CD4063B Types

CMOS 4-Bit Magnitude Comparator

High Voltage Types (20-Volt Rating)

■ CD4063B is a 4-bit magnitude comparator designed for use in computer and logic applications that require the comparison of two 4-bit words. This logic circuit determines whether one 4-bit word (Binary or BCD) is "less than", "equal to", or "greater than" a second 4-bit word.

The CD4063B has eight comparing inputs (A3, B3, through A0, B0), three outputs (A < B, A = B, A > B) and three cascading inputs (A < B, A = B, A > B) that permit systems designers to expand the comparator function to 8, 12, 16 . . . 4N bits. When a single CD4063B is used, the cascading inputs are connected as follows: (A < B) = low, (A = B) = high, (A > B) = low.

For words longer than 4 bits, CD4063B devices may be cascaded by connecting the outputs of the less-significant comparator to the corresponding cascading inputs of the more-significant comparator. Cascading inputs (A < B, A = B, and A > B) on the least significant comparator are connected to a low, a high, and a low level, respectively.

The CD4063B types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (M, M96, MT, and NSR suffixes), and 16-lead thin shrink small-outline packages (PW and PWR suffixes). This device is pin-compatible with the standard 7485 TTL type.

Features:

■ Expansion to 8, 12, 16....4N bits by cascading units
■ Medium-speed operation:
  compares two 4-bit words
  in 250 ns (typ.) at 10 V
■ 100% tested for quiescent current at 20 V
■ Standardized symmetrical output characteristics
■ 5-V, 10-V, and 15-V parametric ratings
■ Maximum input current of 1 μA at 18 V over full package temperature range; 100 nA at 18 V and 25°C
■ Noise margin (full package temperature range) range) = 1 V at V_{DD} = 5 V
  2 V at V_{DD} = 10 V
  2.5 V at V_{DD} = 15 V
■ Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

*Applications:*

■ Servo motor controls   ■ Process controllers

FUNCTIONAL DIAGRAM

(TOP VIEW)
92CS-24523
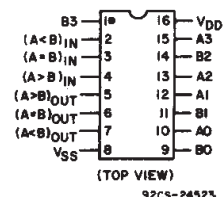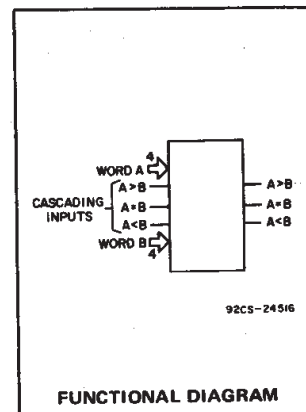
TERMINAL ASSIGNMENT

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC SUPPLY–VOLTAGE RANGE, (V_{DD})
  Voltages referenced to V_{SS} Terminal) .... −0.5V to +20V
INPUT VOLTAGE RANGE, ALL INPUTS .... −0.5V to V_{DD} +0.5V
DC INPUT CURRENT, ANY ONE INPUT .... ±10mA
POWER DISSIPATION PER PACKAGE (P_D):
  For T_A = −55°C to +100°C 500mW
  For T_A = +100°C to +125°C..Derate Linearity at 12mW/°C to 200mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR
  FOR T_A = FULL PACKAGE-TEMPERATURE RANGE (All Package Types)......................... 100mW
OPERATING–TEMPERATURE RANGE (T_A)... −55°C to +125°C
STORAGE TEMPERATURE RANGE (T_{stg}) .... −65°C to +150°C
LEAD TEMPERATURE (DURING SOLDERING):
  At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10s max .... +265°C

RECOMMENDED OPERATING CONDITIONS
For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	LIMITS		UNITS
	Min.	Max.	
Supply-Voltage Range (For T_A=Full Package-Temperature Range)	3	18	V
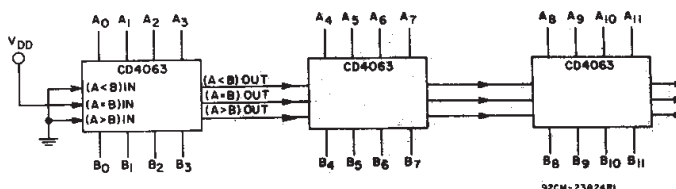
I_P TOTAL = I_P $\binom{COMPARE}{INPUTS}$ + 2 x I_P $\binom{CASCADE}{INPUTS}$, AT V_{DD} = 10V
(3 STAGES)

= 250 +(2 x 200) = 650 ns (TYP.)

Fig. 1 — Typical speed characteristics of a 12-bit comparator.

CD4063B Types

STATIC ELECTRICAL CHARACTERISTICS

CHARACTER-ISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V_O (V)	V_{IN} (V)	V_{DD} (V)	−55	−40	+85	+125	+25 Min.	+25 Typ.	+25 Max.	
Quiescent Device Current, I_{DD} Max.	−	0,5	5	5	5	150	150	−	0.04	5	μA
	−	0,10	10	10	10	300	300	−	0.04	10	
	−	0,15	15	20	20	600	600	−	0.04	20	
	−	0,20	20	100	100	3000	3000	−	0.08	100	
Output Low (Sink) Current I_{OL} Min.	0.4	0,5	5	0.64	0.61	0.42	0.36	0.51	1	−	mA
	0.5	0,10	10	1.6	1.5	1.1	0.9	1.3	2.6	−	
	1.5	0,15	15	4.2	4	2.8	2.4	3.4	6.8	−	
Output High (Source) Current, I_{OH} Min.	4.6	0,5	5	−0.64	−0.61	−0.42	−0.36	−0.51	−1	−	
	2.5	0,5	5	−2	−1.8	−1.3	−1.15	−1.6	−3.2	−	
	9.5	0,10	10	−1.6	−1.5	−1.1	−0.9	−1.3	−2.6	−	
	13.5	0,15	15	−4.2	−4	−2.8	−2.4	−3.4	−6.8	−	
Output Voltage: Low-Level, V_{OL} Max.	−	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	
Output Voltage: High-Level, V_{OH} Min.	−	0,5	5	4.95				4.95	5	−	
	−	0,10	10	9.95				9.95	10	−	
	−	0,15	15	14.95				14.95	15	−	
Input Low Voltage, V_{IL} Max.	0.5, 4.5	−	5	1.5				−	−	1.5	V
	1, 9	−	10	3				−	−	3	
	1.5, 13.5	−	15	4				−	−	4	
Input High Voltage, V_{IH} Min.	0.5, 4.5	−	5	3.5				3.5	−	−	
	1, 9	−	10	7				7	−	−	
	1.5, 13.5	−	15	11				11	−	−	
Input Current I_{IN} Max.	−	0,18	18	±0.1	±0.1	±1	±1	−	±10⁻⁵	±0.1	μA

TRUTH TABLE

INPUTS							OUTPUTS		
COMPARING				CASCADING					
A3, B3	A2, B2	A1, B1	A0, B0	A < B	A = B	A > B	A < B	A = B	A > B
A3 > B3	X	X	X	X	X	X	0	0	1
A3 = B3	A2 > B2	X	X	X	X	X	0	0	1
A3 = B3	A2 = B2	A1 > B1	X	X	X	X	0	0	1
A3 = B3	A2 = B2	A1 = B1	A0 > B0	X	X	X	0	0	1
A3 = B3	A2 = B2	A1 = B1	A0 = B0	0	0	1	0	0	1
A3 = B3	A2 = B2	A1 = B1	A0 = B0	0	1	0	0	1	0
A3 = B3	A2 = B2	A1 = B1	A0 = B0	1	0	0	1	0	0
A3 = B3	A2 = B2	A1 = B1	A0 < B0	X	X	X	1	0	0
A3 = B3	A2 = B2	A1 < B1	X	X	X	X	1	0	0
A3 = B3	A2 < B2	X	X	X	X	X	1	0	0
A3 < B3	X	X	X	X	X	X	1	0	0

X = Don't Care   Logic 1 ≡ High Level   Logic 0 ≡ Low Level

COMMERCIAL CMOS HIGH VOLTAGE ICs
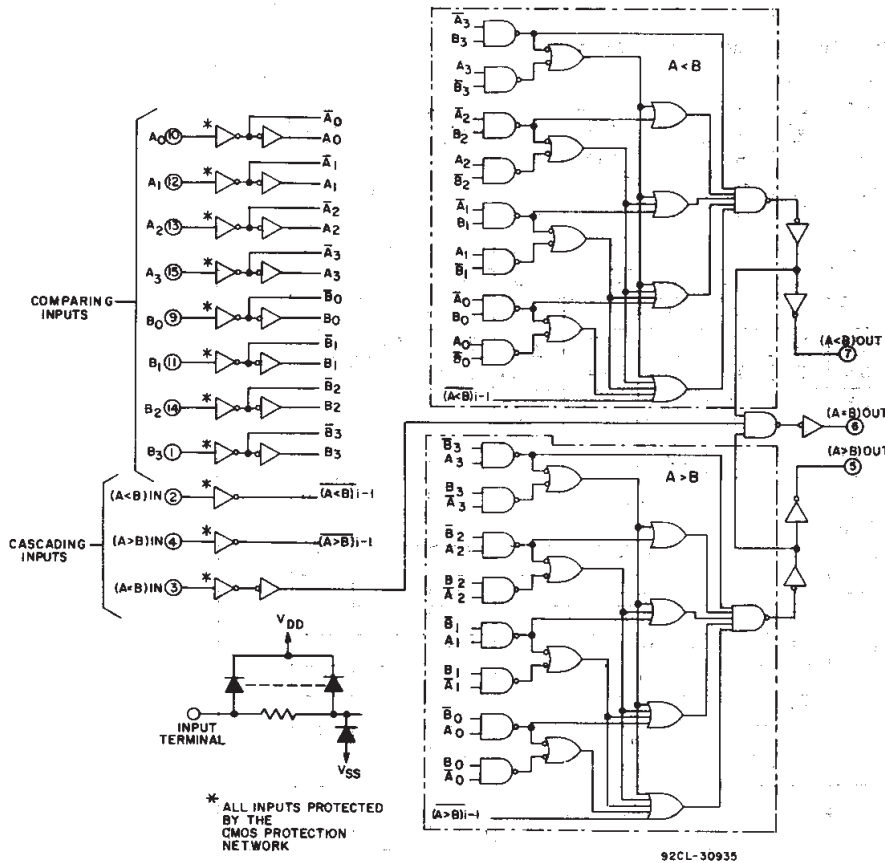
Fig. 2 — Logic diagram for CD4063B.

Fig. 3 — Typical output low (sink) current characteristics.

Fig. 4 — Minimum output low (sink) current characteristics.

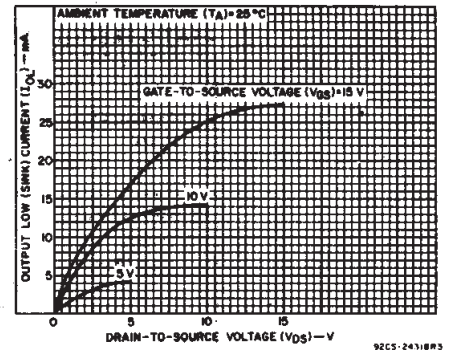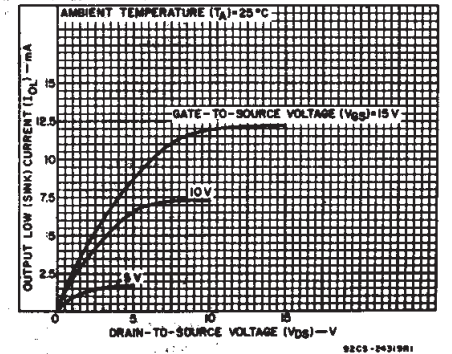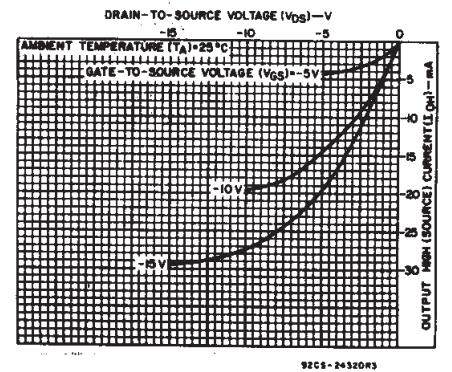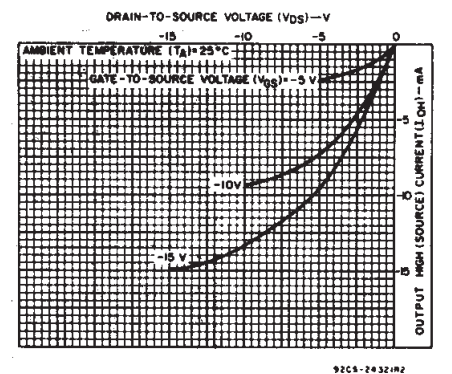Fig. 5 — Typical output high (source) current characteristics.

Fig. 6 — Minimum output high (source) current characteristics.

DYNAMIC ELECTRICAL CHARACTERISTICS

At $T_A = 25°C$; Input t_r, $t_f = 20$ ns, $C_L = 50$ pF, $R_L = 200 k\Omega$

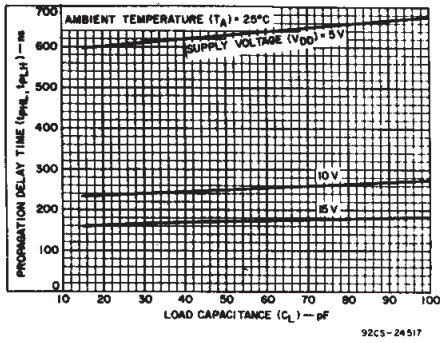| CHARACTERISTIC	TEST CONDITIONS	LIMITS		UNITS
	V_{DD} Volts	Typ.	Max.	
Propagation Delay Time: Comparing Inputs to Outputs, t_{PHL}, t_{PLH}	5	625	1250	ns
	10	250	500	
	15	175	350	
Cascading Inputs to Outputs, t_{PHL}, t_{PLH}	5	500	1000	
	10	200	400	
	15	140	280	
Transition Time, t_{THL}, t_{TLH}	5	100	200	ns
	10	50	100	
	15	40	80	
Input Capacitance, C_{IN}	Any Input	5	7.5	pF

Fig. 7 — Typical propagation delay time vs. load capacitance ("comparing inputs" to outputs).
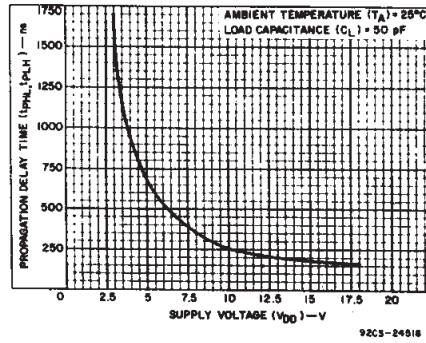

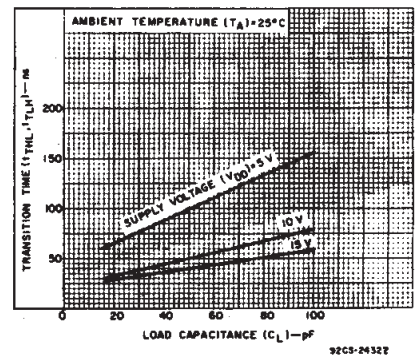Fig. 8 — Typical propagation delay time vs. supply voltage ("comparing inputs" to outputs).

Fig. 9 — Typical transition time vs. load capacitance.
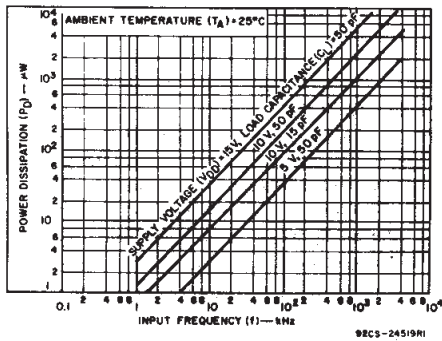
Fig. 10 — Typical power dissipation vs. frequency (see Fig. 12 — dynamic power dissipation test circuit).

NOTE:
MEASURE INPUTS SEQUENTIALLY. TO BOTH V_{DD} AND V_{SS}. CONNECT ALL UNUSED INPUTS TO EITHER V_{DD} OR V_{SS}.
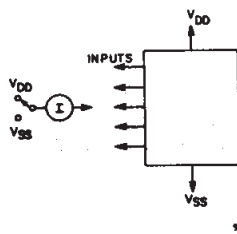
Fig. 11 — Input current test circuit.

Fig. 12 — Dynamic power dissipation test circuit.

NOTE:
TEST ANY COMBINATION OF INPUTS
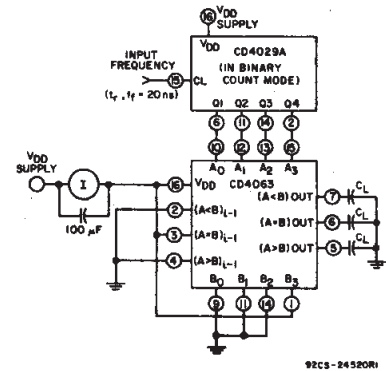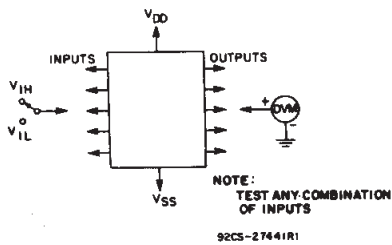
Fig. 13 — Input-voltage test circuit.

Dimensions and pad layout for CD4063BH.

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

Fig. 14 — Quiescent-device-current test circuit.

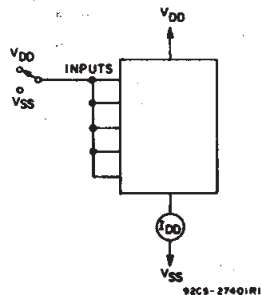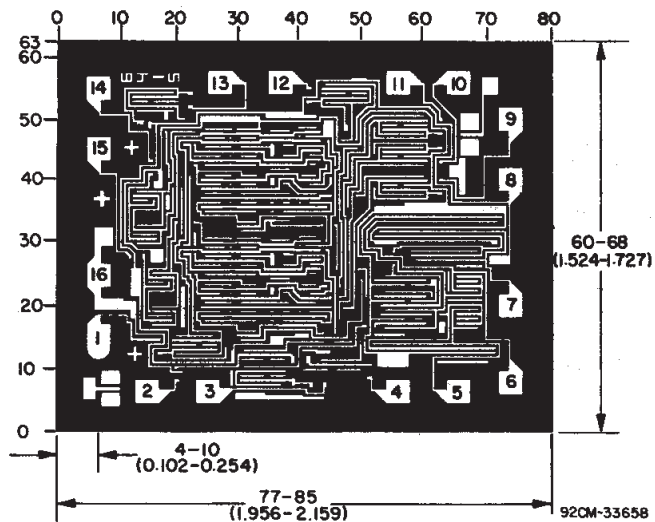## PACKAGING INFORMATION

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
CD4063BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-55 to 125	CD4063BE	Samples
CD4063BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-55 to 125	CD4063BE	Samples
CD4063BF	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	CD4063BF	Samples
CD4063BF3A	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type	-55 to 125	CD4063BF3A	Samples
CD4063BM	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4063BM	Samples
CD4063BM96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4063BM	Samples
CD4063BM96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4063BM	Samples
CD4063BME4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4063BM	Samples
CD4063BMT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4063BM	Samples
CD4063BMTG4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4063BM	Samples
CD4063BNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	CD4063B	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 CD4063B, CD4063B-MIL :

● Catalog: CD4063B

● Military: CD4063B-MIL

NOTE: Qualified Version Definitions:

     ● Catalog - TI's standard catalog product

     ● Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSIONS

A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
CD4063BM96	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
CD4063BNSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD4063BM96	SOIC	D	16	2500	333.2	345.9	28.6
CD4063BNSR	SO	NS	16	2000	367.0	367.0	38.0

DIM \ PINS **	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)

B

14   8

0.065 (1,65)
0.045 (1,14)

1   7

C

0.005 (0,13) MIN

0.060 (1,52)
0.015 (0,38)

0.200 (5,08) MAX

Seating Plane

0.130 (3,30) MIN

0.026 (0,66)
0.014 (0,36)

0.100 (2,54)

A

0°—15°

0.014 (0,36)
0.008 (0,20)

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**)　　　　　　　PLASTIC DUAL-IN-LINE PACKAGE
16 PINS SHOWN

DIM ＼ PINS **	14	16	18	20
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

A

16　　　　　　9

0.260 (6,60) / 0.240 (6,10)

1　　　　　　8

0.070 (1,78) / 0.045 (1,14)

0.045 (1,14) / 0.030 (0,76)

0.020 (0,51) MIN

0.200 (5,08) MAX

Seating Plane

0.125 (3,18) MIN

0.100 (2,54)

0.021 (0,53) / 0.015 (0,38)

⊕ | 0.010 (0,25) Ⓜ

14/18 Pin Only
20 Pin vendor option

0.325 (8,26) / 0.300 (7,62)

0.015 (0,38)

Gauge Plane

0.010 (0,25) NOM

0.430 (10,92) MAX

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.

TEXAS
INSTRUMENTS
www.ti.com

D (R−PDSO−G16)   PLASTIC SMALL OUTLINE

0.394 (10,00)
0.386 (9,80)
⚠C

16   9

0.244 (6,20)
0.228 (5,80)

0.157 (4,00)
0.150 (3,80) ⚠D

1   8

Pin 1
Index Area

0.050 (1,27)

0.020 (0,51)
0.012 (0,31)

⊕ 0.010 (0,25) Ⓜ

0.069 (1,75) Max

0.010 (0,25)
0.004 (0,10)

0.010 (0,25)
0.005 (0,13)

0.004 (0,10)

Gauge Plane

Seating Plane

0.010 (0,25)   0°−8°

0.050 (1,27)
0.016 (0,40)

4040047−6/M   06/11

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.

TEXAS INSTRUMENTS
www.ti.com

D (R−PDSO−G16)   PLASTIC SMALL OUTLINE

Example Board Layout
(Note C)

14x1,27

5,40

Stencil Openings
(Note D)

16x0,55

16x1,50

14x1,27

5.40

Example
Non Soldermask Defined Pad

0,60

1,55

0,07

All Around

Example
Pad Geometry
(See Note C)

Example
Solder Mask Opening
(See Note E)

4211283−4/E 08/12

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.

NS (R-PDSO-G)**   PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN

	PINS **	14	16	20	24
DIM					
A	MAX	10,50	10,50	12,90	15,30
A	MIN	9,90	9,90	12,30	14,70

4040062/C 03/03

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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