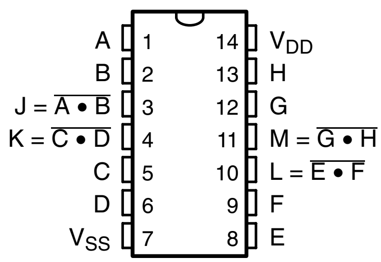
- **Qualified for Automotive Applications**
- **Schmitt-Trigger Action on Each Input With No External Components**
- **Hysteresis Voltage Typically 0.9 V at V_{DD} = 5 V and 2.3 V at V_{DD} = 10 V**
- **Noise Immunity Greater Than 50%**
- **No Limit on Input Rise and Fall Times**
- **Standardized, Symmetrical Output Characteristics**
- **100% Tested for Quiescent Current at 20 V**
- **Maximum Input Current of 1µA 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**
- **ESD Protection Level Per AEC-Q100 Classification**
  - **2000-V (H2) Human-Body Model**
  - **200-V (M3) Machine-Model**
  - **1000-V (C5) Charge-Device Model**
- **Applications**
  - **Wave and Pulse Shapers**
  - **High-Noise-Environment Systems**
  - **Monostable Multivibrators**
  - **Astable Multivibrators**
  - **NAND Logic**

M PACKAGE
(TOP VIEW)



description/ordering information

The CD4093B consists of four Schmitt-trigger circuits. Each circuit functions as a two-input NAND gate, with Schmitt-trigger action on both inputs. The gate switches at different points for positive- and negative-going signals. The difference between the positive voltage (V_P) and the negative voltage (V_N) is defined as hysteresis voltage (V_H) (see Figure 2).

The CD4093B is available in 14-lead small-outline plastic package (M96) and 14-lead thin shrink small-outline packages (PWR suffixes).

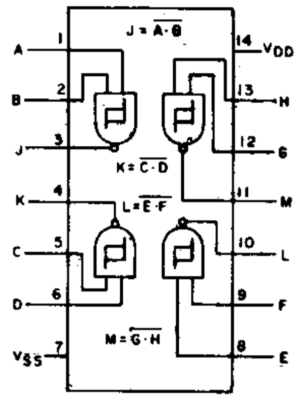
ORDERING INFORMATION†

T_A	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	SOIC (M)	Reel of 2000	CD4093BQM96Q1	CD4093BQ

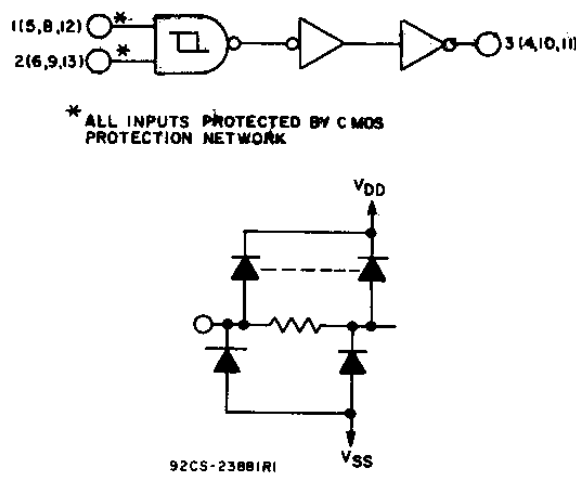
† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at http://www.ti.com.
‡ Package drawings, thermal data, and symbolization are available at http://www.ti.com/packaging.

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

functional block diagram



logic diagram



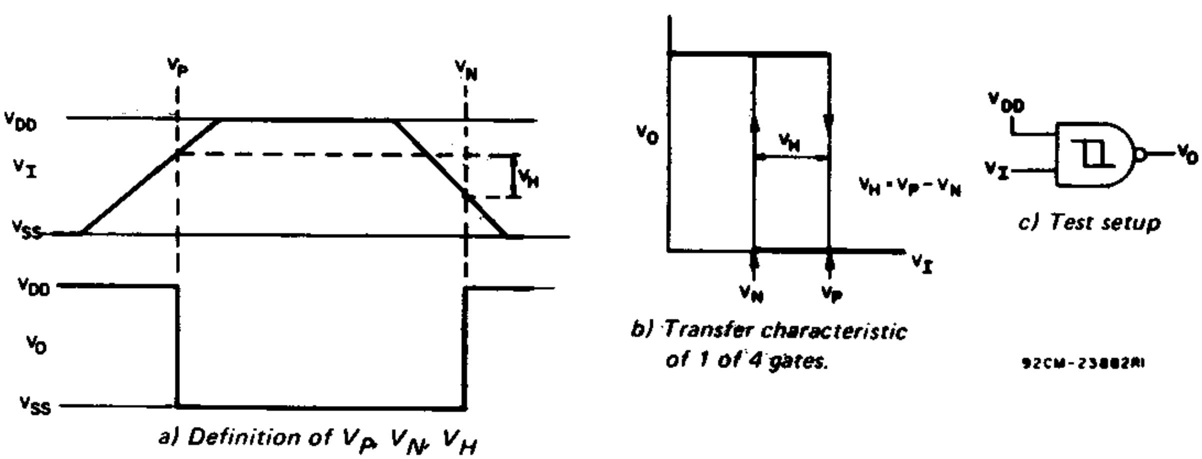


Figure 1. Hysteresis Definition, Characteristic, and Test Setup

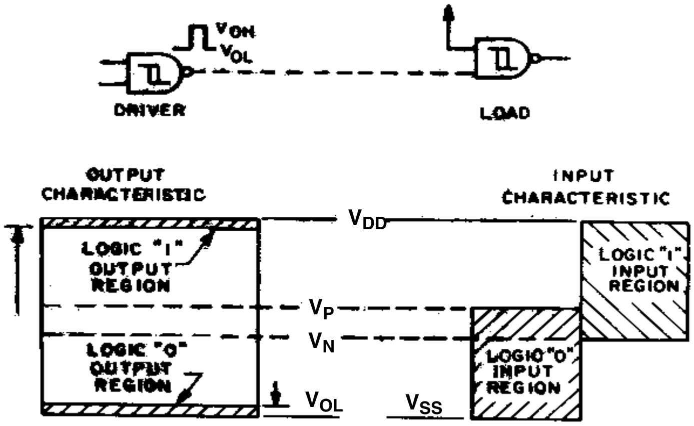


Figure 2. Input and Output Characteristics

TYPICAL CHARACTERISTICS

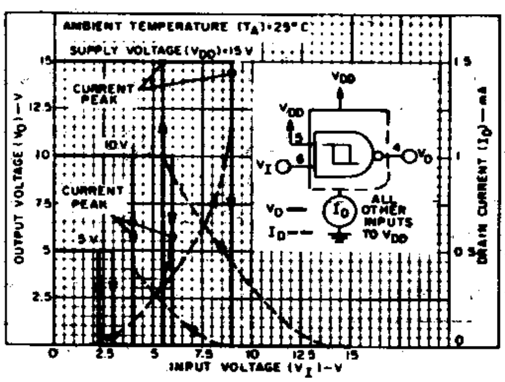


Figure 3. Typical Current and Voltage Transfer Characteristics

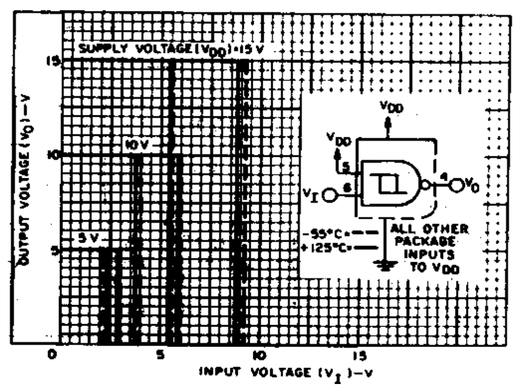


Figure 4. Typical Voltage Transfer Characteristics as a Function of Temperature

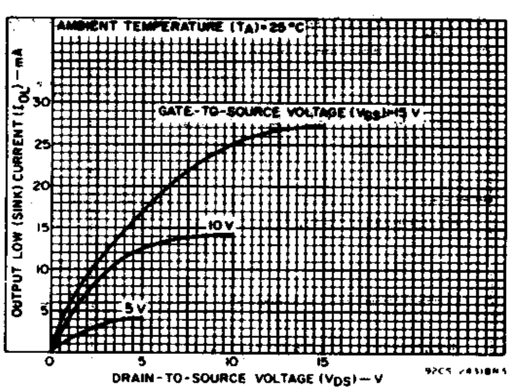


Figure 5. Typical Output Low (Sink) Current Characteristics

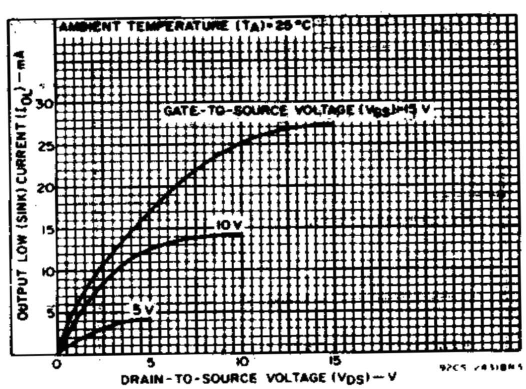


Figure 6. Minimum Output Low (Sink) Current Characteristics

TYPICAL CHARACTERISTICS

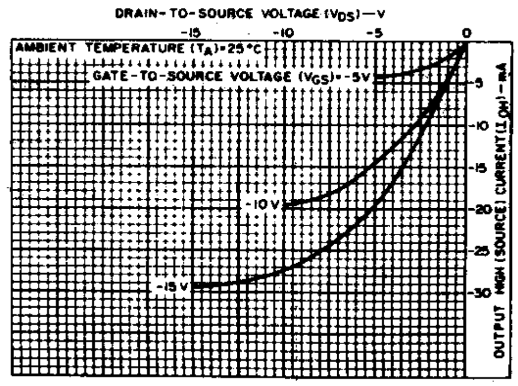


Figure 7. Typical Output High (Source) Current Characteristics

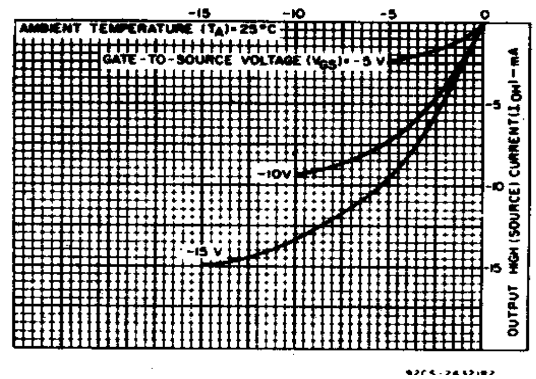


Figure 8. Minimum Output High (Source) Current Characteristics

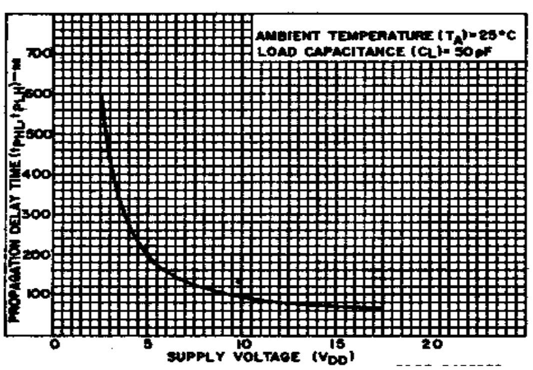


Figure 9. Typical Propagation Delay Time vs Supply Voltage

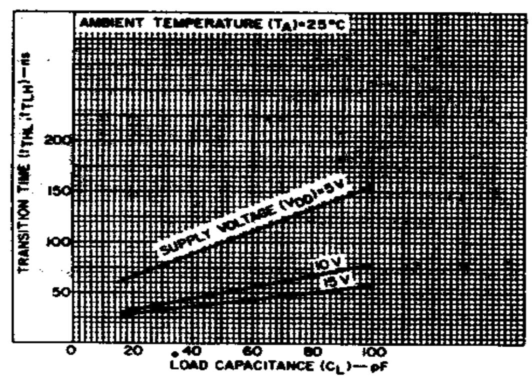


Figure 10. Typical Transition Time vs Load Capacitance

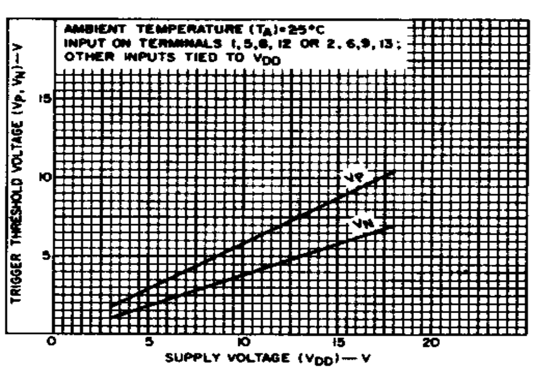


Figure 11. Typical Trigger Threshold Voltage vs V_{DD}

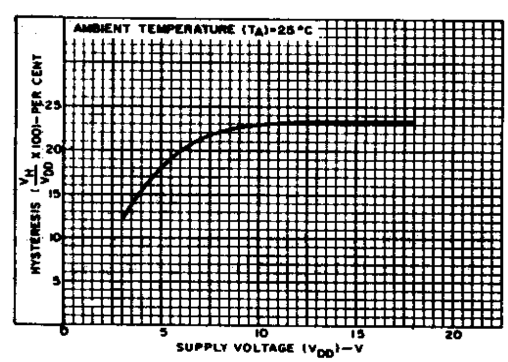


Figure 12. Typical Percent Hysteresis vs Supply Voltage

TYPICAL CHARACTERISTICS

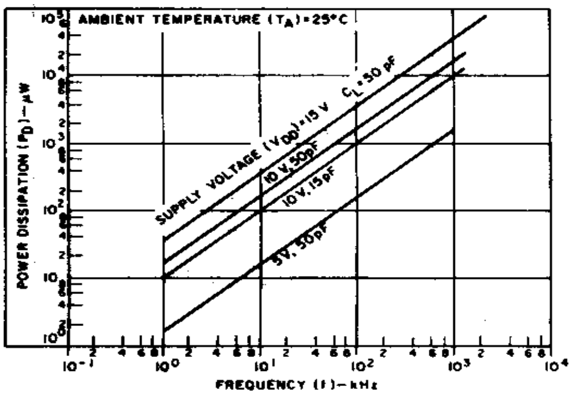


Figure 13. Typical Power Dissipation vs Frequency Characteristics

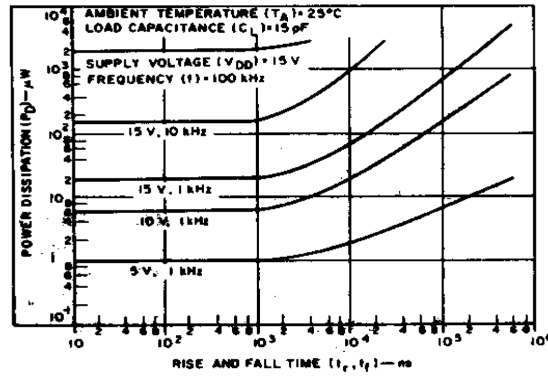


Figure 14. Typical Power Dissipation vs Rise and Fall Times

APPLICATION INFORMATION

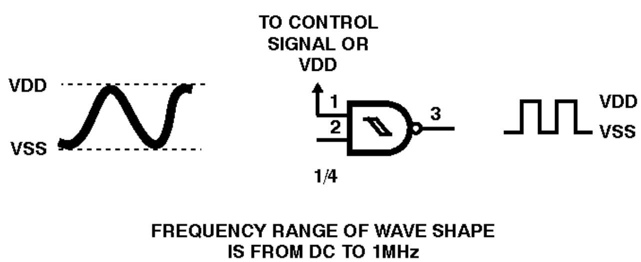


Figure 15. Wave Shaper

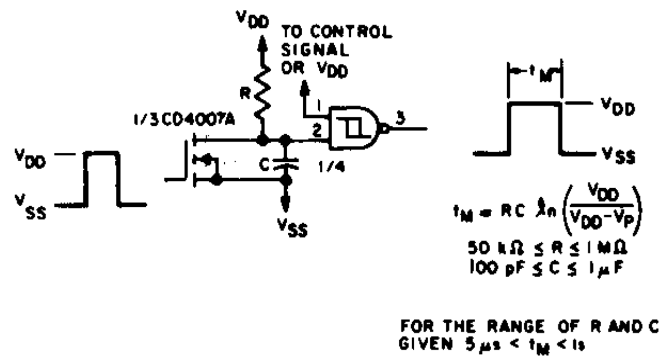
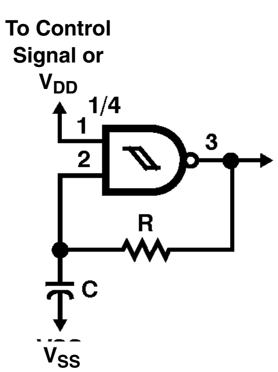
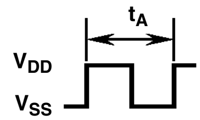


Figure 16. Monostable Multivibrator





$$t_A = RC\ell n\left[\left(\frac{V_P}{V_N}\right)\left(\frac{V_{DD-V_N}}{V_{DD-V_P}}\right)\right]$$

50 kΩ ≤ R ≤ 1 MΩ
100 pF ≤ C ≤ 1 µF
For the Range of R and C
Given 2 ms < t_A < 0.4 s

Figure 17. Astable Multivibrator

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

DC supply voltage range, V_{DD} . . . . –0.5 V to 20 V
Input voltage range, V_I, all inputs . . . . –0.5 V to V_{DD} + 0.5 V
DC input current, any one input . . . . ±10 mA
Package thermal impedance, θ_{JA} (see Note 1) . . . . 86°C/W
Device dissipation per output transistor for T_A, all package types . . . . 100 mW
Operating temperature range, T_A . . . . –40°C to 125°C
Storage temperature range, T_{stg} . . . . –65°C to 150°C

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

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions‡

		MIN	MAX	UNIT
V_{CC}	Supply voltage range (T_A = full package temperature range)	3	18	V

‡ For maximum reliability, nominal operating conditions should be selected so that operation is always within the given range.

static electrical characteristics

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)						UNIT
	V_O (V)	V_I (V)	V_{DD} (V)	−40	85	125	25 MIN	25 TYP†	25 MAX	
Quiescent device current, I_{DD} max		0,5	5	1	30	30		0.02	1	μA
		0,10	10	2	60	60		0.02	2	
		0,15	15	4	120	120		0.02	4	
		0,20	20	20	600	600		0.04	20	
Positive trigger theshold voltage, V_P min		A	5	2.2	2.2	2.2	2.2	2.9		V
		A	10	4.6	4.6	4.6	4.6	5.9		
		A	15	6.8	6.8	6.8	6.8	8.8		
		B	5	2.6	2.6	2.6	2.6	3.3		
		B	10	5.6	5.6	5.6	5.6	7		
		B	15	6.3	6.3	6.3	6.3	9.4		
V_P max		A	5	3.6	3.6	3.6		2.9	3.6	V
		A	10	7.1	7.1	7.1		5.9	7.1	
		A	15	10.8	10.8	10.8		8.8	10.8	
		B	5	4	4	4		3.3	4	
		B	10	8.2	8.2	8.2		7	8.2	
		B	15	12.7	12.7	12.7		9.4	12.7	
Negative trigger threshold voltage, V_N min		A	5	0.9	0.9	0.9	0.9	1.9		V
		A	10	2.5	2.5	2.5	2.5	3.9		
		A	15	4	4	4	4	5.8		
		B	5	1.4	1.4	1.4	1.4	2.3		
		B	10	3.4	3.4	3.4	3.4	5.1		
		B	15	4.8	4.8	4.8	4.8	7.3		
V_N max		A	5	2.8	2.8	2.8		1.9	2.8	V
		A	10	5.2	5.2	5.2		3.9	5.2	
		A	15	7.4	7.4	7.4		5.8	7.4	
		B	5	3.2	3.2	3.2		2.3	3.2	
		B	10	6.6	6.6	6.6		5.1	6.6	
		B	15	9.6	9.6	9.6		7.3	9.6	
Hysteresis voltage, V_H min		A	5	0.3	0.3	0.3	0.3	0.9		V
		A	10	1.2	1.2	1.2	1.2	2.3		
		A	15	1.6	1.6	1.6	1.6	3.5		
		B	5	0.3	0.3	0.3	0.3	0.9		
		B	10	1.2	1.2	1.2	1.2	2.3		
		B	15	1.6	1.6	1.6	1.6	3.5		
V_H max		A	5	1.6	1.6	1.6		0.9	1.6	V
		A	10	3.4	3.4	3.4		2.3	3.4	
		A	15	5	5	5		3.5	5	
		B	5	1.6	1.6	1.6		0.9	1.6	
		B	10	3.4	3.4	3.4		2.3	3.4	
		B	15	5	5	5		3.5	5	

NOTES: A. Inputs on terminals 1, 5, 8, 12 or 2, 6, 9, 13; other inputs to V_{DD}.
B. Inputs on terminals 1 and 2, 5 and 6, 8 and 9, or 12 and 13; other inputs to V_{DD}.

static electrical characteristics (continued)

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)						UNIT
	V_O (V)	V_I (V)	V_{DD} (V)	–40	85	125	25			
							MIN	TYP†	MAX	
Output low (sink) current, I_{OL} min	0.4	0,5	5	0.61	0.42	0.36	0.51	1		mA
	0.5	0,10	10	1.5	1.1	0.9	1.3	2.6		
	1.5	0,15	15	4	2.8	2.4	3.4	6.8		
Output high (source) current, I_{OH} min	4.6	0,5	5	–0.61	–0.42	–0.36	–0.51	–1		mA
	2.5	0,5	5	–1.8	–1.3	–1.15	–1.6	–3.2		
	9.5	0,10	10	–1.5	–1.1	–0.9	–1.3	–2.6		
	13.5	0,15	15	–4	–2.8	–2.4	–3.4	–6.8		
Output voltage low level, V_{OL} max		0,5	5	0.05	0.05	0.05		0	0.05	V
		0,10	10	0.05	0.05	0.05		0	0.05	
		0,15	15	0.05	0.05	0.05		0	0.05	
Output voltage high level, V_{OH} min		0,5	5	4.95	4.95	4.95	4.95	5		V
		0,10	10	9.95	9.95	9.95	9.95	10		
		0,15	15	14.95	14.95	14.95	14.95			
Input current, I_{IN} max		0,18	18	±0.1	±1	±1		$\pm10^{-5}$	±0.1	µA

dynamic electrical characteristics

T_A = 25°C, input t_r, t_f = 20 ns, C_L = 50 pF, R_L = 200 kΩ

CHARACTERISTIC	TEST CONDITIONS	V_{DD} (V)	LIMITS			UNIT
			MIN	TYP	MAX	
Propagation delay time, t_{PHL}, t_{PLH}		5		190	380	ns
		10		90	180	
		15		65	130	
Transition time, t_{THL}, t_{TLH}		5		100	200	ns
		10		50	100	
		15		40	80	
Input capacitance, C_{IN}	Any Input			5	7.5	pF

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
CD4093BQM96G4Q1	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4093BQM96Q1	ACTIVE	SOIC	D	14	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.

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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.

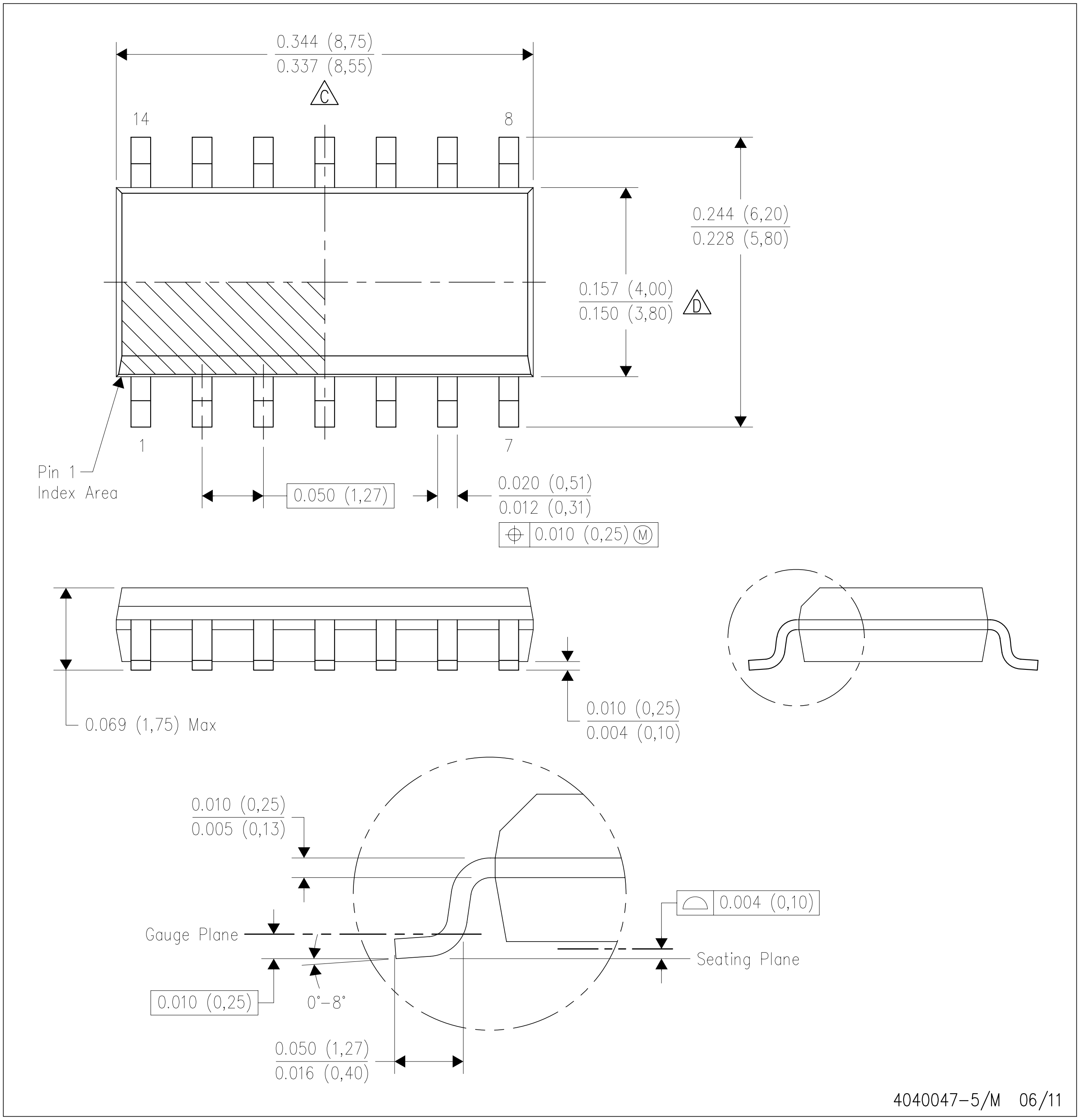
OTHER QUALIFIED VERSIONS OF CD4093B-Q1 :

- Catalog: CD4093B
- Military: CD4093B-MIL

NOTE: Qualified Version Definitions:

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

D (R–PDSO–G14) 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 AB.

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Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

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- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

Как с нами связаться

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