Data sheet acquired from Harris Semiconductor
SCHS106B – Revised July 2003

CD40192B, CD40193B Types

CMOS Presettable Up/Down Counters (Dual Clock With Reset)

High-Voltage Types (20-Volt Rating)
CD40192 – BCD Type
CD40193 – Binary Type

■ CD40192B Presettable BCD Up/Down Counter and the CD40193B Presettable Binary Up/Down Counter each consist of 4 synchronously clocked, gated "D" type flip-flops connected as a counter. The inputs consist of 4 individual jam lines, a PRESET ENABLE control, individual CLOCK UP and CLOCK DOWN signals and a master RESET. Four buffered Q signal outputs as well as CARRY and BORROW outputs for multiple-stage counting schemes are provided.

The counter is cleared so that all outputs are in a low state by a high on the RESET line. A RESET is accomplished asynchronously with the clock. Each output is individually programmable asynchronously with the clock to the level on the corresponding jam input when the PRESET ENABLE control is low.

The counter counts up one count on the positive clock edge of the CLOCK UP signal provided the CLOCK DOWN line is high. The counter counts down one count on the positive clock edge of the CLOCK DOWN signal provided the CLOCK UP line is high.

The CARRY and BORROW signals are high when the counter is counting up or down. The CARRY signal goes low one-half clock cycle after the counter reaches its maximum count in the count-up mode. The BORROW signal goes low one-half clock cycle after the counter reaches its minimum count in the count-down mode. Cascading of multiple packages is easily accomplished without the need for additional external circuitry by tying the BORROW and CARRY outputs to the CLOCK DOWN and CLOCK UP inputs, respectively, of the succeeding counter package.

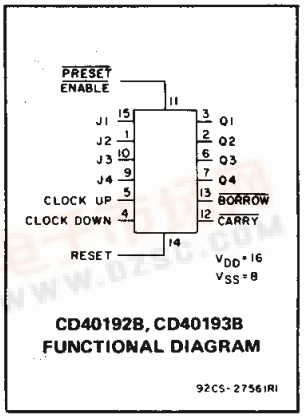
The CD40192B and CD40193B types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (NSR suffix), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

Features:

- Individual clock lines for counting up or counting down
- Synchronous high-speed carry and borrow propagation delays for cascading
- Asynchronous reset and preset capability
- Medium-speed operation—f_{CL} = 8 MHz (typ.) @ 10 V
- 5-V, 10-V, and 15-V parametric ratings
- Standardized, symmetrical output characteristics
- 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
- Noise margin over full package temperature 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"**

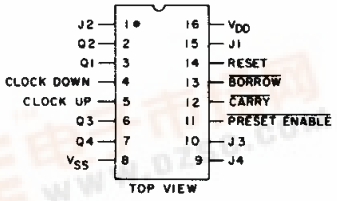
Applications:

- Up/down difference counting
- Multistage ripple counting
- Synchronous frequency dividers
- A/D and D/A conversion
- Programmable binary or BCD counting



CD40192B, CD40193B
FUNCTIONAL DIAGRAM

92CS-27561RI



92CS-27564R2

CD40192B, CD40193B
TERMINAL ASSIGNMENT

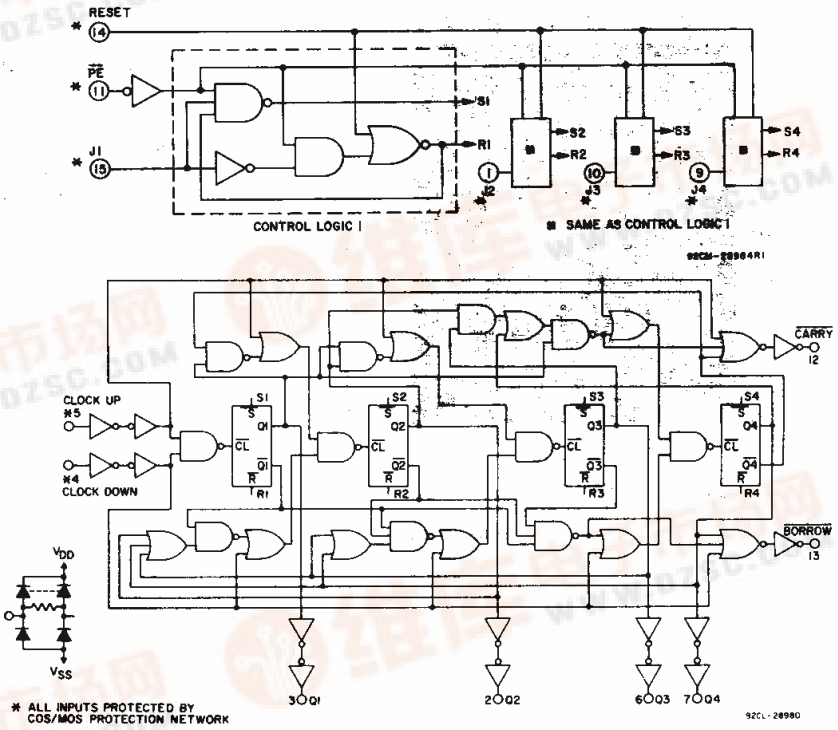


Fig. 1 — CD40192B logic diagram (BCD).

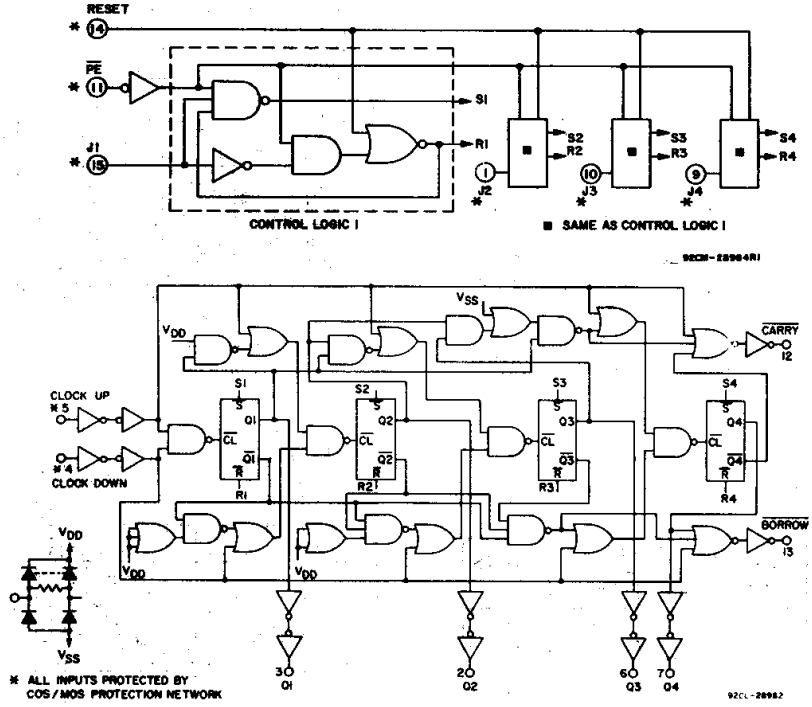


Fig. 2 — CD40193B logic diagram (binary).

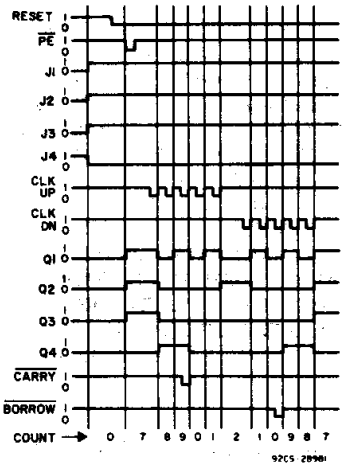


Fig. 3 — CD40192B timing diagram.

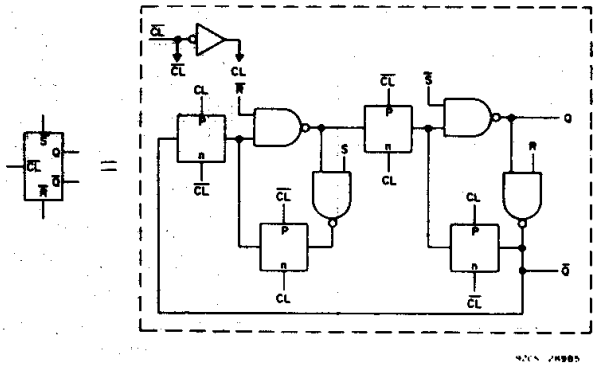


Fig. 4 — Internal logic of Flip-flop.

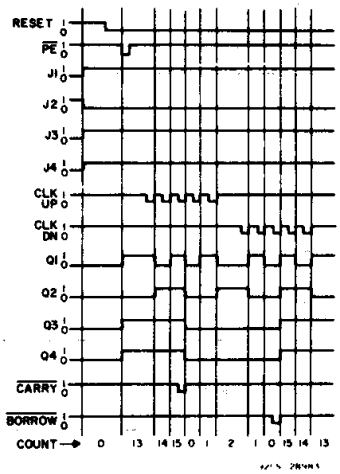


Fig. 5 — CD40193B timing diagram.

TRUTH TABLE

CLOCK UP	CLOCK DOWN	PRESET ENABLE	RESET	ACTION
⌐¬	1	1	0	COUNT UP
¬⌐	1	1	0	NO COUNT
1	⌐¬	1	0	COUNT DOWN
1	¬⌐	1	0	NO COUNT
X	X	0	0	PRESET
X	X	X	1	RESET

1 = HIGH LEVEL 0 = LOW LEVEL X = DON'T CARE

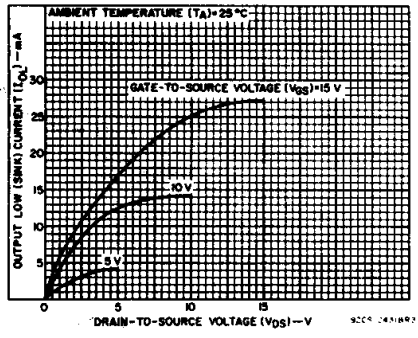


Fig. 6 — Typical output low (sink) current characteristics.

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 at T_A = 25°C (unless otherwise specified)

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges.

CHARACTERISTIC	V_{DD} (V)	LIMITS Min.	LIMITS Max.	UNITS
Supply Voltage Range (For T_A = Full Temp. Range)	–	3	18	V
Removal Time: RESET or $\overline{PE}$	5	80	–	ns
	10	40	–	
	15	30	–	
Pulse Width: RESET	5	480	–	ns
	10	300	–	
	15	260	–	
$\overline{PE}$	5	240	–	ns
	10	170	–	
	15	140	–	
CLOCK	5	180	–	ns
	10	90	–	
	15	60	–	
Clock Input Frequency	5	DC	2	MHz
	10		4	
	15		5.5	
Clock Rise & Fall Time	5	–	15	μs
	10	–	15	
	15	–	5	

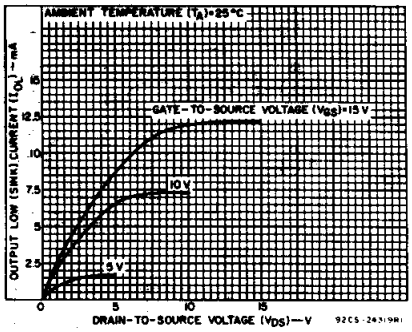


Fig. 7 — Minimum output low (sink) current characteristics.

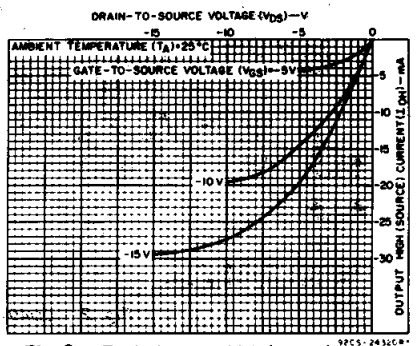


Fig. 8 — Typical output high (source) current characteristics.

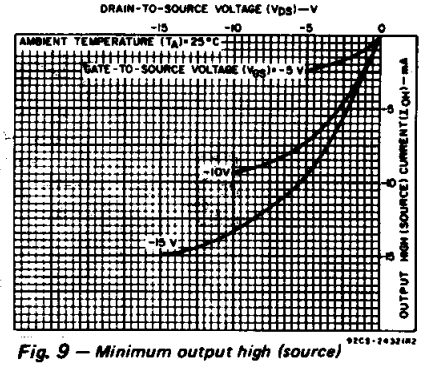


Fig. 9 — Minimum output high (source) current characteristics.

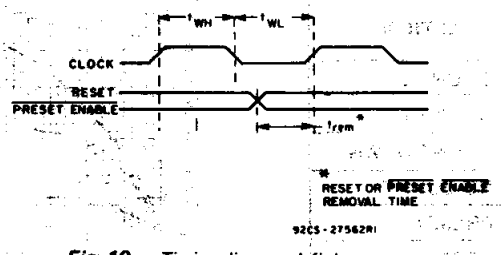


Fig. 10 — Timing diagram defining t_{rem}

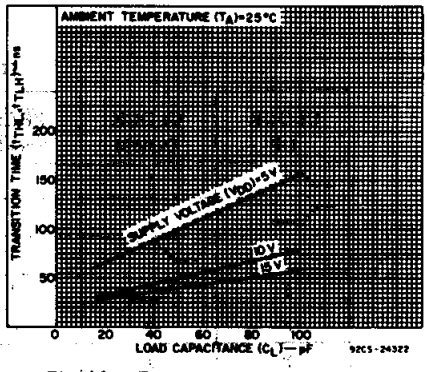


Fig. 11 — Typical transition time as a function of load capacitance.

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
								+25			
	V_O (V)	V_{IN} (V)	V_{DD} (V)	−55	−40	+85	+125	Min.	Typ.	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

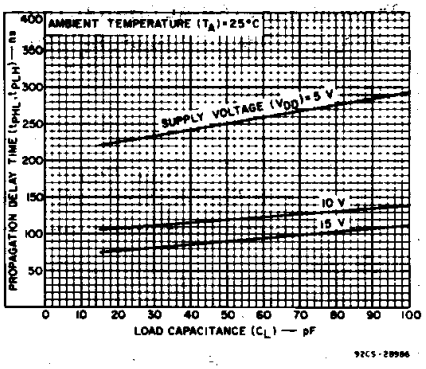


Fig. 12 – Typical propagation delay time as a function of load capacitance.

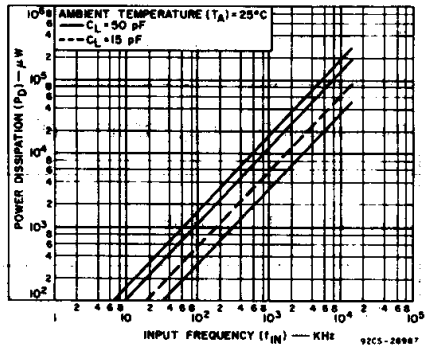
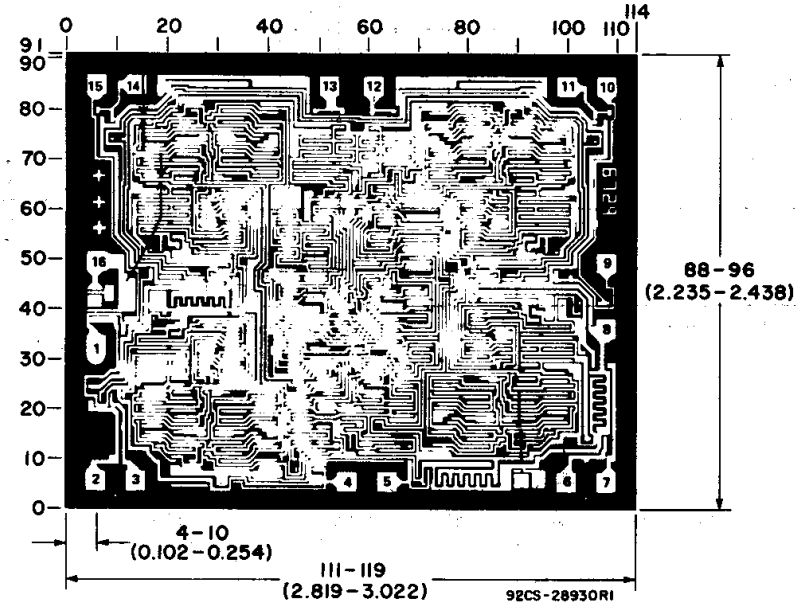


Fig. 13 – Dynamic power dissipation.



Dimensions and pad layout for the CD40192BH (dimensions and pad layout for the CD40193BH are identical).

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

DYNAMIC ELECTRICAL CHARACTERISTICS at $T_A = 25^oC$
Input t_r, t_f = 20 ns, C_L = 50 pF, R_L = 200 kΩ

CHARACTERISTIC	V_{DD} (V)	LIMITS Min.	Typ.	Max.	UNITS
Propagation Delay Time t_{PHL}, t_{PLH}: CLOCK UP or CLOCK DOWN to Q, RESET to Q	5	–	250	500	ns
	10	–	120	240	
	15	–	90	180	
$\overline{PE}$ to Q	5	–	200	400	ns
	10	–	100	200	
	15	–	70	140	
CLOCK UP to $\overline{CARRY}$, CLOCK DOWN to $\overline{BORROW}$	5	–	160	320	ns
	10	–	80	160	
	15	–	60	120	
$\overline{RESET}$ or $\overline{PE}$ to $\overline{BORROW}$ or $\overline{CARRY}$	5	–	300	600	ns
	10	–	150	300	
	15	–	110	220	
Transition Time, t_{THL}, t_{TLH}	5	–	100	200	ns
	10	–	50	100	
	15	–	40	80	
Min. Removal Time, t_{rem}* RESET or $\overline{PE}$	5	–	40	80	ns
	10	–	20	40	
	15	–	15	30	
Min. Pulse Width, t_w RESET	5	–	240	480	ns
	10	–	150	300	
	15	–	130	260	
$\overline{PE}$	5	–	120	240	ns
	10	–	85	170	
	15	–	70	140	
CLOCK	5	–	90	180	ns
	10	–	45	90	
	15	–	30	60	
Max. Clock Input Frequency, f_{CL}	5	2	4	–	MHz
	10	4	8	–	
	15	5.5	11	–	
Clock Rise & Fall Time, t_r, t_f	5	–	–	15	μs
	10	–	–	15	
	15	–	–	5	
Input Capacitance, C_{IN}: RESET	–	–	10	15	pF
All Other Inputs	–	–	5	7.5	pF

* The time required for RESET or PRESET ENABLE control to be removed before clocking (see timing diagram, Fig. 10.

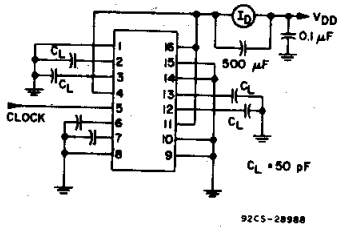


Fig. 14 – Dynamic power dissipation test circuit.

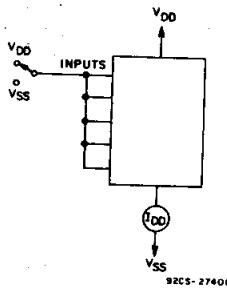


Fig. 15 – Quiescent-device-current test circuit.

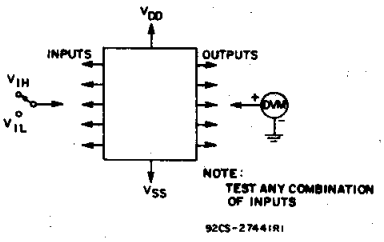


Fig. 16 – Input-voltage test circuit.

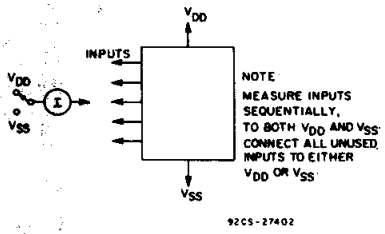


Fig. 17 – Input current test circuit.

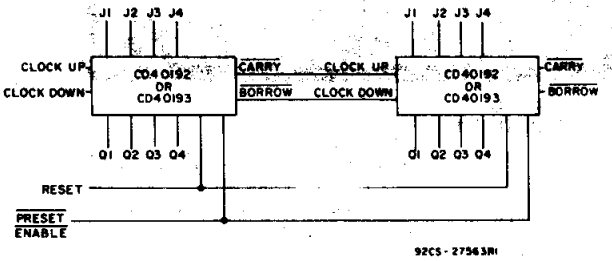


Fig. 18 – Cascaded counter packages.

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
CD40192BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD40192BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD40192BF	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
CD40192BF3A	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
CD40192BNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD40192BNSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD40192BNSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD40193BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD40193BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD40193BF3A	ACTIVE	CDIP	J	16	1	TBD	A42	N / A for Pkg Type
CD40193BNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD40193BNSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD40193BNSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD40193BPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD40193BPWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD40193BPWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD40193BPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD40193BPWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD40193BPWRG4	ACTIVE	TSSOP	PW	16	2000	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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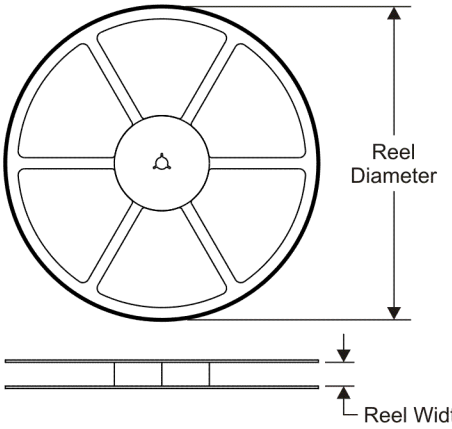
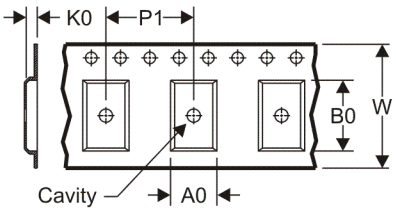
TAPE AND REEL INFORMATION

REEL DIMENSIONS

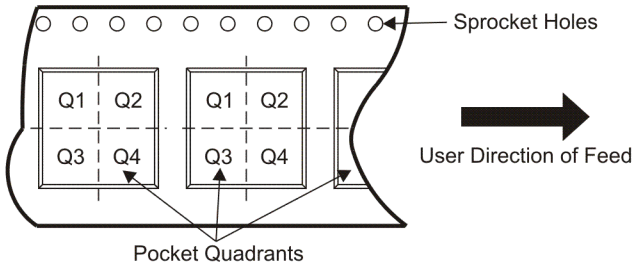


TAPE DIMENSIONS



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

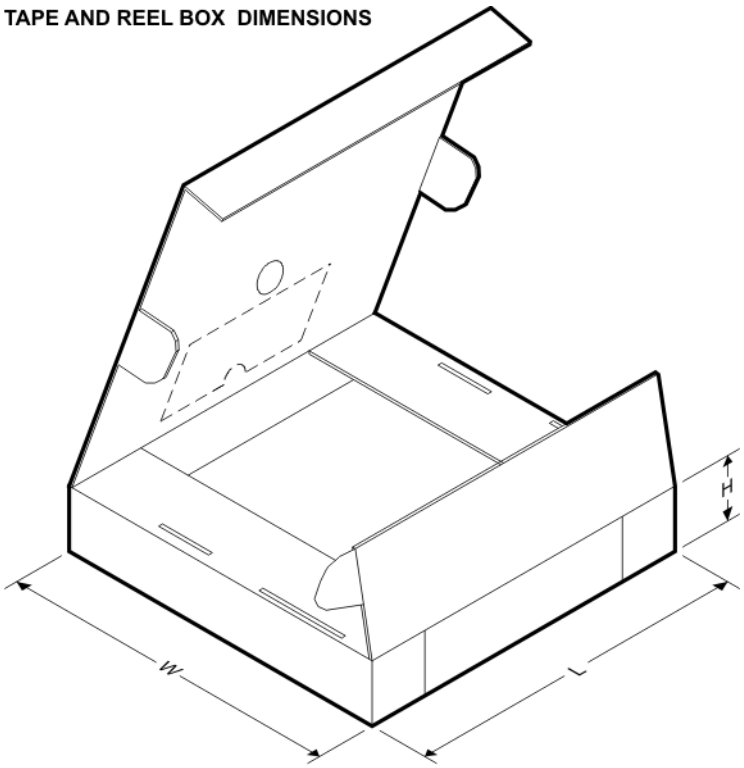
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CD40192BNSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
CD40193BNSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
CD40193BPWR	TSSOP	PW	16	2000	330.0	12.4	7.0	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



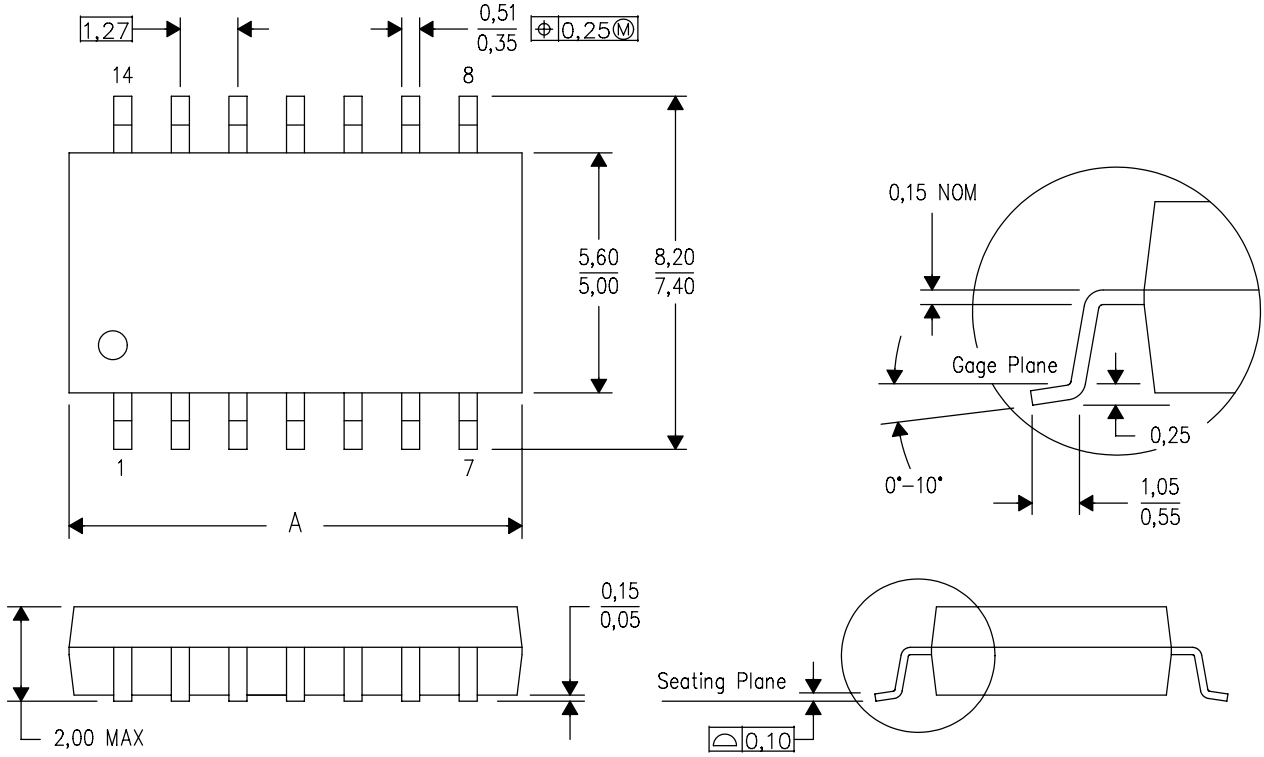
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD40192BNSR	SO	NS	16	2000	346.0	346.0	33.0
CD40193BNSR	SO	NS	16	2000	346.0	346.0	33.0
CD40193BPWR	TSSOP	PW	16	2000	346.0	346.0	29.0

MECHANICAL DATA

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

14-PINS SHOWN



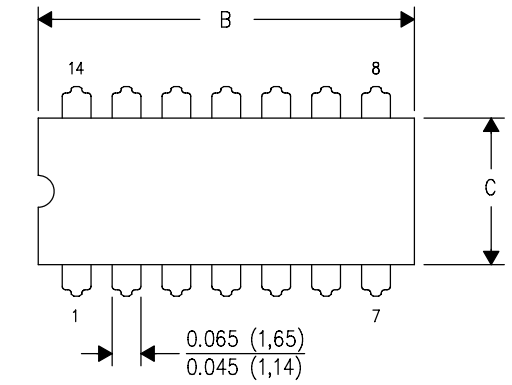
DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

4040062/C 03/03

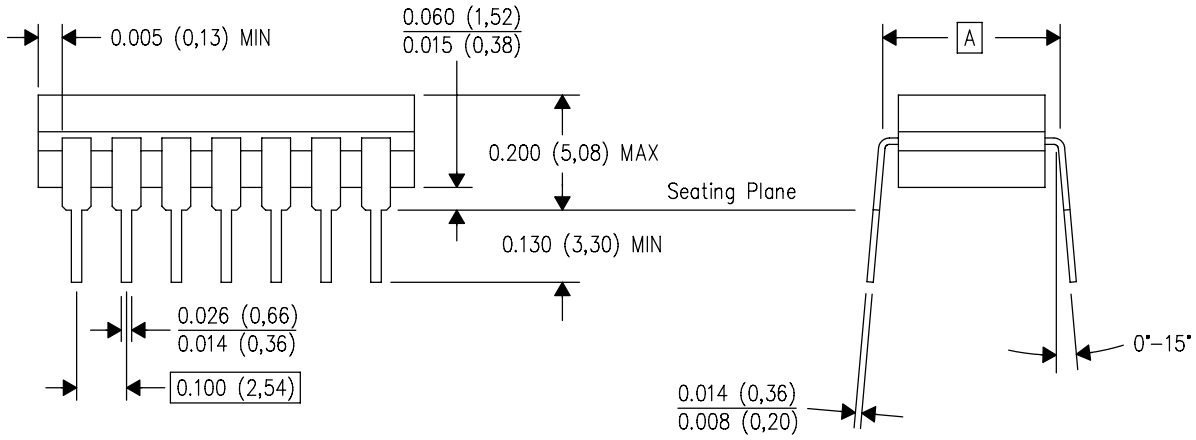
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

J (R–GDIP–T**) CERAMIC DUAL IN–LINE PACKAGE

14 LEADS SHOWN



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)

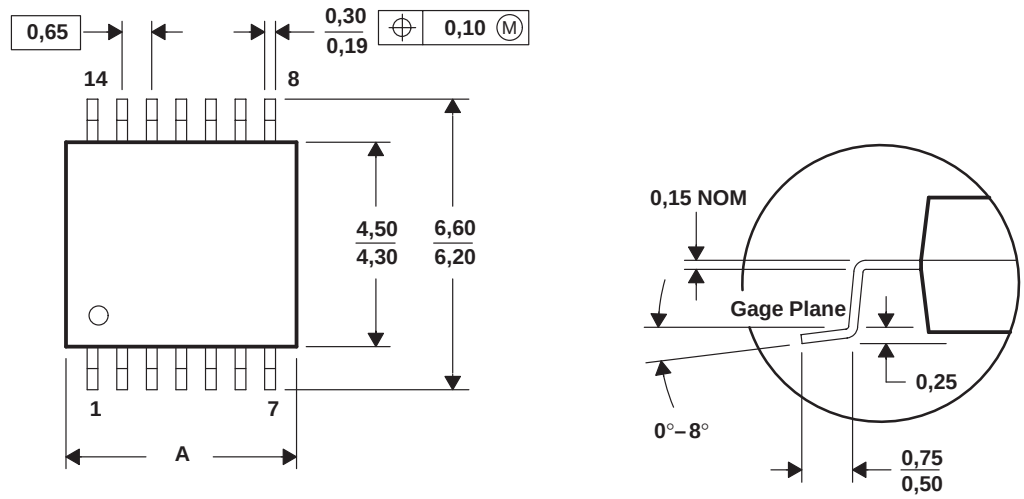


4040083/F 03/03

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.

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

14 PINS SHOWN



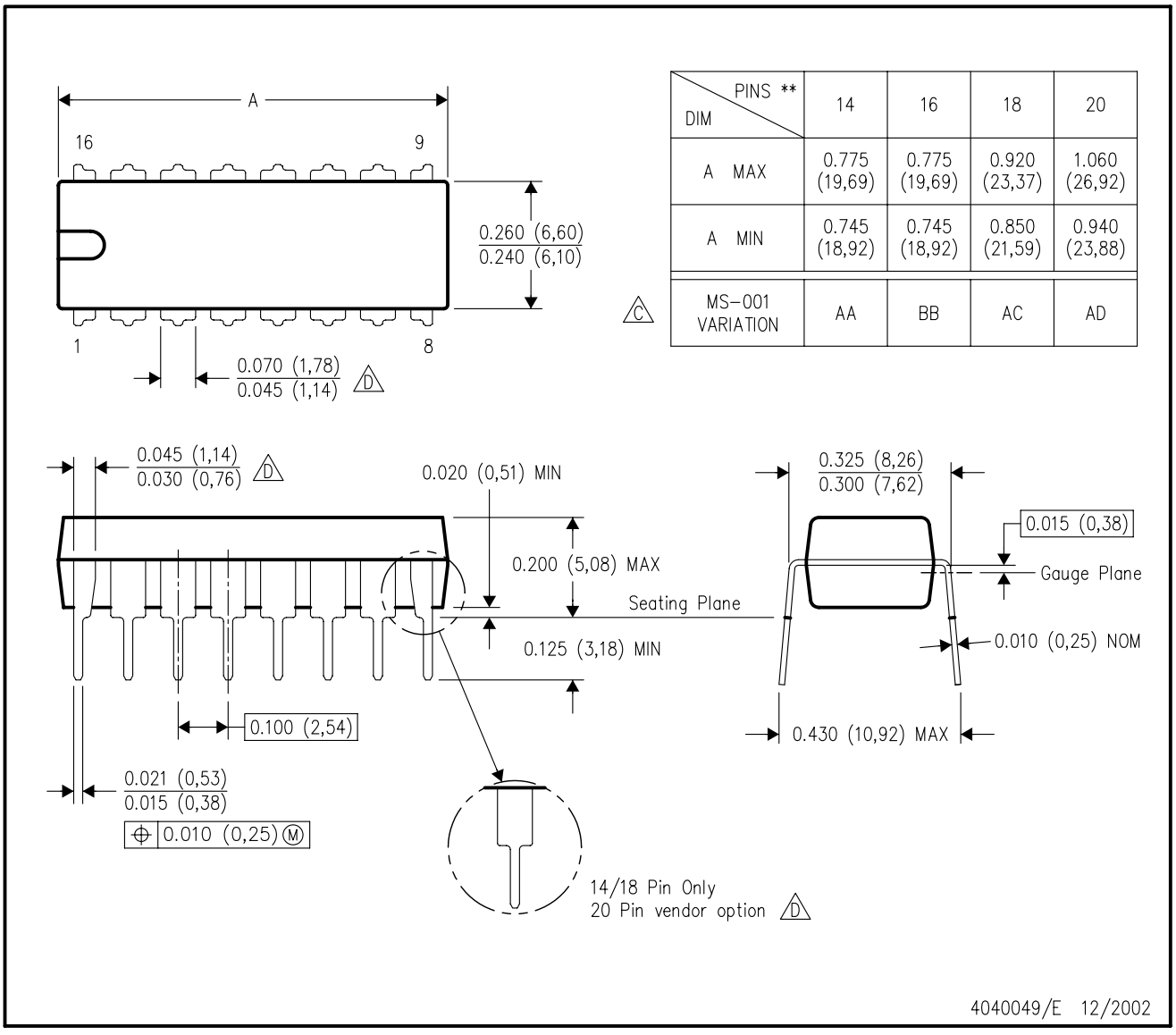
DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

4040064/F 01/97

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.
D. Falls within JEDEC MO-153

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 (C)	AA	BB	AC	AD

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

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