TEXAS INSTRUMENTS
Data sheet acquired from Harris Semiconductor
SCHS106

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 $\overline{\text{PRESET}}$ $\overline{\text{ENABLE}}$ control, individual CLOCK UP and CLOCK DOWN signals and a master RESET. Four buffered Q signal outputs as well as $\overline{\text{CARRY}}$ and $\overline{\text{BORROW}}$ 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 $\overline{\text{PRESET}}$ $\overline{\text{ENABLE}}$ 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 $\overline{\text{CARRY}}$ and $\overline{\text{BORROW}}$ signals are high when the counter is counting up or down. The $\overline{\text{CARRY}}$ signal goes low one-half clock cycle after the counter reaches its maximum count in the count-up mode. The $\overline{\text{BORROW}}$ 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 $\overline{\text{BORROW}}$ and $\overline{\text{CARRY}}$ outputs to the CLOCK DOWN and CLOCK UP inputs, respectively, of the succeeding counter package.

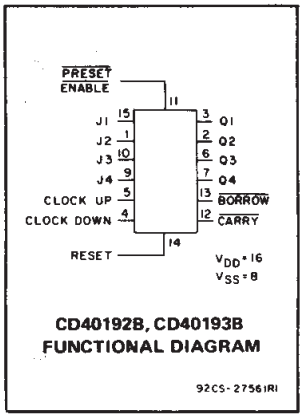
The CD40192B and CD40193B types are supplied in 16-lead hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic packages (E suffix), and in chip form (H suffix).

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"**

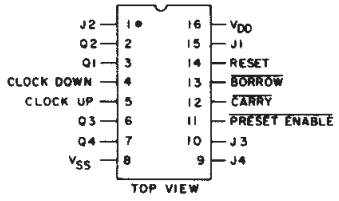
Applications:

- 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

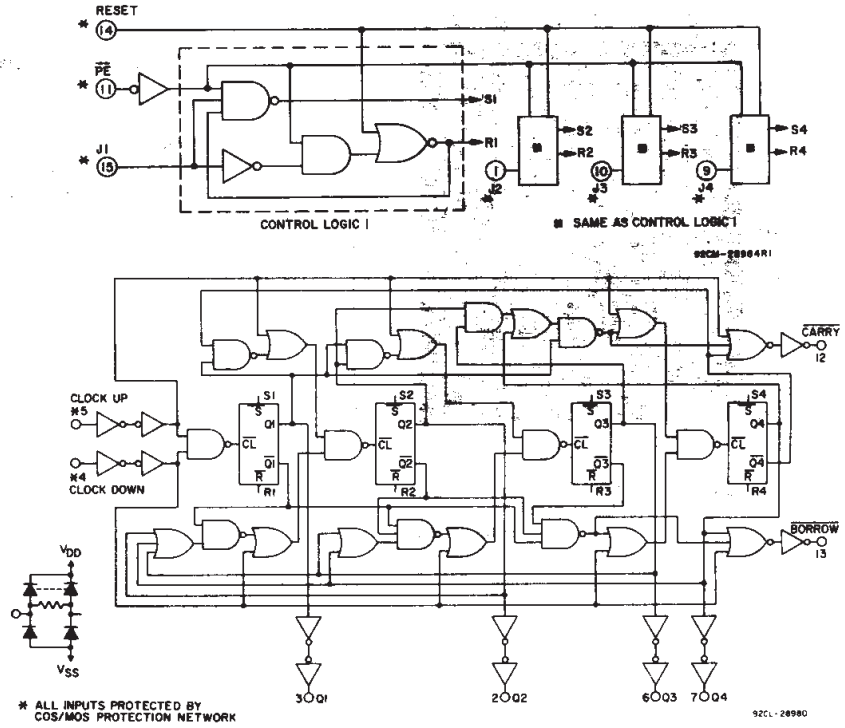


Fig. 1 — CD40192B logic diagram (BCD).

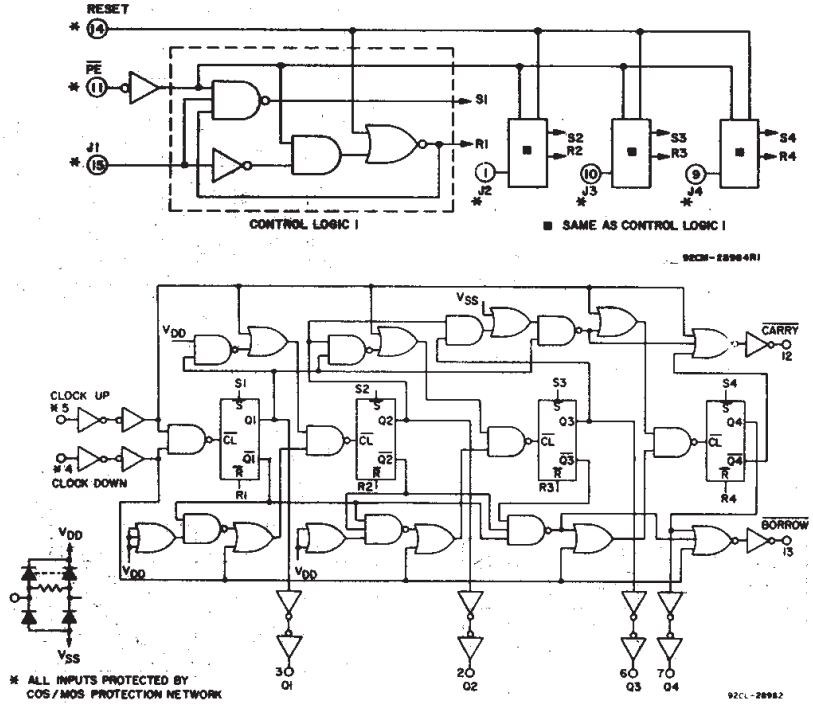


Fig. 2 — CD40193B logic diagram (binary).

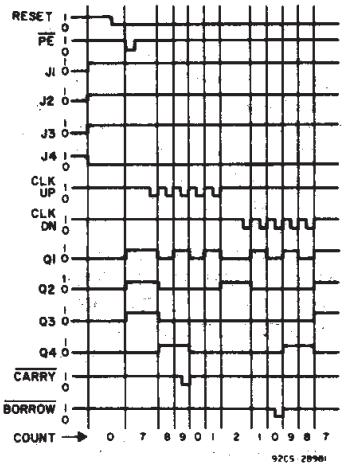


Fig. 3 — CD40192B timing diagram.

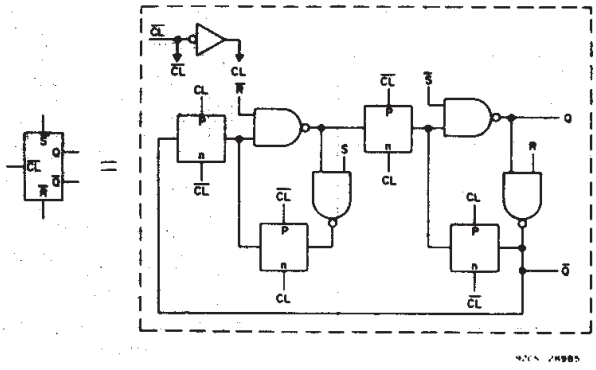


Fig. 4 — Internal logic of Flip-flop.

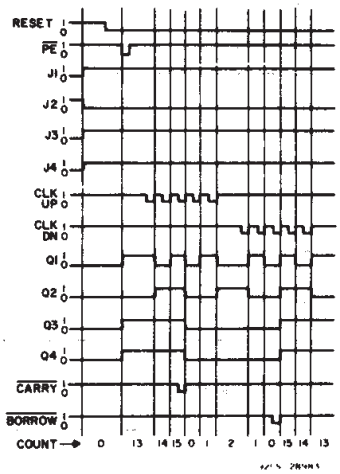


Fig. 5 — CD40193B timing diagram.

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

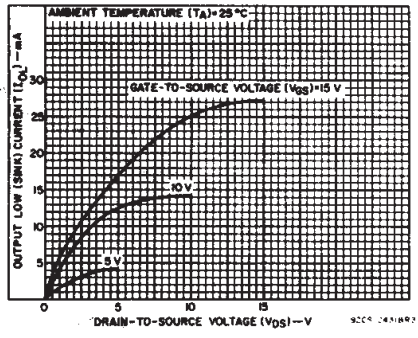


Fig. 6 — Typical output low (sink) current characteristics.

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		UNITS
		Min.	Max.	
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	

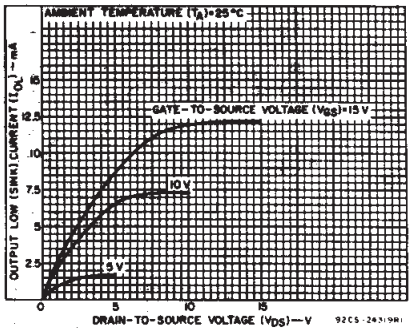


Fig. 7 — Minimum output low (sink) current characteristics.

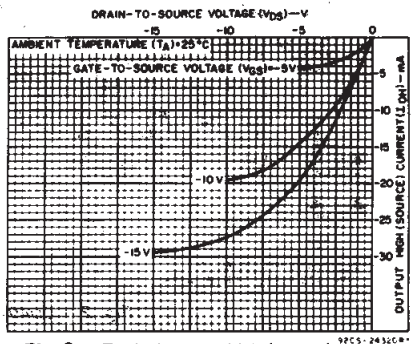


Fig. 8 — Typical output high (source) current characteristics.

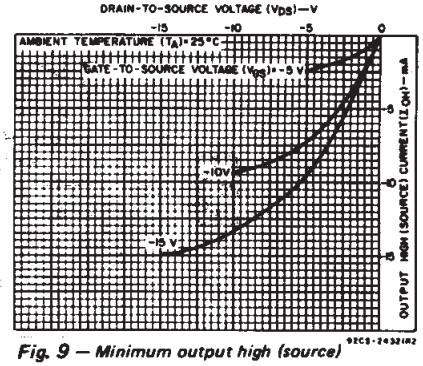


Fig. 9 — Minimum output high (source) current characteristics.

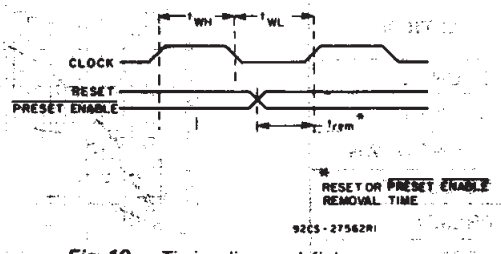


Fig. 10 — Timing diagram defining t_{rem}

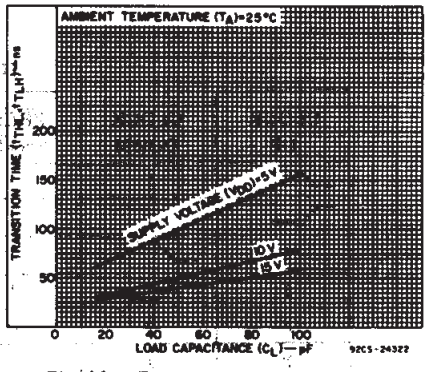


Fig. 11 — Typical transition time as a function of load capacitance.

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

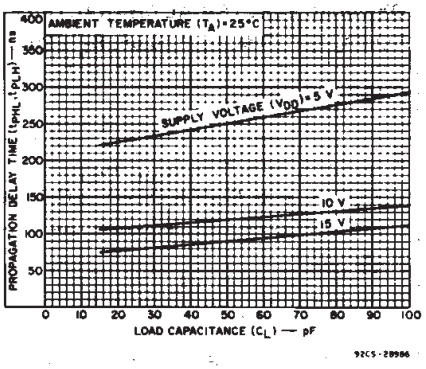


Fig. 12 – Typical propagation delay time as a function of load capacitance.

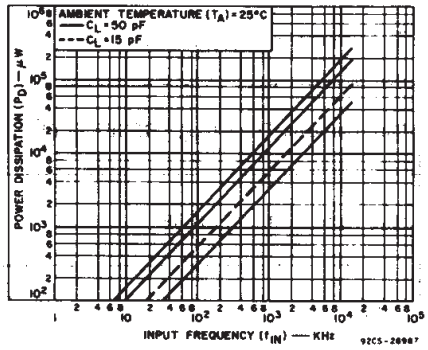
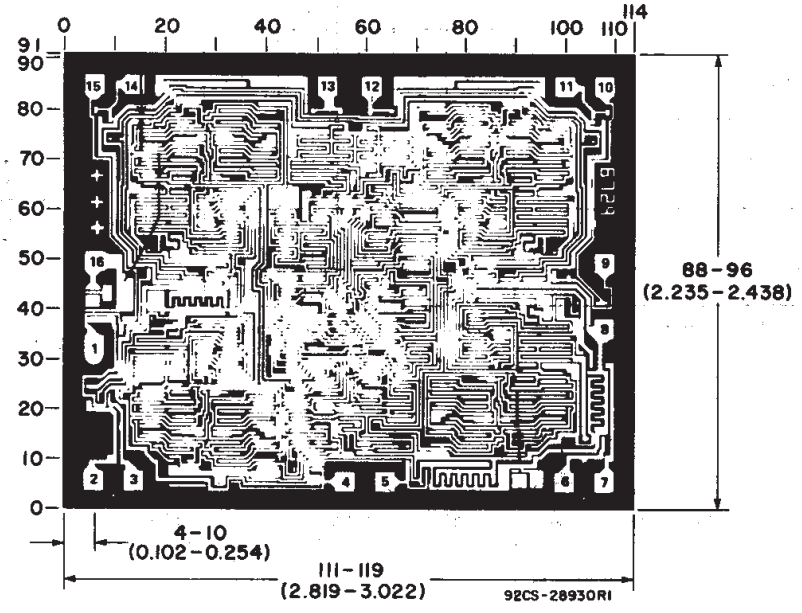


Fig. 13 – Dynamic power dissipation.



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.

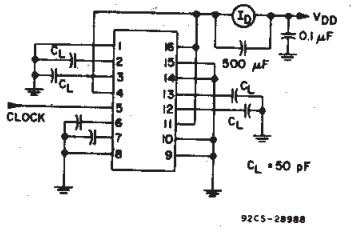


Fig. 14 – Dynamic power dissipation test circuit.

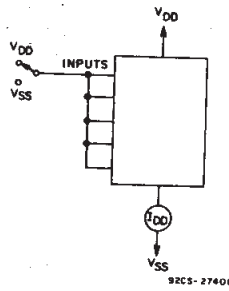


Fig. 15 – Quiescent-device-current test circuit.

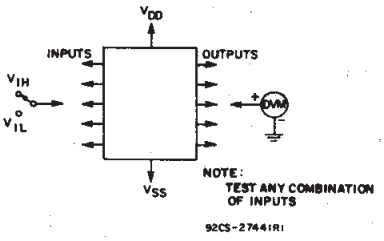


Fig. 16 – Input-voltage test circuit.

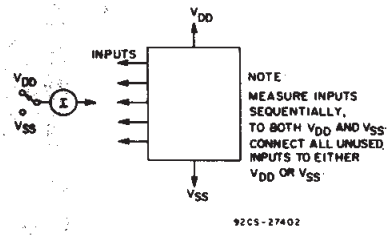


Fig. 17 – Input current test circuit.

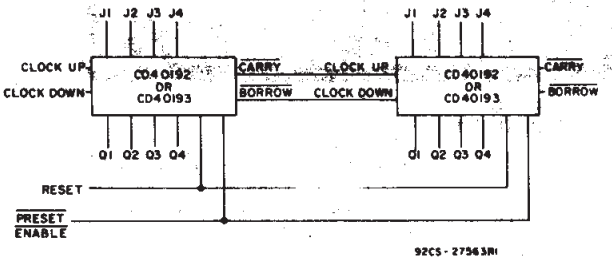


Fig. 18 – Cascaded counter packages.

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. 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 of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.