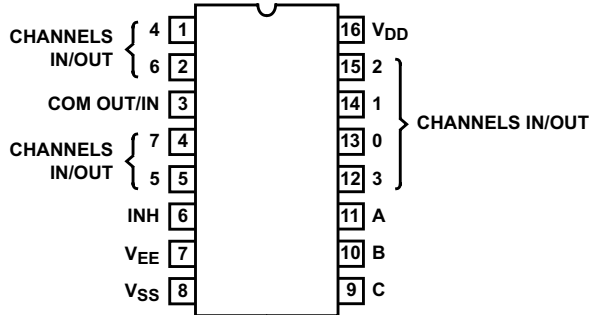
Changes from Revision G (October 2003) to Revision H

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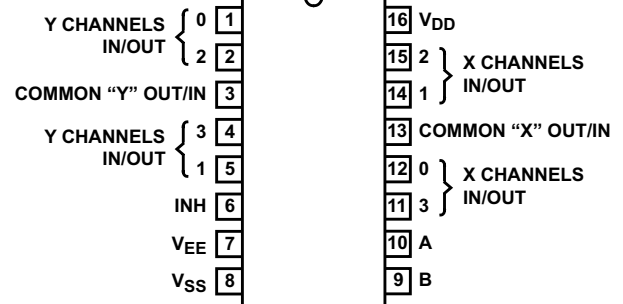
- Added *Pin Configuration and Functions* section, *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section **1**
- Added *Device Information* table. **1**

5 Pin Configuration and Functions

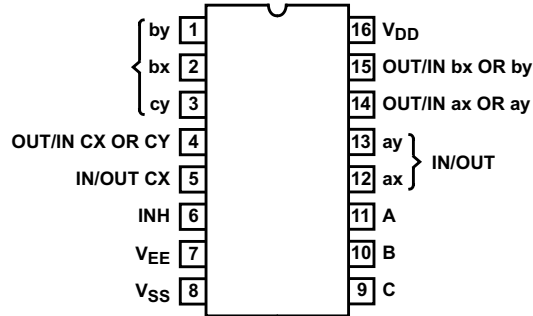
CD4051B E, M, NS, and PW Package
16-Pin PDIP, CDIP, SOIC, SOP, and TSSOP
(Top View)



CD4052B E, M, NS, and PW Package
16-Pin PDIP, CDIP, SOP, and TSSOP
(Top View)



CD4053B E, M, NS, and PW Package
16-Pin PDIP, CDIP, SOP, and TSSOP
(Top View)



Pin Functions CD4051B

| PIN | | I/O | 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 1 . |
| 7 | V _{EE} | — | Negative power input |
| 8 | V _{SS} | — | Ground |
| 9 | C | I | Channel select C. See Table 1 . |
| 10 | B | I | Channel select B. See Table 1 . |
| 11 | A | I | Channel select A. See Table 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 | V _{DD} | — | Positive power input |

CD4051B, CD4052B, CD4053B

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Pin Functions CD4052B

| PIN | | I/O | DESCRIPTION |
|-----|-----------------|-----|--|
| NO. | NAME | | |
| 1 | Y CH 0 IN/OUT | I/O | Channel Y0 in/out |
| 2 | Y CH 2 IN/OUT | I/O | Channel Y2 in/out |
| 3 | Y COM OUT/IN | I/O | Y common out/in |
| 4 | Y CH 3 IN/OUT | I/O | Channel Y3 in/out |
| 5 | Y CH 1 IN/OUT | I/O | Channel Y1 in/out |
| 6 | INH | I | Disables all channels. See Table 1 . |
| 7 | V _{EE} | — | Negative power input |
| 8 | V _{SS} | — | Ground |
| 9 | B | I | Channel select B. See Table 1 . |
| 10 | A | I | Channel select A. See Table 1 . |
| 11 | X CH 3 IN/OUT | I/O | Channel X3 in/out |
| 12 | X CH 0 IN/OUT | I/O | Channel X0 in/out |
| 13 | X COM IN/OUT | I/O | X common out/in |
| 14 | X CH 1 IN/OUT | I/O | Channel in/out |
| 15 | X CH 2 IN/OUT | I/O | Channel in/out |
| 16 | V _{DD} | — | Positive power input |

Pin Functions CD4053B

| PIN | | I/O | DESCRIPTION |
|-----|-----------------|-----|--|
| NO. | NAME | | |
| 1 | BY IN/OUT | I/O | B channel Y in/out |
| 2 | BX IN/OUT | I/O | B channel X in/out |
| 3 | CY IN/OUT | I/O | C channel Y in/out |
| 4 | CX OR CY OUT/IN | I/O | C common out/in |
| 5 | CX IN/OUT | I/O | C channel X in/out |
| 6 | INH | I | Disables all channels. See Table 1 . |
| 7 | V _{EE} | — | Negative power input |
| 8 | V _{SS} | — | Ground |
| 9 | C | I | Channel select C. See Table 1 . |
| 10 | B | I | Channel select B. See Table 1 . |
| 11 | A | I | Channel select A. See Table 1 . |
| 12 | AX IN/OUT | I/O | A channel X in/out |
| 13 | AY IN/OUT | I/O | A channel Y in/out |
| 14 | AX OR AY OUT/IN | I/O | A common out/in |
| 15 | BX OR BY OUT/IN | I/O | B common out/in |
| 16 | V _{DD} | — | Positive power input |

6 Specifications

6.1 Absolute Maximum Ratings

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

| | | 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 _{LMAX} | Maximum lead temperature, SOIC - Lead Tips Only, Soldering 10s | | 265 | °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, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6.2 ESD Ratings

| | | VALUE | UNIT |
|--|--|-------|------|
| CD4051B in PDIP, CDIP, SOIC, SOP, TSSOP Packages | | | |
| V _(ESD) Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | +3000 | V |
| | Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ | +2000 | |
| CD4053B in PDIP, CDIP, SOP and TSSOP Packages | | | |
| V _(ESD) Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾ | +2500 | V |
| | Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾ | +1500 | |

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

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

6.3 Recommended Operating Conditions

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

| | MIN | MAX | UNIT |
|-------------------|-----|-----|------|
| Temperature Range | –55 | 125 | °C |

6.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | CD405xB | | | | UNIT |
|---|----------|----------|----------|------------|------|
| | E (PDIP) | M (SOIC) | NS (SOP) | PW (TSSOP) | |
| | 16 PINS | 16 PINS | 16 PINS | 16 PINS | |
| R _{θJA} Junction-to-ambient thermal resistance | 67 | 73 | 64 | 108 | °C/W |

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

6.5 Electrical Characteristics


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

| PARAMETER | TEST CONDITIONS | | | | | MIN | TYP | MAX | UNIT |
|--|---------------------|---------------------|---------------------|---------------------|-------|-----|------|------|------|
| | V _{IS} (V) | V _{EE} (V) | V _{SS} (V) | V _{DD} (V) | TEMP | | | | |
| SIGNAL INPUTS (V _{IS}) AND OUTPUTS (V _{OS}) | | | | | | | | | |
| Quiescent Device Current, I _{DD} Max | | | | 5 | –55°C | | | 5 | μA |
| | | | | | –40°C | | | 5 | |
| | | | | | 25°C | | 0.04 | 5 | |
| | | | | | 85°C | | | 150 | |
| | | | | | 125°C | | | 150 | |
| | | | | 10 | –55°C | | | 10 | |
| | | | | | –40°C | | | 10 | |
| | | | | | 25°C | | 0.04 | 10 | |
| | | | | | 85°C | | | 300 | |
| | | | | | 125°C | | | 300 | |
| | | | | 15 | –55°C | | | 20 | |
| | | | | | –40°C | | | 20 | |
| | | | | | 25°C | | 0.04 | 20 | |
| | | | | | 85°C | | | 600 | |
| | | | | | 125°C | | | 600 | |
| | | | | 20 | –55°C | | | 100 | |
| | | | | | –40°C | | | 100 | |
| | | | | | 25°C | | 0.08 | 100 | |
| | | | | | 85°C | | | 3000 | |
| | | | | | 125°C | | | 3000 | |
| Drain to Source ON Resistance r _{ON} Max 0 ≤ V _{IS} ≤ V _{DD} | | 0 | 0 | 5 | –55°C | | | 800 | Ω |
| | | | | | –40°C | | | 850 | |
| | | | | | 25°C | | 470 | 1050 | |
| | | | | | 85°C | | | 1200 | |
| | | | | | 125°C | | | 1300 | |
| | | 0 | 0 | 10 | –55°C | | | 310 | |
| | | | | | –40°C | | | 300 | |
| | | | | | 25°C | | 180 | 400 | |
| | | | | | 85°C | | | 520 | |
| | | | | | 125°C | | | 550 | |
| | | 0 | 0 | 15 | –55°C | | | 200 | |
| | | | | | –40°C | | | 210 | |
| | | | | | 25°C | | 125 | 240 | |
| | | | | | 85°C | | | 300 | |
| | | | | | 125°C | | | 300 | |
| Change in ON Resistance (Between Any Two Channels), Δr _{ON} | | 0 | 0 | 5 | 25°C | | 15 | Ω | |
| | | 0 | 0 | 10 | | | 10 | | |
| | | 0 | 0 | 15 | | | 5 | | |

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

Electrical Characteristics (continued)

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

| PARAMETER | | | TEST CONDITIONS | | | | | MIN | TYP | MAX | UNIT |
|--|---|--------------------------------|---------------------|---|---------------------------|---------------------|-------|---------------------|--------------------|-----|------|
| | | | V _{IS} (V) | V _{EE} (V) | V _{SS} (V) | V _{DD} (V) | TEMP | | | | |
| OFF Channel Leakage Current: Any Channel OFF (Max) or ALL Channels OFF (Common OUT/IN) (Max) | | | | 0 | 0 | 18 | −55°C | ± 100 | | nA | |
| | | | | | | | −40°C | | | | |
| | | | | | | | 25°C | ± 0.01 | 100 ⁽²⁾ | | |
| | | | | | | | 85°C | 1000 ⁽²⁾ | | | |
| | | | | | | | 125°C | | | | |
| Capacitance | Input, C _{IS} | | | −5 | −5 | −5 | 25°C | 5 | | pF | |
| | Output, C _{OS} | CD4051 | | | | 25°C | 30 | | | | |
| | | CD4052 | | | | | 18 | | | | |
| | | CD4053 | | | | | 9 | | | | |
| | | Feed through, C _{IOS} | | | | | 0.2 | | | | |
| | Propagation Delay Time (Signal Input to Output) | | |  | R _L = 200 kΩ , | | 5 | 25°C | 30 | | 60 |
| C _L = 50 pF, | | | | | 10 | 15 | 30 | | | | |
| t _r , t _f = 20 ns | | | | | 15 | 10 | 20 | | | | |

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

Electrical Characteristics (continued)

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

| PARAMETER | | TEST CONDITIONS | | | | | MIN | TYP | MAX | UNIT |
|--|--|--|---|---------------------|---------------------|--------------------------|-------|-----|-----|------|
| | | V _{IS} (V) | V _{EE} (V) | V _{SS} (V) | V _{DD} (V) | TEMP | | | | |
| CONTROL (ADDRESS OR INHIBIT), V _C | | | | | | | | | | |
| Input Low Voltage, V _{IL} , Max | | V _{IL} = V _{DD} through 1 kΩ ; V _{IH} = V _{DD} through 1 kΩ | V _{EE} = V _{SS} , R _L = 1 kΩ to V _{SS} , I _{IS} < 2 μA on All OFF Channels | 5 | –55°C | 1.5 | | V | | |
| | | | | | –40°C | 1.5 | | | | |
| | | | | | 25°C | 1.5 | | | | |
| | | | | | 85°C | 1.5 | | | | |
| | | | | | 125°C | 1.5 | | | | |
| | | | | | 10 | –55°C | 3 | | | |
| | | | | | | –40°C | 3 | | | |
| | | | | | | 25°C | 3 | | | |
| | | | | | | 85°C | 3 | | | |
| | | | | | | 125°C | 3 | | | |
| | | | | 15 | –55°C | 4 | | | | |
| | | | | | –40°C | 4 | | | | |
| | | | | | 25°C | 4 | | | | |
| | | | | | 85°C | 4 | | | | |
| | | | | | 125°C | 4 | | | | |
| Input High Voltage, V _{IH} , Min | | V _{IL} = V _{DD} through 1 kΩ ; V _{IH} = V _{DD} through 1 kΩ | V _{EE} = V _{SS} , R _L = 1 kΩ to V _{SS} , I _{IS} < 2 μA on All OFF Channels | 5 | –55°C | 3.5 | | V | | |
| | | | | | –40°C | 3.5 | | | | |
| | | | | | 25°C | 3.5 | | | | |
| | | | | | 85°C | 3.5 | | | | |
| | | | | | 125°C | 3.5 | | | | |
| | | | | 10 | –55°C | 7 | | | | |
| | | | | | –40°C | 7 | | | | |
| | | | | | 25°C | 7 | | | | |
| | | | | | 85°C | 7 | | | | |
| | | | | | 125°C | 7 | | | | |
| | | | | 15 | –55°C | 11 | | | | |
| | | | | | –40°C | 11 | | | | |
| | | | | | 25°C | 11 | | | | |
| | | | | | 85°C | 11 | | | | |
| | | | | | 125°C | 11 | | | | |
| Input Current, I _{IN} (Max) | | | V _{IN} = 0, 18 | 18 | –55°C | | ± 0.1 | μA | | |
| | | | | | –40°C | | ± 0.1 | | | |
| | | | | | 25°C | ± 10 ^{–5} ± 0.1 | | | | |
| | | | | | 85°C | ± 1 | | | | |
| | | | | | 125°C | ± 1 | | | | |
| Propagation Delay Time | Address-to-Signal OUT (Channels ON or OFF) (See Figure 10, Figure 11, and Figure 14) | t _r , t _f = 20 ns, C _L = 50 pF, R _L = 10 kΩ | 0 | 0 | 5 | | 450 | 720 | ns | |
| | | | 0 | 0 | 10 | | 160 | 320 | | |
| | | | 0 | 0 | 15 | | 120 | 240 | | |
| | | | –5 | 0 | 5 | | 225 | 450 | | |
| Propagation Delay Time | Inhibit-to-Signal OUT (Channel Turning ON) (See Figure 11) | t _r , t _f = 20 ns, C _L = 50 pF, R _L = 1 kΩ | 0 | 0 | 5 | | 400 | 720 | ns | |
| | | | 0 | 0 | 10 | | 160 | 320 | | |
| | | | 0 | 0 | 15 | | 120 | 240 | | |
| | | | –10 | 0 | 5 | | 200 | 400 | | |

Electrical Characteristics (continued)

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

| PARAMETER | | TEST CONDITIONS | | | | | MIN | TYP | MAX | UNIT |
|---|---|---|---------------------|---------------------|---------------------|------|-----|-----|-----|------|
| | | V _{IS} (V) | V _{EE} (V) | V _{SS} (V) | V _{DD} (V) | TEMP | | | | |
| Propagation Delay Time | Inhibit-to-Signal OUT (Channel Turning OFF) (See Figure 16) | t _r , t _f = 20 ns, C _L = 50 pF, R _L = 10 kΩ | 0 | 0 | 5 | | | 200 | 450 | ns |
| | | | 0 | 0 | 10 | | | 90 | 210 | |
| | | | 0 | 0 | 15 | | | 70 | 160 | |
| | | | −10 | 0 | 5 | | | 130 | 300 | |
| Input Capacitance, C _{IN} (Any Address or Inhibit Input) | | | | | | | | 5 | 7.5 | pF |

6.6 AC Performance Characteristics

| 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 | CD4053 | 30 | MHz |
| | | | | | CD4052 | 25 | |
| | | | | | CD4051 | 20 | |
| | V _{EE} = V _{SS} , $20Log \frac{V_{OS}}{V_{IS}} = -3 \text{ dB}$ | | | V _{OS} at Any Channel | | 60 | |
| Total Harmonic Distortion, THD | 2 ⁽¹⁾ | 5 | 10 | | | 0.3% | |
| | 3 ⁽¹⁾ | 10 | | | | 0.2% | |
| | 5 ⁽¹⁾ | 15 | | | | 0.12% | |
| | V _{EE} = V _{SS} , f _{IS} = 1 kHz Sine Wave | | | | | | |
| −40dB Feedthrough Frequency (All Channels OFF) | 5 ⁽¹⁾ | 10 | 1 | V _{OS} at Common OUT/IN | CD4053 | 8 | MHz |
| | V _{EE} = V _{SS} , $20Log \frac{V_{OS}}{V_{IS}} = -40dB$ | | | | CD4052 | 10 | |
| | | | | | CD4051 | 12 | |
| | | | | V _{OS} at Any Channel | | 8 | |
| −40dB Signal Crosstalk Frequency | 5 ⁽¹⁾ | 10 | 1 | Between Any two Channels | | 3 | MHz |
| | V _{EE} = V _{SS} , $20Log \frac{V_{OS}}{V_{IS}} = -40dB$ | | | Between Sections, CD4052 Only | Measured on Common | 6 | |
| | | | | | Measured on Any Channel | 10 | |
| | | | | Between Any Two Sections, CD4053 Only | In Pin 2, Out Pin 14 | 2.5 | |
| | | | | | In Pin 15, Out Pin 14 | 6 | |
| Address-or-Inhibit- to-Signal Crosstalk | | 10 | 10 ⁽²⁾ | | | 65 | mV _{PEAK} |
| | V _{EE} = 0, V _{SS} = 0, t _r , t _f = 20 ns, V _{CC} = V _{DD} − V _{SS} (Square Wave) | | | | | 65 | |

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

(2) Both ends of channel.

6.7 Typical Characteristics

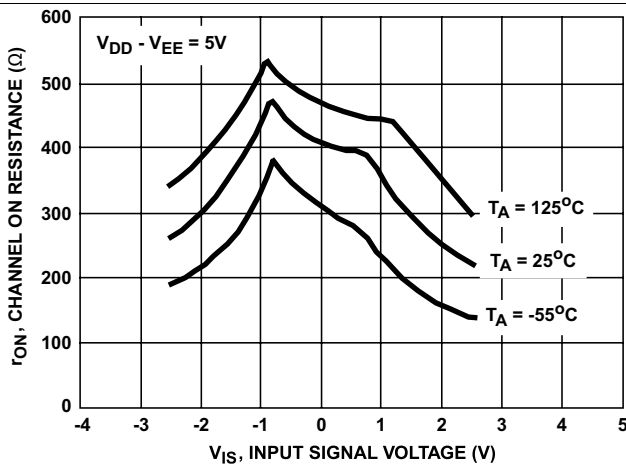


Figure 1. Channel ON Resistance vs Input Signal Voltage (All Types)

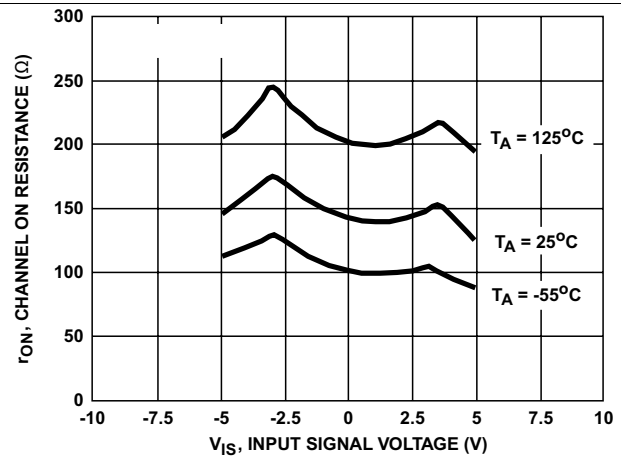


Figure 2. Channel ON Resistance vs Input Signal Voltage (All Types)

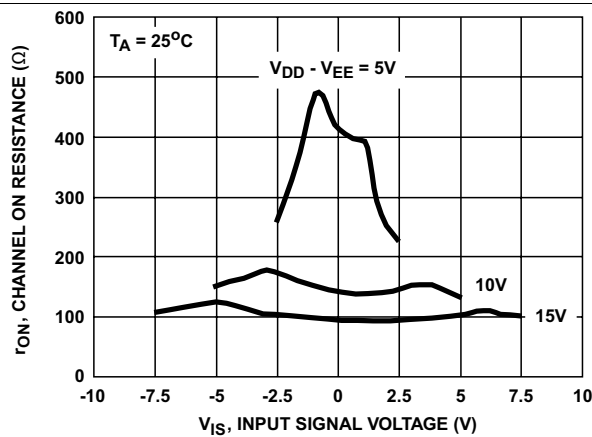


Figure 3. Channel ON Resistance vs Input Signal Voltage (All Types)

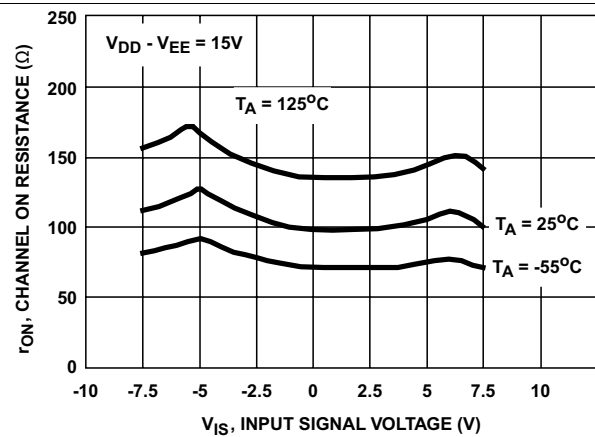


Figure 4. Channel ON Resistance vs Input Signal Voltage (All Types)

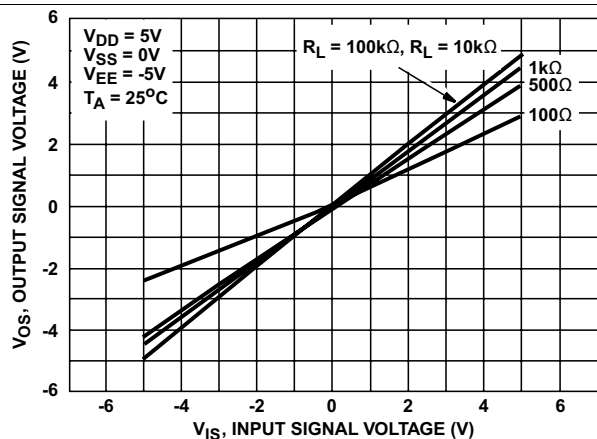


Figure 5. ON Characteristics for 1 of 8 Channels (CD4051B)

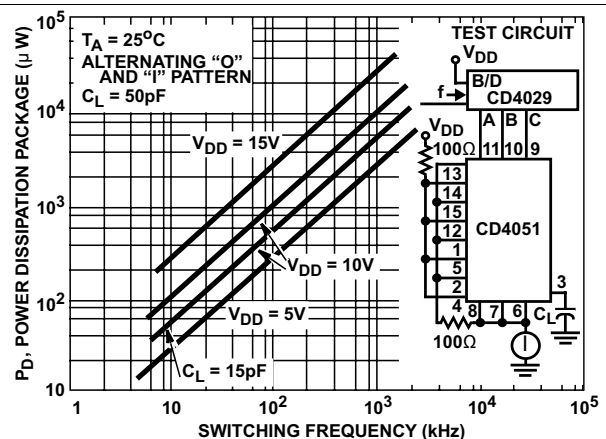
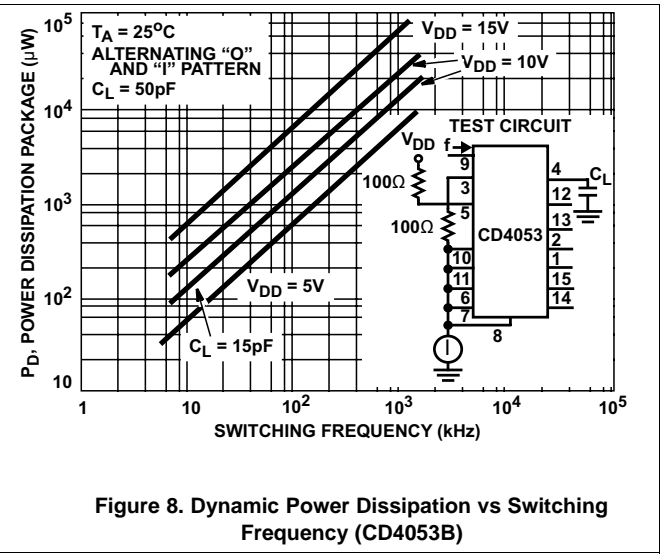
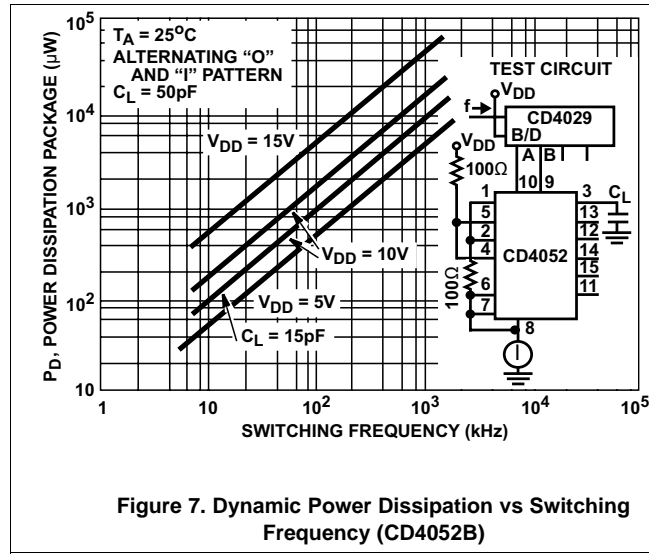


Figure 6. Dynamic Power Dissipation vs Switching Frequency (CD4051B)

Typical Characteristics (continued)



7 Parameter Measurement Information

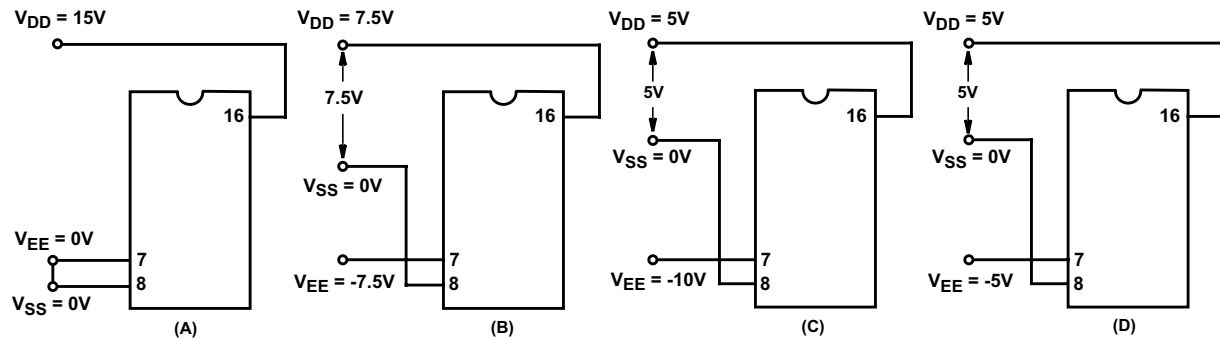


Figure 9. Typical Bias Voltages

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} .

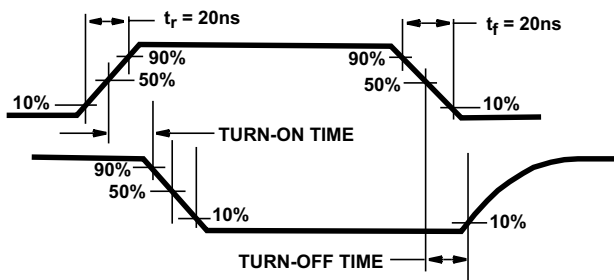


Figure 10. Waveforms, Channel Being Turned ON ($R_L = 1\text{ k}\Omega$)

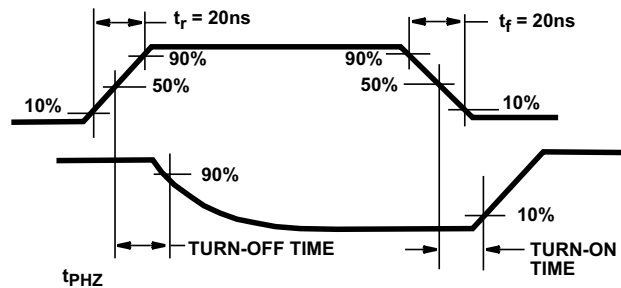


Figure 11. Waveforms, Channel Being Turned OFF ($R_L = 1\text{ k}\Omega$)

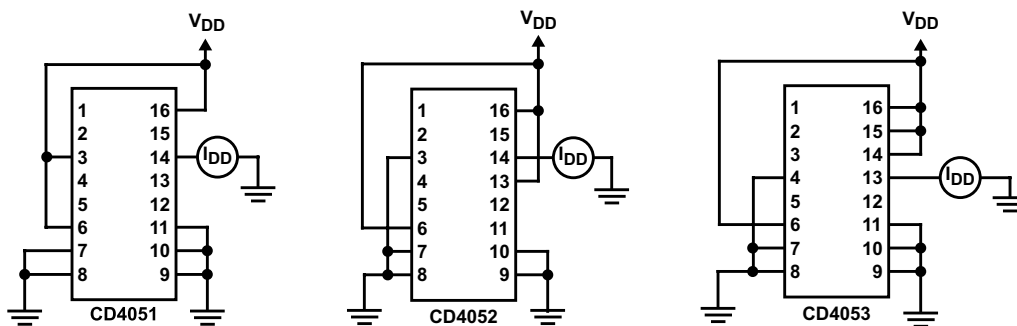


Figure 12. OFF Channel Leakage Current - Any Channel OFF

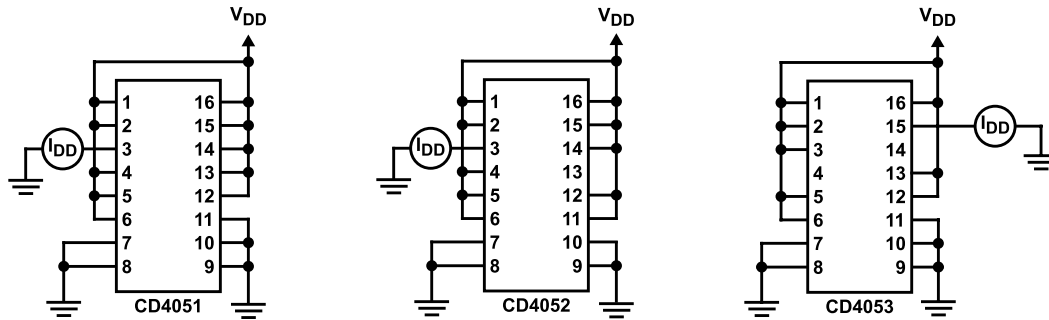


Figure 13. OFF Channel Leakage Current - All Channels OFF

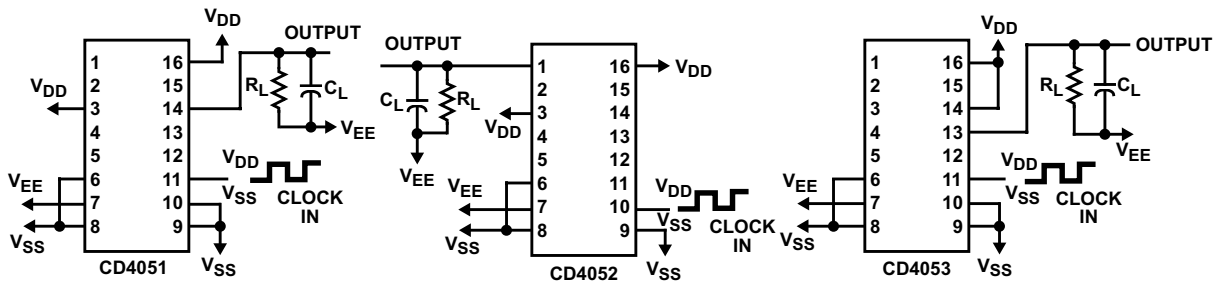


Figure 14. Propagation Delay - Address Input to Signal Output

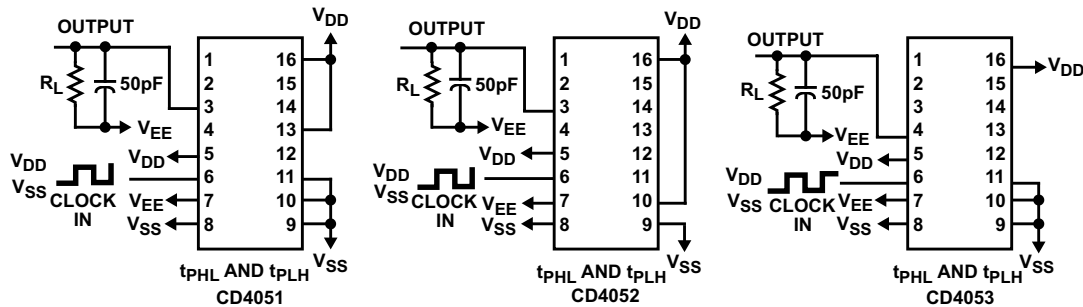


Figure 15. Propagation Delay - Inhibit Input to Signal Output

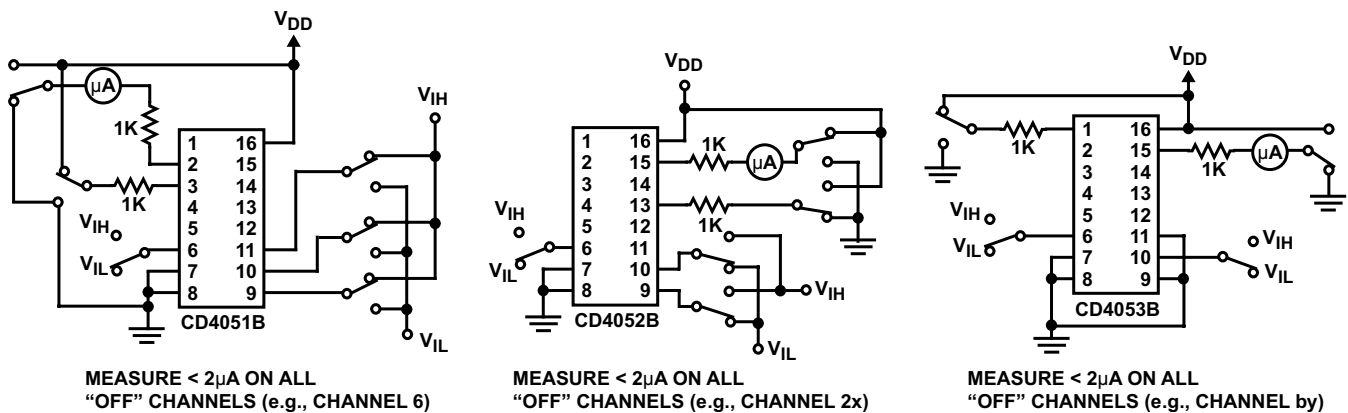
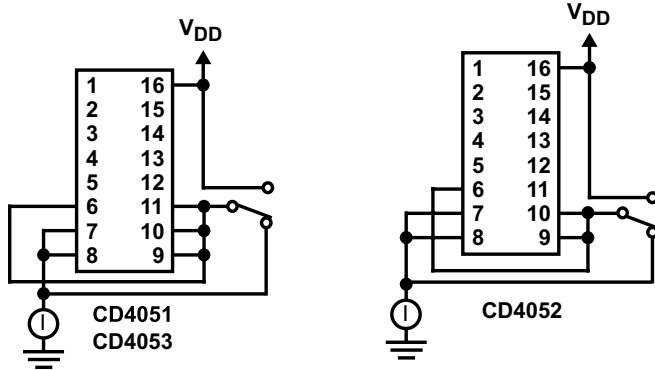
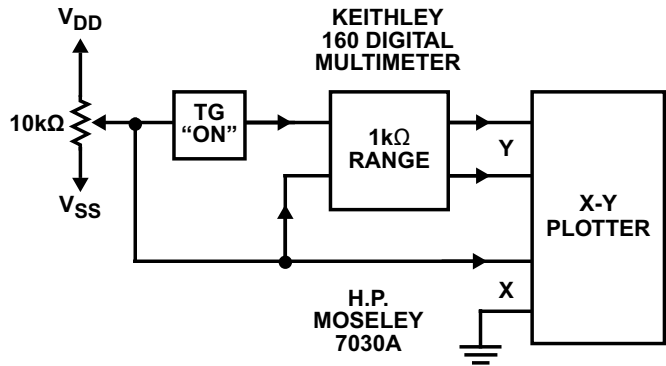
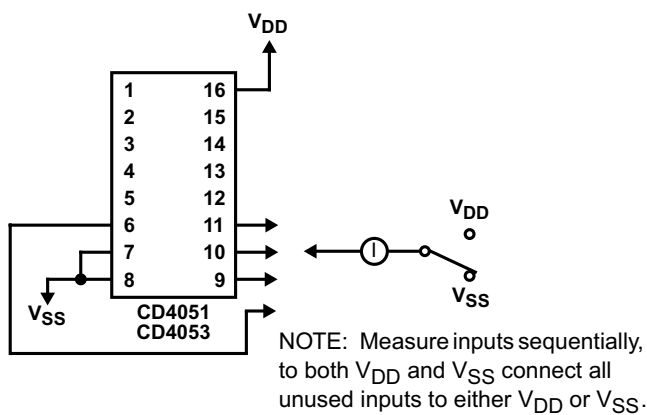
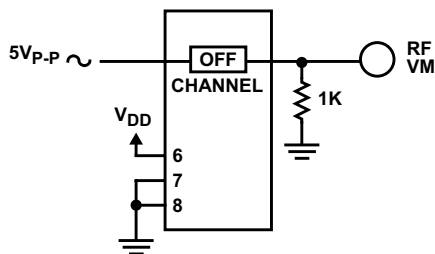
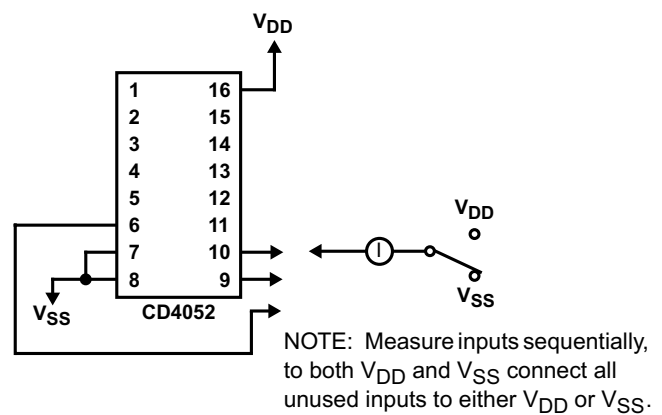
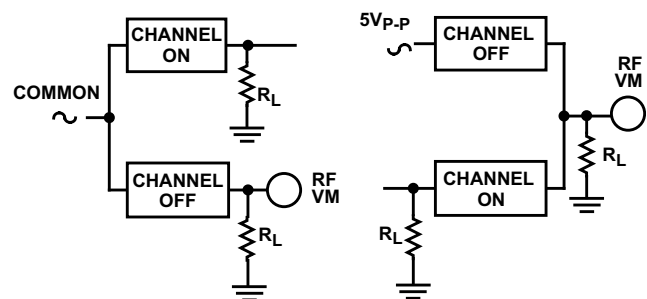
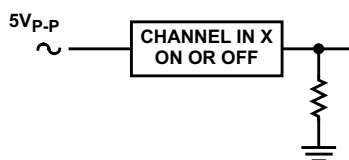
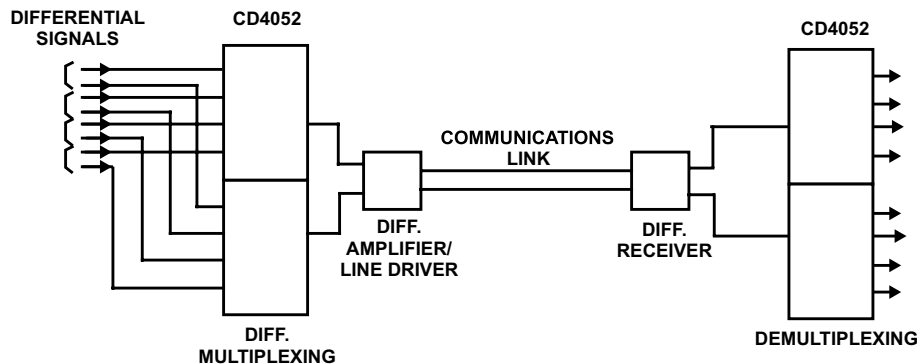


Figure 16. Input Voltage Test Circuits (Noise Immunity)

CD4051B, CD4052B, CD4053B

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Figure 17. Quiescent Device Current

Figure 18. Channel ON Resistance Measurement Circuit

Figure 19. Input Current

Figure 20. Feedthrough (All Types)

Figure 21. Crosstalk Between Any Two Channels (All Types)

Figure 22. Crosstalk Between Duals or Triplets (CD4052B, CD4053B)



Special Considerations: In applications where separate power sources are used to drive V_{DD} and the signal inputs, the V_{DD} current capability should exceed V_{DD}/R_L (R_L = effective external load). This provision avoids permanent current flow or clamp action on the V_{DD} supply when power is applied or removed from the CD4051B, CD4052B or CD4053B.

Figure 23. Typical Time-Division Application of the CD4052B

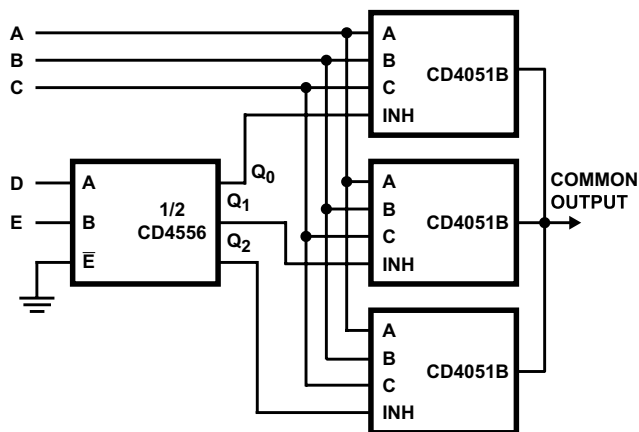


Figure 24. 24-to-1 MUX Addressing

8 Detailed Description

8.1 Overview

The CD4051B, CD4052B, and CD4053B analog multiplexers are digitally-controlled analog switches having low ON impedance and very low OFF leakage current. Control of analog signals up to 20 V_{P-P} can be achieved by digital signal amplitudes of 4.5 V to 20 V (if $V_{DD} - V_{SS} = 3$ V, a $V_{DD} - V_{EE}$ of up to 13 V can be controlled; for $V_{DD} - V_{EE}$ level differences above 13 V, a $V_{DD} - V_{SS}$ of at least 4.5 V is required). For example, if $V_{DD} = +4.5$ V, $V_{SS} = 0$ V, and $V_{EE} = -13.5$ V, analog signals from -13.5 V to $+4.5$ V can be controlled by digital inputs of 0 V to 5 V. 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. When a logic 1 is present at the inhibit input terminal, all channels are off.

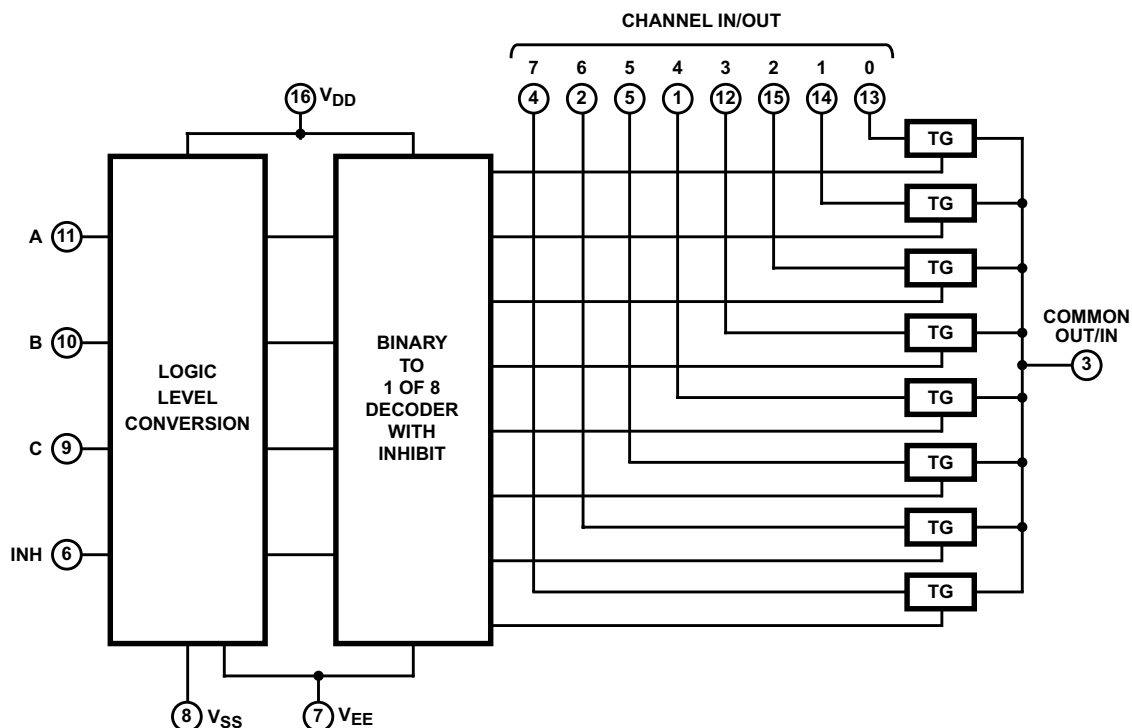
The CD4051B device is a single 8-channel multiplexer having three binary control inputs, A, B, and C, and an inhibit input. The three binary signals select 1 of 8 channels to be turned on, and connect one of the 8 inputs to the output.

The CD4052B device is a differential 4-channel multiplexer having two binary control inputs, A and B, and an inhibit input. The two binary input signals select 1 of 4 pairs of channels to be turned on and connect the analog inputs to the outputs.

The CD4053B device is a triple 2-channel multiplexer having three separate digital control inputs, A, B, and C, and an inhibit input. Each control input selects one of a pair of channels which are connected in a single-pole, double-throw configuration.

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

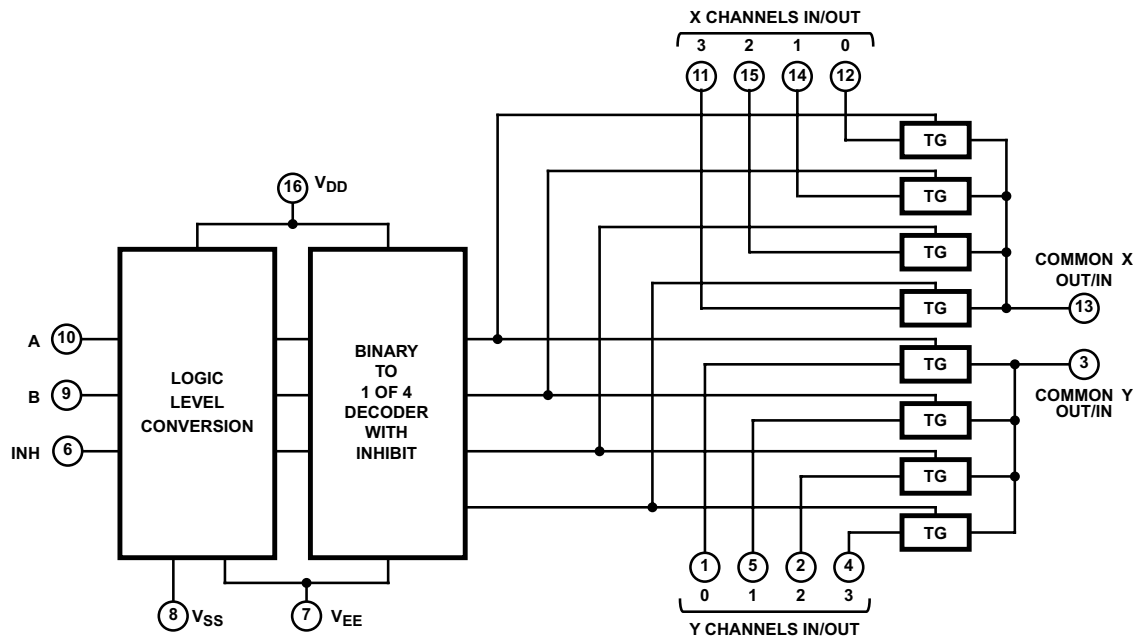
8.2 Functional Block Diagrams



All inputs are protected by standard CMOS protection network.

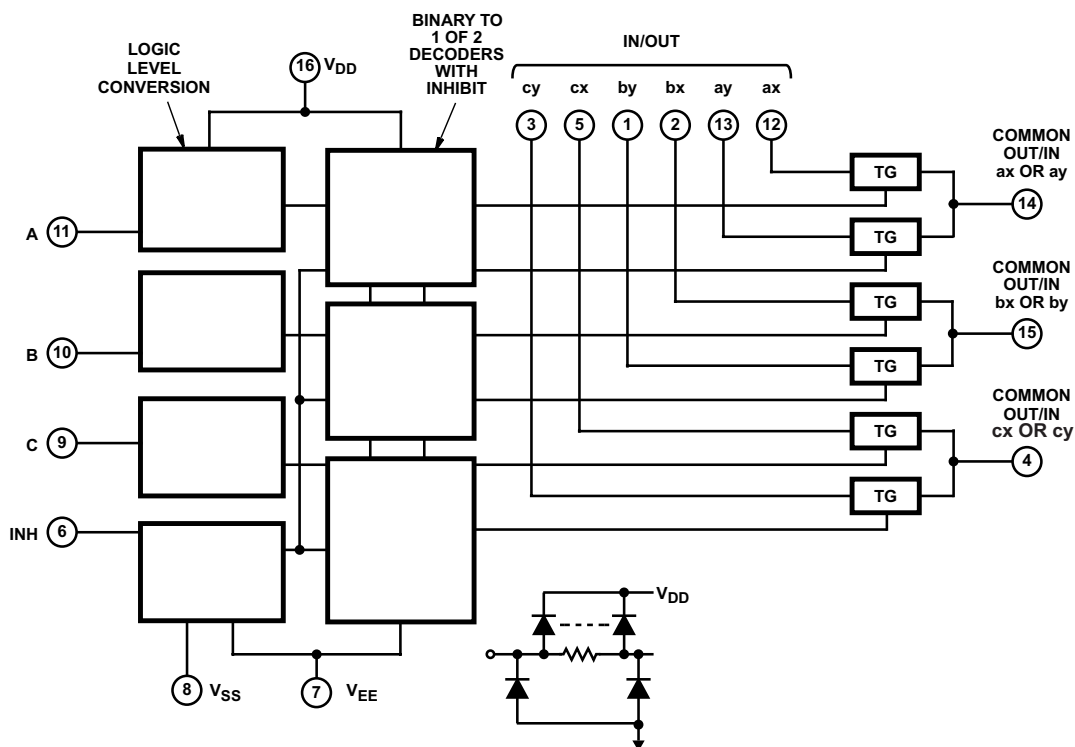
Figure 25. Functional Block Diagram, CD4051B

Functional Block Diagrams (continued)



All inputs are protected by standard CMOS protection network.

Figure 26. Functional Block Diagram, CD4052B



All inputs are protected by standard CMOS protection network.

Figure 27. Functional Block Diagram, CD4053B

8.3 Feature Description

The CD405xB line of multiplexers and demultiplexers can accept a wide range of digital and analog signal levels. Digital signals range from 3 V to 20 V, and analog signals are accepted at levels ≤ 20 V. They have low ON resistance, typically 125 Ω over 15 V_{P-P} signal input range for $V_{DD} - V_{EE} = 18$ V. This allows for very little signal loss through the switch. Matched switch characteristics are typically $r_{ON} = 5 \Omega$ for $V_{DD} - V_{EE} = 15$ V.

The CD405xB devices also have high OFF resistance, which keeps from wasting power when the switch is in the OFF position, with typical channel leakage of ± 100 pA at $V_{DD} - V_{EE} = 18$ V. Very low quiescent power dissipation under all digital-control input and supply conditions, typically 0.2 μ W at $V_{DD} - V_{SS} = V_{DD} - V_{EE} = 10$ V keeps power consumption total very low. All devices have been 100% tested for quiescent current at 20 V with maximum input current of 1 μ A at 18 V over the full package temperature range, and only 100 nA at 18 V and 25°C.

Logic-level conversion for digital addressing signals of 3 V to 20 V ($V_{DD} - V_{SS} = 3$ V to 20 V) to switch analog signals to 20 V_{P-P} ($V_{DD} - V_{EE} = 20$ V). Binary address decoding on chip makes channel selection easy. When channels are changed, a break-before-make system eliminates channel overlap.

8.4 Device Functional Modes

Table 1. Truth Table⁽¹⁾

| INPUT STATES | | | | ON CHANNEL(S) |
|--------------|---|---|---|---------------|
| INHIBIT | C | B | A | |
| CD4051B | | | | |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 2 |
| 0 | 0 | 1 | 1 | 3 |
| 0 | 1 | 0 | 0 | 4 |
| 0 | 1 | 0 | 1 | 5 |
| 0 | 1 | 1 | 0 | 6 |
| 0 | 1 | 1 | 1 | 7 |
| 1 | X | X | X | None |
| CD4052B | | | | |
| 0 | | 0 | 0 | 0x, 0y |
| 0 | | 0 | 1 | 1x, 1y |
| 0 | | 1 | 0 | 2x, 2y |
| 0 | | 1 | 1 | 3x, 3y |
| 1 | | X | X | None |
| CD4053B | | | | |
| 0 | X | X | 0 | ax |
| 0 | X | X | 1 | ay |
| 0 | X | 0 | X | bx |
| 0 | X | 1 | X | by |
| 0 | 0 | X | X | cx |
| 0 | 1 | X | X | cy |
| 1 | X | X | X | None |

(1) X = Don't Care

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

The CD405xB multiplexers and demultiplexers can be used for a wide variety of applications.

9.2 Typical Application

One application of the CD4051B is to use it in conjunction with a microcontroller to poll a keypad. [Figure 28](#) 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 is a very robust setup, allowing for multiple simultaneous key-presses with very little power consumption. It also utilizes 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.

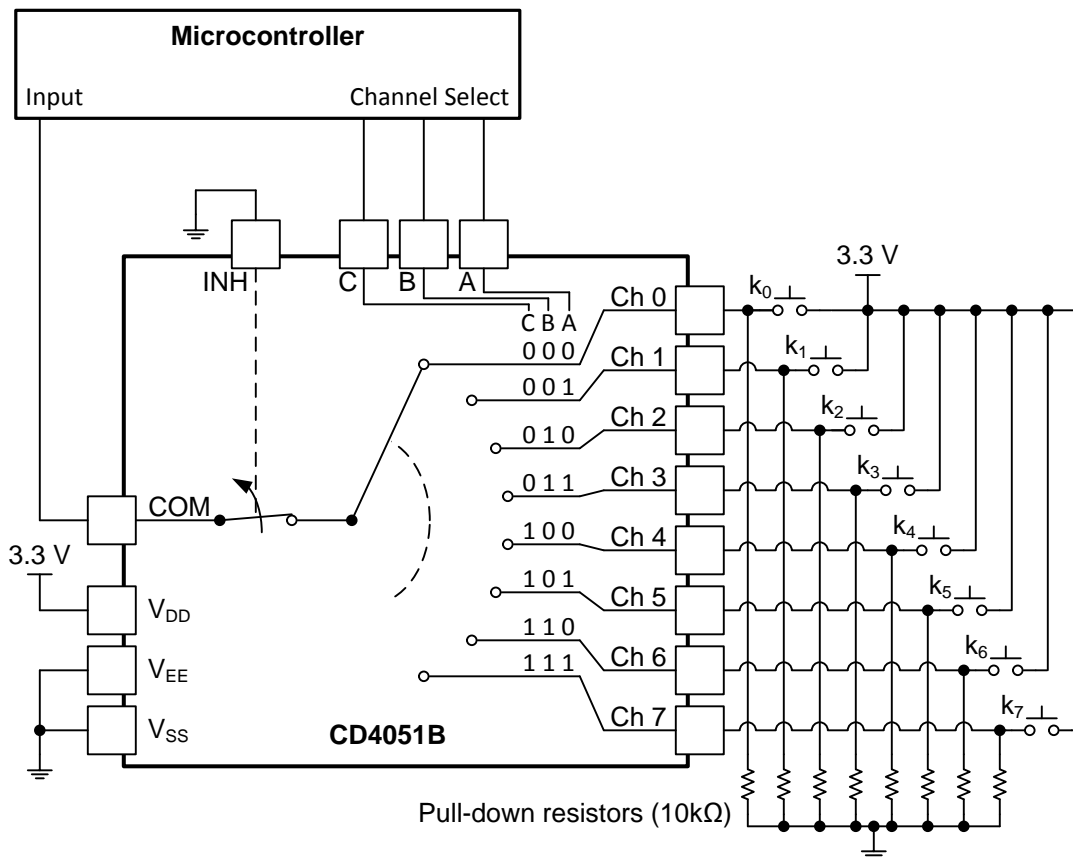


Figure 28. The CD4051B Being Used to Help Read Button Presses on a Keypad.

9.2.1 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.

Typical Application (continued)

9.2.2 Detailed Design Procedure

1. Recommended Input Conditions
 - For switch time specifications, see propagation delay times in [Electrical Characteristics](#).
 - Inputs should not be pushed more than 0.5 V above V_{DD} or below V_{EE} .
 - For input voltage level specifications for control inputs, see V_{IH} and V_{IL} in [Electrical Characteristics](#).
2. Recommended Output Conditions
 - Outputs should not be pulled above V_{DD} or below V_{EE} .
3. Input/output current consideration: The CD405xB 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.

9.2.3 Application Curve

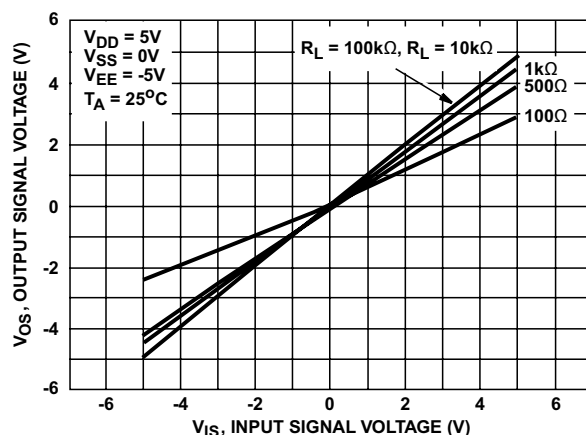


Figure 29. ON Characteristics for 1 of 8 Channels (CD4051B)

10 Power Supply Recommendations

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

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.

11 Layout

11.1 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 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 30](#) shows progressively better techniques of rounding corners. Only the last example maintains constant trace width and minimizes reflections.

11.2 Layout Example

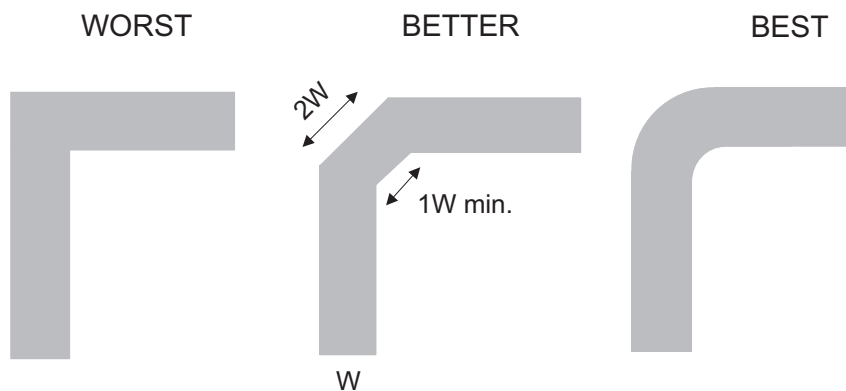


Figure 30. Trace Example

12 Device and Documentation Support

12.1 Documentation Support

12.1.1 Related Documentation

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

12.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 2. Related Links

| PARTS | PRODUCT FOLDER | SAMPLE & BUY | TECHNICAL DOCUMENTS | TOOLS & SOFTWARE | SUPPORT & COMMUNITY |
|---------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| CD4051B | Click here | Click here | Click here | Click here | Click here |
| CD4052B | Click here | Click here | Click here | Click here | Click here |
| CD4053B | Click here | Click here | Click here | Click here | Click here |

12.3 Trademarks

All 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/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| 7901502EA | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | 7901502EA CD4052BF3A | Samples |
| 8101801EA | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | 8101801EA CD4053BF3A | Samples |
| CD4051BE | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU CU SN | N / A for Pkg Type | -55 to 125 | CD4051BE | Samples |
| CD4051BEE3 | PREVIEW | PDIP | N | 16 | | TBD | Call TI | Call TI | -55 to 125 | CD4051BE | |
| CD4051BEE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -55 to 125 | CD4051BE | Samples |
| CD4051BF | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | CD4051BF | Samples |
| CD4051BF3A | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | CD4051BF3A | Samples |
| CD4051BF3AS2283 | OBSOLETE | CDIP | J | 16 | | TBD | Call TI | Call TI | | | |
| CD4051BM | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4051BM | Samples |
| CD4051BM96 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -55 to 125 | CD4051BM | Samples |
| CD4051BM96G3 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -55 to 125 | CD4051BM | Samples |
| CD4051BM96G4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4051BM | Samples |
| CD4051BMG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4051BM | Samples |
| CD4051BMT | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4051BM | Samples |
| CD4051BNSR | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4051B | Samples |
| CD4051BNSRE4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4051B | Samples |
| CD4051BPW | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM051B | Samples |
| CD4051BPWE4 | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM051B | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| CD4051BPWG4 | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM051B | Samples |
| CD4051BPWR | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -55 to 125 | CM051B | Samples |
| CD4051BPWRG4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM051B | Samples |
| CD4052BE | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU CU SN | N / A for Pkg Type | -55 to 125 | CD4052BE | Samples |
| CD4052BEE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -55 to 125 | CD4052BE | Samples |
| CD4052BF | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | CD4052BF | Samples |
| CD4052BF3A | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | 7901502EA CD4052BF3A | Samples |
| CD4052BM | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4052BM | Samples |
| CD4052BM96 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -55 to 125 | CD4052BM | Samples |
| CD4052BM96E4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4052BM | Samples |
| CD4052BM96G3 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -55 to 125 | CD4052BM | Samples |
| CD4052BM96G4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4052BM | Samples |
| CD4052BMG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4052BM | Samples |
| CD4052BMT | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4052BM | Samples |
| CD4052BNSR | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4052B | Samples |
| CD4052BNSRG4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4052B | Samples |
| CD4052BPW | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM052B | Samples |
| CD4052BPWE4 | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM052B | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| CD4052BPWR | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -55 to 125 | CM052B | Samples |
| CD4052BPWRG3 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -55 to 125 | CM052B | Samples |
| CD4052BPWRG4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM052B | Samples |
| CD4053BE | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -55 to 125 | CD4053BE | Samples |
| CD4053BEE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -55 to 125 | CD4053BE | Samples |
| CD4053BF | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | CD4053BF | Samples |
| CD4053BF3A | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | 8101801EA CD4053BF3A | Samples |
| CD4053BF3AS2283 | OBSOLETE | CDIP | J | 16 | | TBD | Call TI | Call TI | | | |
| CD4053BM | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4053M | Samples |
| CD4053BM96 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -55 to 125 | CD4053M | Samples |
| CD4053BM96E4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4053M | Samples |
| CD4053BM96G3 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -55 to 125 | CD4053M | Samples |
| CD4053BM96G4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4053M | Samples |
| CD4053BMG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4053M | Samples |
| CD4053BMT | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4053M | Samples |
| CD4053BNSR | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD4053B | Samples |
| CD4053BPW | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM053B | Samples |
| CD4053BPWG4 | ACTIVE | TSSOP | PW | 16 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM053B | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| CD4053BPWR | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU CU SN | Level-1-260C-UNLIM | -55 to 125 | CM053B | Samples |
| CD4053BPWRG3 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -55 to 125 | CM053B | Samples |
| CD4053BPWRG4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM053B | 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) 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.

(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/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF CD4051B, CD4051B-MIL, CD4052B, CD4052B-MIL, CD4053B, CD4053B-MIL :

- Catalog: [CD4051B](#), [CD4052B](#), [CD4053B](#)
- Automotive: [CD4051B-Q1](#), [CD4051B-Q1](#), [CD4053B-Q1](#), [CD4053B-Q1](#)
- Military: [CD4051B-MIL](#), [CD4052B-MIL](#), [CD4053B-MIL](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Military - QML certified for Military and Defense Applications

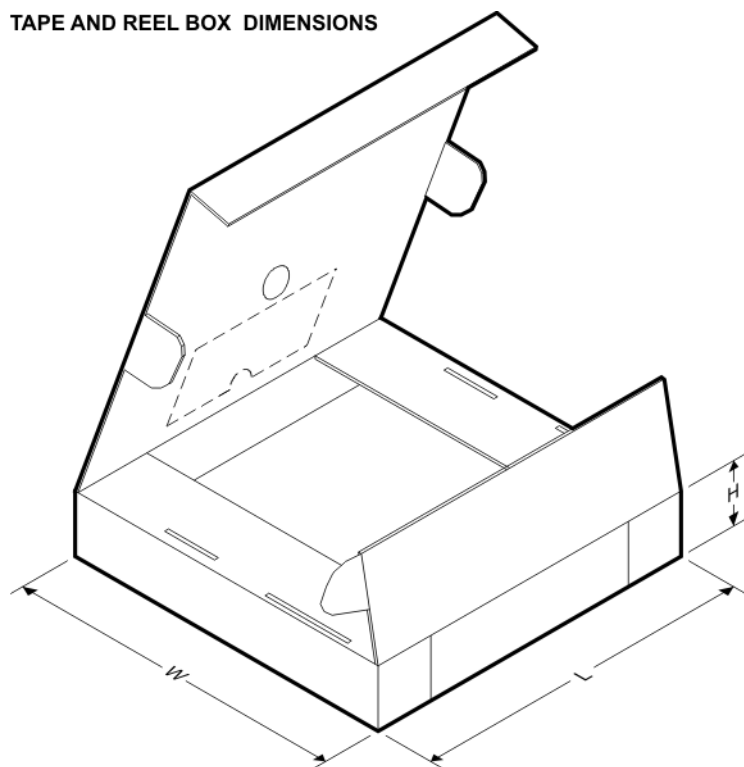
TAPE AND REEL INFORMATION


*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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD4051BM96 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4051BM96 | SOIC | D | 16 | 2500 | 330.0 | 16.8 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4051BM96 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4051BM96G3 | SOIC | D | 16 | 2500 | 330.0 | 16.8 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4051BM96G4 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4051BM96G4 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4051BPWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD4051BPWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD4051BPWRG4 | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD4052BM96 | SOIC | D | 16 | 2500 | 330.0 | 16.8 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4052BM96G3 | SOIC | D | 16 | 2500 | 330.0 | 16.8 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4052BM96G4 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4052BPWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD4052BPWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD4052BPWRG3 | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD4052BPWRG4 | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD4053BM96 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4053BM96 | SOIC | D | 16 | 2500 | 330.0 | 16.8 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |

| 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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD4053BM96G3 | SOIC | D | 16 | 2500 | 330.0 | 16.8 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4053BM96G4 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| CD4053BPWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD4053BPWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD4053BPWRG3 | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD4053BPWRG4 | 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) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD4051BM96 | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| CD4051BM96 | SOIC | D | 16 | 2500 | 364.0 | 364.0 | 27.0 |
| CD4051BM96 | SOIC | D | 16 | 2500 | 367.0 | 367.0 | 38.0 |
| CD4051BM96G3 | SOIC | D | 16 | 2500 | 364.0 | 364.0 | 27.0 |
| CD4051BM96G4 | SOIC | D | 16 | 2500 | 367.0 | 367.0 | 38.0 |
| CD4051BM96G4 | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| CD4051BPWR | TSSOP | PW | 16 | 2000 | 364.0 | 364.0 | 27.0 |
| CD4051BPWR | TSSOP | PW | 16 | 2000 | 367.0 | 367.0 | 35.0 |
| CD4051BPWRG4 | TSSOP | PW | 16 | 2000 | 367.0 | 367.0 | 35.0 |
| CD4052BM96 | SOIC | D | 16 | 2500 | 364.0 | 364.0 | 27.0 |
| CD4052BM96G3 | SOIC | D | 16 | 2500 | 364.0 | 364.0 | 27.0 |

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD4052BM96G4 | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| CD4052BPWR | TSSOP | PW | 16 | 2000 | 367.0 | 367.0 | 35.0 |
| CD4052BPWR | TSSOP | PW | 16 | 2000 | 364.0 | 364.0 | 27.0 |
| CD4052BPWRG3 | TSSOP | PW | 16 | 2000 | 364.0 | 364.0 | 27.0 |
| CD4052BPWRG4 | TSSOP | PW | 16 | 2000 | 367.0 | 367.0 | 35.0 |
| CD4053BM96 | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| CD4053BM96 | SOIC | D | 16 | 2500 | 364.0 | 364.0 | 27.0 |
| CD4053BM96G3 | SOIC | D | 16 | 2500 | 364.0 | 364.0 | 27.0 |
| CD4053BM96G4 | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| CD4053BPWR | TSSOP | PW | 16 | 2000 | 367.0 | 367.0 | 35.0 |
| CD4053BPWR | TSSOP | PW | 16 | 2000 | 364.0 | 364.0 | 27.0 |
| CD4053BPWRG3 | TSSOP | PW | 16 | 2000 | 364.0 | 364.0 | 27.0 |
| CD4053BPWRG4 | TSSOP | PW | 16 | 2000 | 367.0 | 367.0 | 35.0 |

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



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



4040083/F 03/03

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

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 |



14/18 Pin Only
20 Pin vendor option

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.

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:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - 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 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G16)

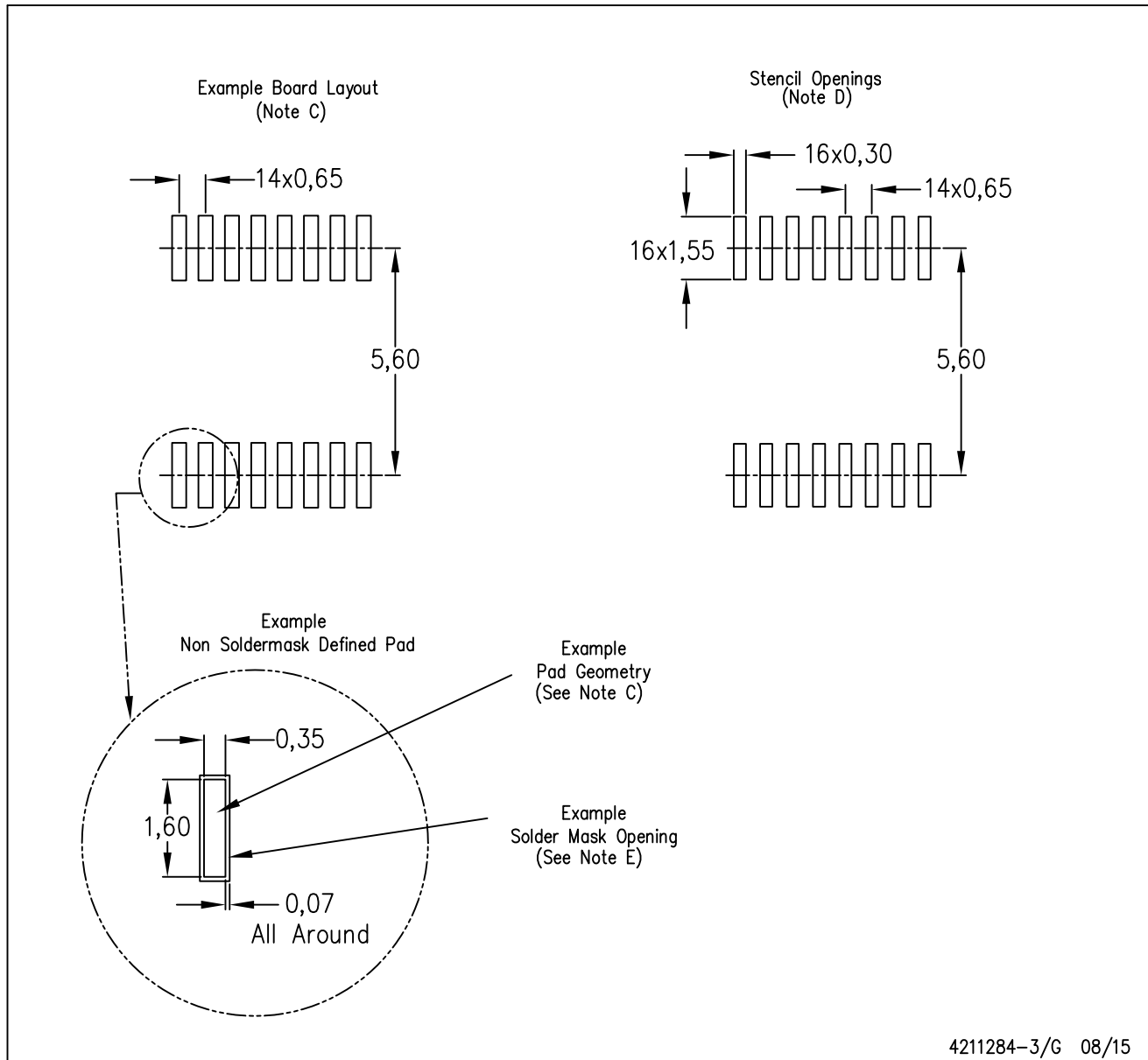
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - Δ C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
 - Δ D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

PW (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.

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.

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