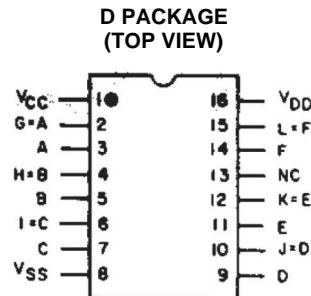


CMOS HEX BUFFER/CONVERTER

 Check for Samples: [CD4010B-Q1](#)

FEATURES

- Qualified for Automotive Applications
- 100% Tested for Quiescent Current at 20 V
- Maximum Input Current of 1 μ A at 18 V Over Full Package-Temperature Range:
100 nA at 18 V and 25°C
- 5-V, 10-V, and 15-V Parametric Ratings
- Latch-Up Performance Meets 100 mA per JESD 78, Class I



APPLICATIONS

- CMOS to DTL/TTL Hex Converter
- CMOS Current "Sink" or "Source" Driver
- CMOS High-to-Low Logic-Level Converter
- Multiplexer: 1-to-6 or 6-to-1

DESCRIPTION

CD4010B hex buffer/converter may be used as CMOS to TTL or DTL logic-level converters or CMOS high-sink-current drivers.

The CD4050B is the preferred hex buffer replacement for the CD4010B in all applications except multiplexers. For applications not requiring high sink current or voltage conversion, the CD4069UB hex inverter is recommended.

The CD4010B is supplied in 16-lead hermetic dual-in-line ceramic (D) packages.

ORDERING INFORMATION⁽¹⁾

T _A	PACKAGE ⁽²⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 125°C	SOIC – D	Reel of 2500	CD4010BQDRQ1	CD4010BQ

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.

(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.



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



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.

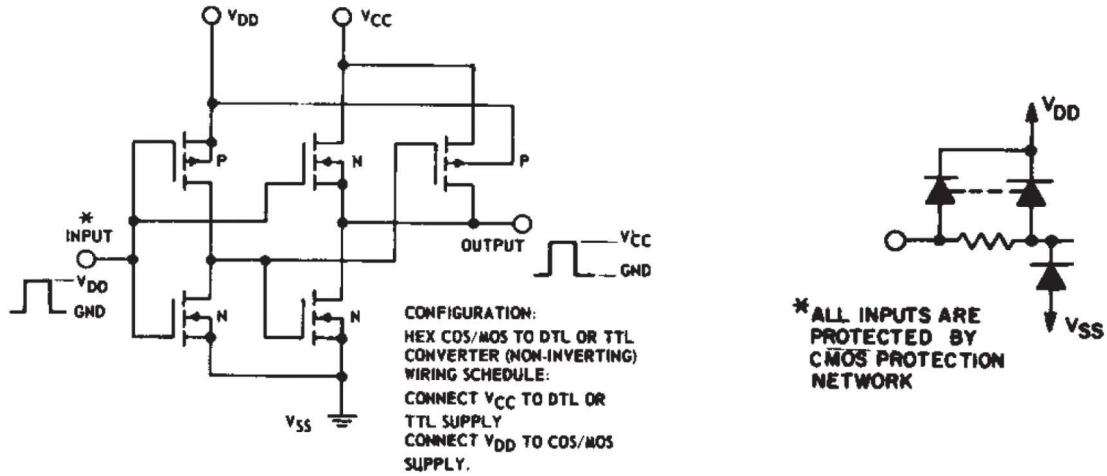
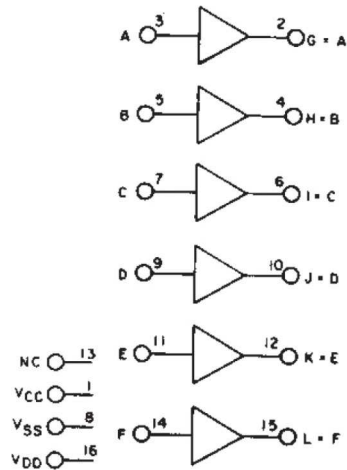


Figure 1. Schematic Diagram – One of Six Identical Stages

Functional Diagram



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

		VALUE	UNIT
V_{DD}	DC supply voltage range, voltages referenced to V_{SS} terminal	–0.5 to +20	V
	Input voltage range, all inputs	–0.5 to $V_{DD} + 0.5$	V
	DC input current, any one input	±10	mA
P_D	Power dissipation per package	$T_A = -40^\circ\text{C}$ to $+100^\circ\text{C}$	500
		$T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$	Derate linearly at 12 mW/°C to 200 mW
	Device dissipation per output transistor	$T_A =$ full package-temperature range (all packages types)	100
T_A	Operating temperature range	–40 to +125	°C
T_{stg}	Storage temperature range	–65 to +150	°C
	Latch-up performance per JESD 78, Class I	100	mA
ESD	Electrostatic discharge rating ⁽²⁾	Human-body model (HBM)	500
		Machine model (MM)	100
		Charged-Device Model (CDM)	1000

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) Tested in accordance with AEC-Q100.

RECOMMENDED OPERATING CONDITIONS

		MIN	MAX	UNIT
V_{DD}	Supply voltage range ⁽¹⁾	3	18	V
V_{CC}		3	V_{DD}	
V_I	Input voltage range	V_{CC}	V_{DD}	V

(1) The CD4010B has high-to-low level voltage conversion capability, but not low-to-high level; therefore, it is recommended that $V_{DD} > V_I > V_{CC}$.

STATIC ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)						UNIT
	V _O	V _{IN}	V _{DD}	-40	+85	+125	+25			
							MIN	TYP	MAX	
I _{DD} Max Quiescent device current		0, 5	5	1	30	30	0.02			μA
		0, 10	10	2	60	60	0.02			
		0, 15	15	4	120	120	0.02			
		0,20	20	20	600	600	0.04			
I _{OL} Min Output low (sink) current	0.4	0, 5	4.5	3.1	2.1	1.8	2.6	3.4		mA
	0.4	0, 5	5	3.6	2.4	2.1	3	4		
	0.5	0, 10	10	9.6	6.4	5.6	8	10		
	1.5	0, 15	15	40	19	16	24	36		
I _{OH} Min Output high (source) current	4.6	0, 5	5	-0.23	-0.18	-0.15	-0.2	-0.4		mA
	2.5	0, 5	5	-0.9	-0.65	-0.58	-0.8	-1.6		
	9.5	0, 10	10	-0.5	-0.38	-0.33	-0.45	-0.9		
	13.5	0, 15	15	-1.6	-1.25	-1.1	-1.5	-3		
V _{OL} Max Output voltage: Low-level		0, 5	5	0.05			0	0.05		V
		0, 10	10	0.05			0	0.05		
		0, 15	15	0.05			0	0.05		
V _{OH} Min Output voltage: High-level		0, 5	5	4.95			4.95	5		V
		0, 10	10	9.95			9.95	10		
		0, 15	15	14.95			14.95	15		
V _{IL} Max Input low voltage	0.5		5	1.5				1.5		V
	1		10	3				3		
	1.5		15	4				4		
V _{IH} Min Input high voltage	4.5		5	3.5			3.5		V	
	9		10	7			7			
	13.5		15	11			11			
I _{IN} Max Input current		0, 18	18	±0.1	±1	±1	±10 ⁻⁵		±0.1	μA

DYNAMIC ELECTRICAL CHARACTERISTICS
 $T_A = 25^\circ\text{C}$, Input $t_r/t_f = 20\text{ ns}$, $C_L = 50\text{ pf}$, $R_L = 200\text{ k}\Omega$

PARAMETER	TEST CONDITIONS			LIMITS ALL PKGS		UNIT
	V_{DD} (V)	V_I (V)	V_{CC} (V)	TYP	MAX	
t_{PLH} Propagation delay time: low-to-high	5	5	5	100	200	ns
	10	10	10	50	100	
	10	10	5	50	100	
	15	15	15	35	70	
	15	15	5	35	70	
t_{PHL} Propagation time: high-to-low	5	5	5	65	130	ns
	10	10	10	35	70	
	10	10	5	30	70	
	15	15	15	25	50	
	15	15	5	20	40	
t_{TLH} Transition time: low-to-high	5	5	5	150	350	ns
	10	10	10	75	150	
	15	15	15	55	110	
t_{THL} Transition time: high-to-low	5	5	5	35	90	ns
	10	10	10	20	45	
	15	15	15	15	40	
C_{IN} Input capacitance				5	7.5	pF

TYPICAL CHARACTERISTICS

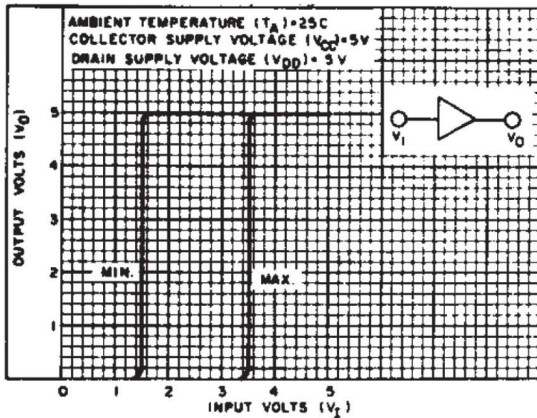


Figure 2. Minimum and Maximum Voltage Transfer Characteristics ($V_{DD} = 5\text{ V}$)

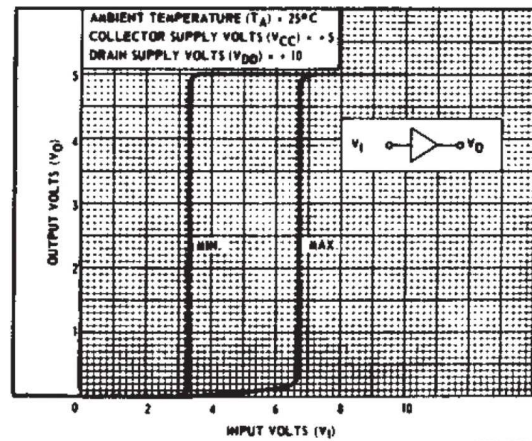


Figure 3. Minimum and Maximum Voltage Transfer Characteristics ($V_{DD} = 10\text{ V}$)

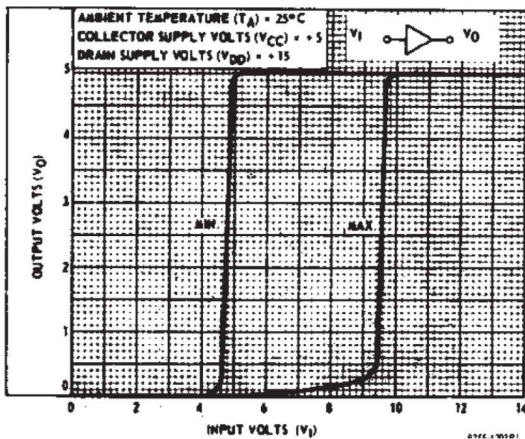


Figure 4. Minimum and Maximum Voltage Transfer Characteristics ($V_{DD} = 15\text{ V}$)

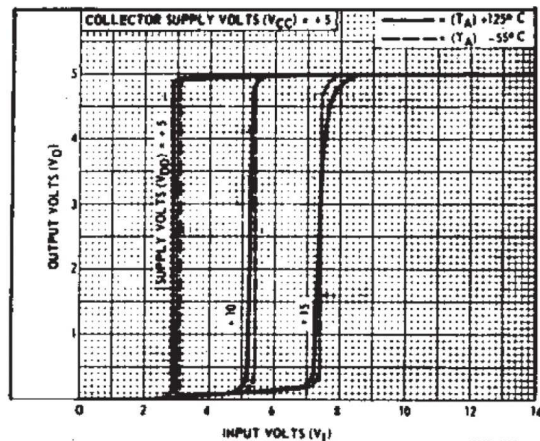


Figure 5. Typical Voltage Transfer Characteristics as a Function of Temperature

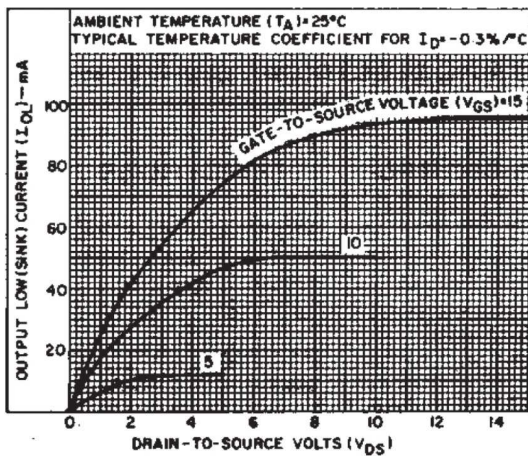


Figure 6. Typical Output Low (Sink) Current Characteristics

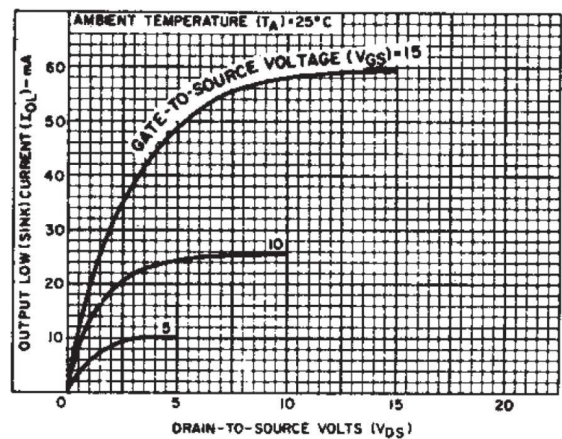


Figure 7. Minimum Output Low (Sink) Current Characteristics

TYPICAL CHARACTERISTICS (continued)

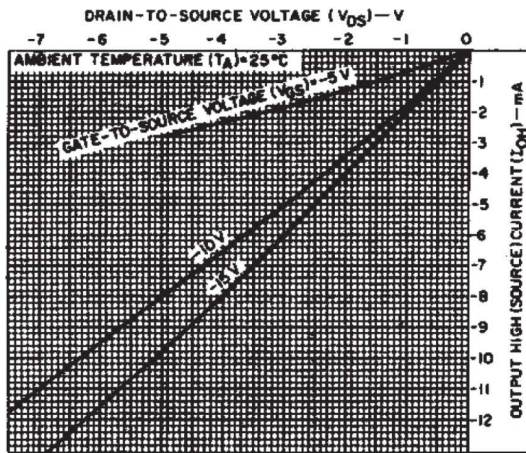


Figure 8. Typical Output High (Source) Current Characteristics

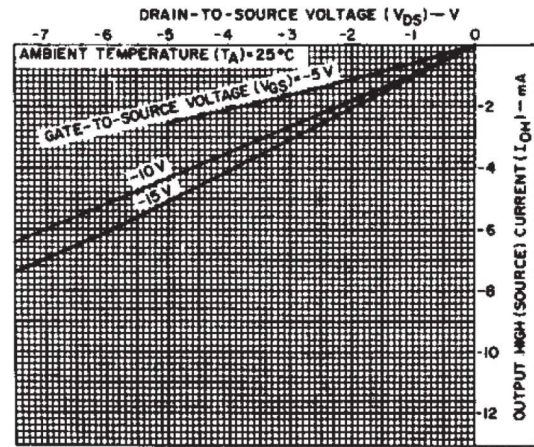


Figure 9. Minimum Output High (Source) Current Characteristics

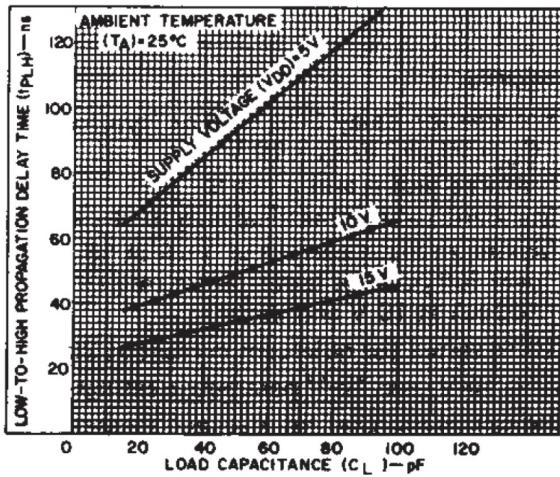


Figure 10. Typical Low-to-High Propagation Delay Time vs Load Capacitance

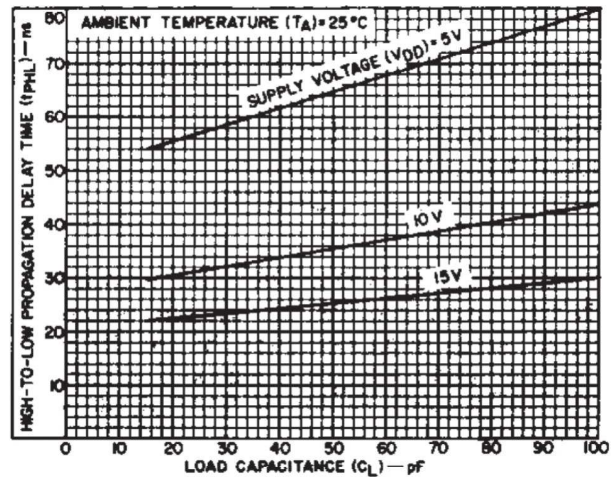


Figure 11. Typical High-to-Low Propagation Delay Time vs Load Capacitance

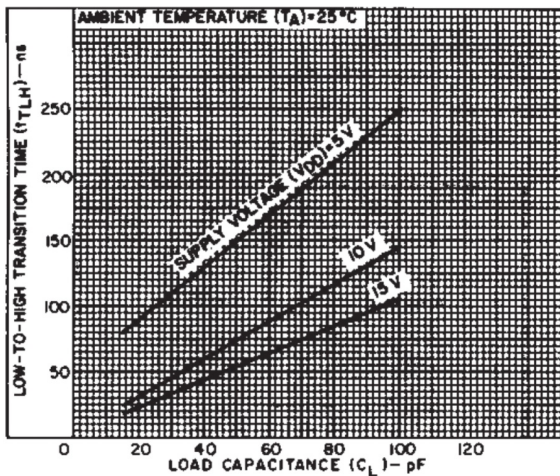


Figure 12. Typical Low-to-High Transition Time vs Load Capacitance

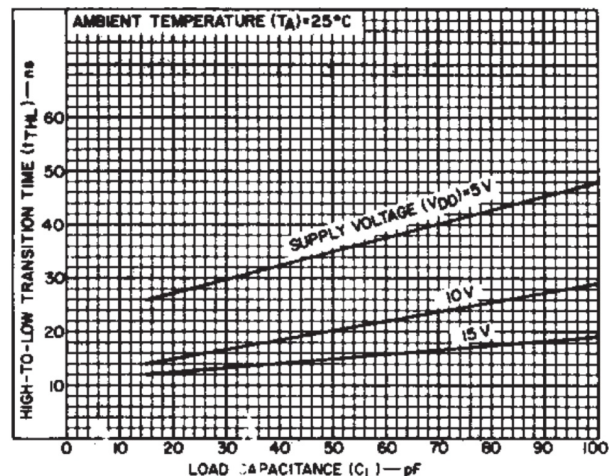


Figure 13. Typical High-to-Low Transition Time vs Load Capacitance

TYPICAL CHARACTERISTICS (continued)

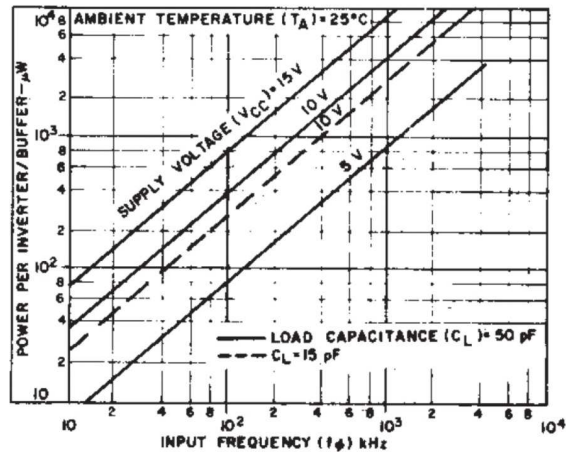


Figure 14. Typical Dissipation Characteristics

PARAMETER MEASUREMENT INFORMATION

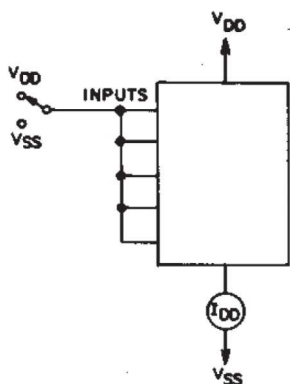


Figure 15. Quiescent Device Current Test Circuit

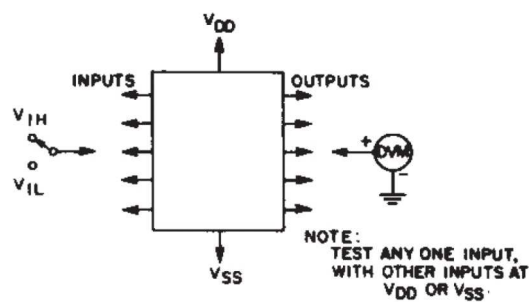


Figure 16. Noise Immunity Test Circuit

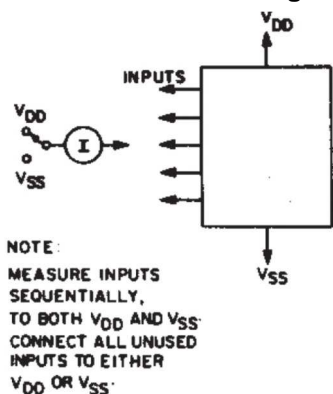
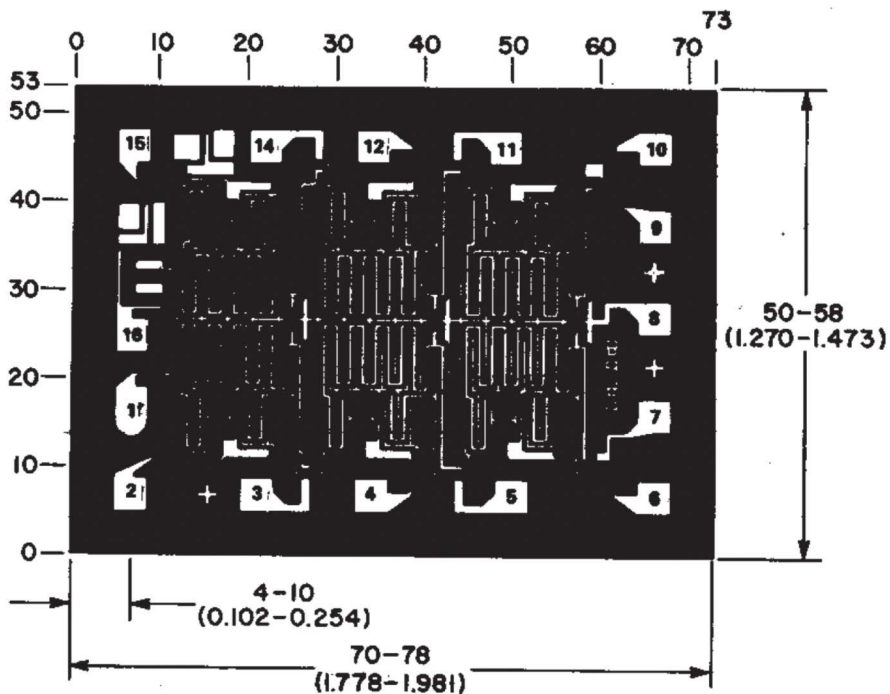


Figure 17. Input Current Test Circuit



Note: Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduation are in mils (10^{-3} inch).

Figure 18. Dimensions and Layout

REVISION HISTORY

Changes from Original (March 2010) to Revision A	Page
• Changed STATIC ELECTRICAL CHARACTERISTICS table to correct typos and misplaced data	4

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
CD4010BQDRQ1	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

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

ACTIVE: Product device recommended for new designs.

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

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

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

OBSOLETE: TI has discontinued the production of the device.

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

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

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

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

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

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

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF CD4010B-Q1 :

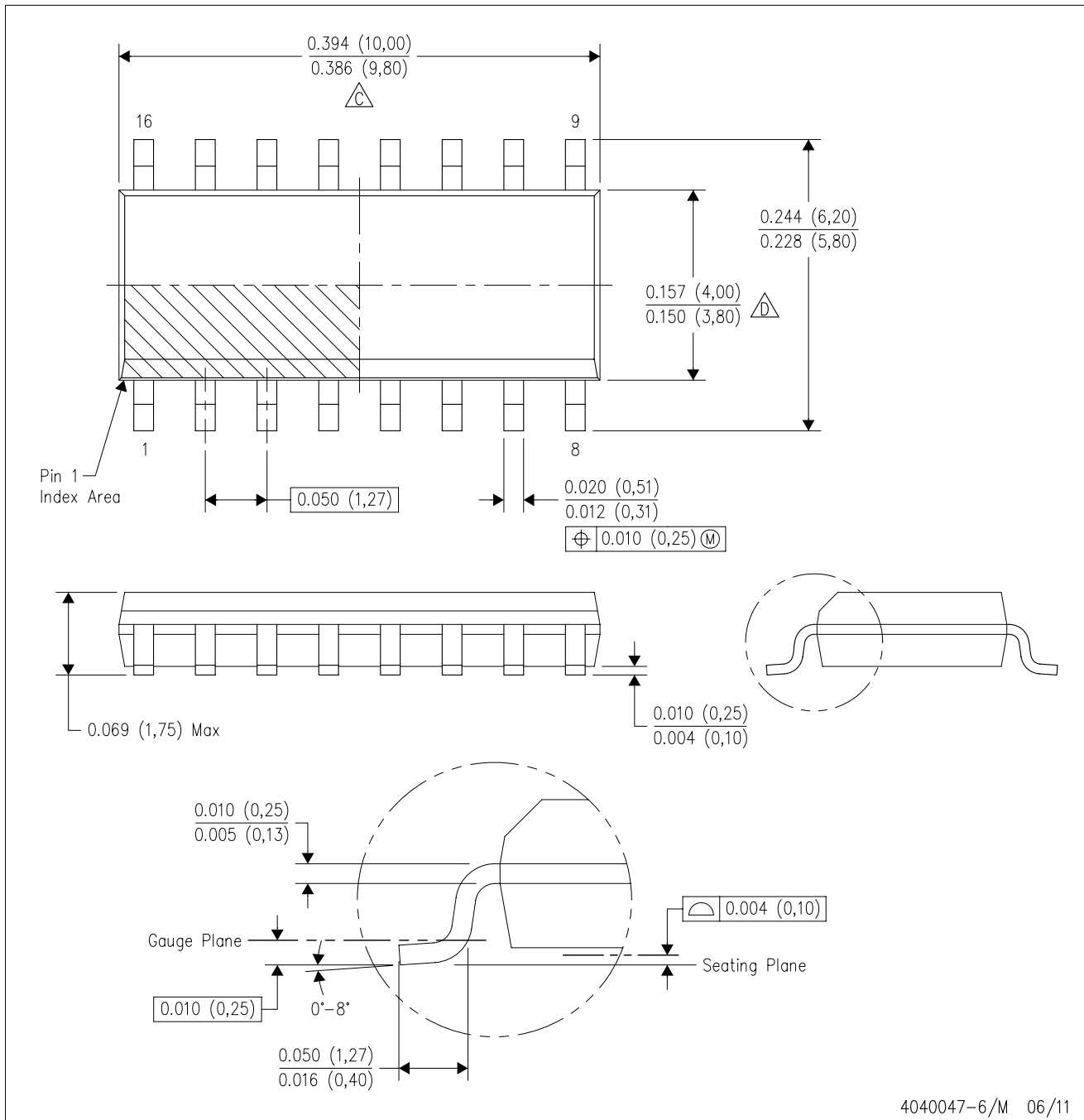
- Catalog: [CD4010B](#)
- Military: [CD4010B-MIL](#)

NOTE: Qualified Version Definitions:



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

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE

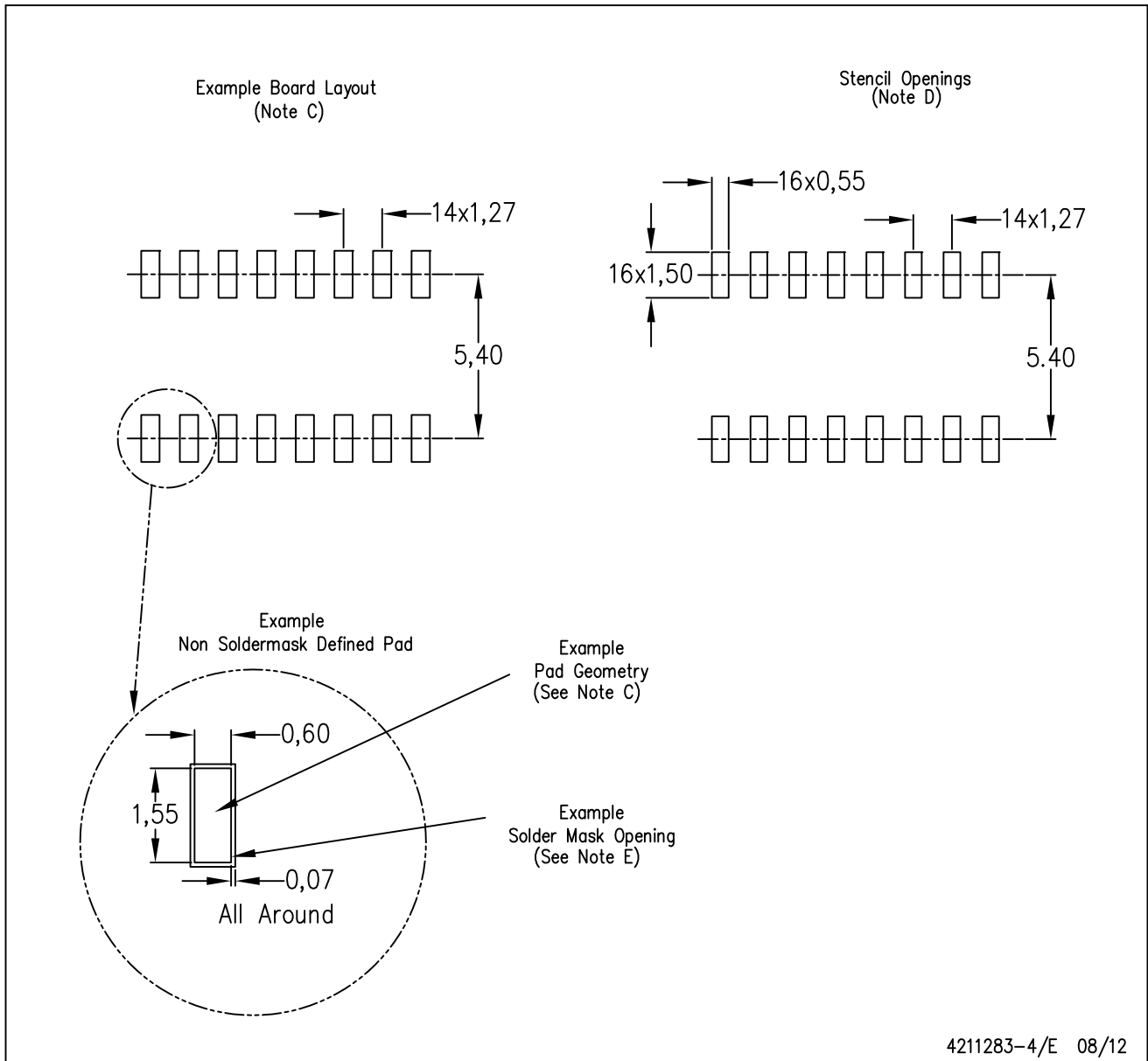


4040047-6/M 06/11

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

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



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

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com