

Features

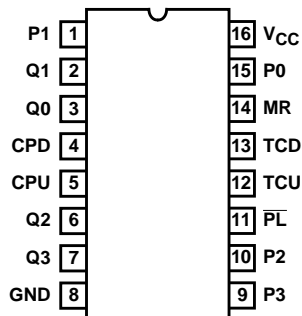
- Synchronous Counting and Asynchronous Loading
- Two Outputs for N-Bit Cascading
- Look-Ahead Carry for High-Speed Counting
- Fanout (Over Temperature Range)
 - Standard Outputs 10 LSTTL Loads
 - Bus Driver Outputs 15 LSTTL Loads
- Wide Operating Temperature Range . . . -55°C to 125°C
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- HC Types
 - 2V to 6V Operation
 - High Noise Immunity: $N_{IL} = 30\%$, $N_{IH} = 30\%$ of V_{CC} at $V_{CC} = 5V$
- HCT Types
 - 4.5V to 5.5V Operation
 - Direct LSTTL Input Logic Compatibility, $V_{IL} = 0.8V$ (Max), $V_{IH} = 2V$ (Min)
 - CMOS Input Compatibility, $I_I \leq 1\mu A$ at V_{OL} , V_{OH}

Description

The 'HC192, 'HC193 and 'HCT193 are asynchronously presettable BCD Decade and Binary Up/Down synchronous counters, respectively.

Pinout

CD54HC192, CD54HC193, CD54HCT193 (CERDIP)
 CD74HC192 (PDIP, SOP, TSSOP)
 CD74HC193 (PDIP, SOIC)
 CD74HCT193 (PDIP)
 TOP VIEW



Presetting the counter to the number on the preset data inputs (P0-P3) is accomplished by a LOW asynchronous parallel load input (\overline{PL}). The counter is incremented on the low-to-high transition of the Clock-Up input (and a high level on the Clock-Down input) and decremented on the low to high transition of the Clock-Down input (and a high level on the Clock-up input). A high level on the MR input overrides any other input to clear the counter to its zero state. The Terminal Count up (carry) goes low half a clock period before the zero count is reached and returns to a high level at the zero count. The Terminal Count Down (borrow) in the count down mode likewise goes low half a clock period before the maximum count (9 in the 192 and 15 in the 193) and returns to high at the maximum count. Cascading is effected by connecting the carry and borrow outputs of a less significant counter to the Clock-Up and Clock-Down inputs, respectively, of the next most significant counter.

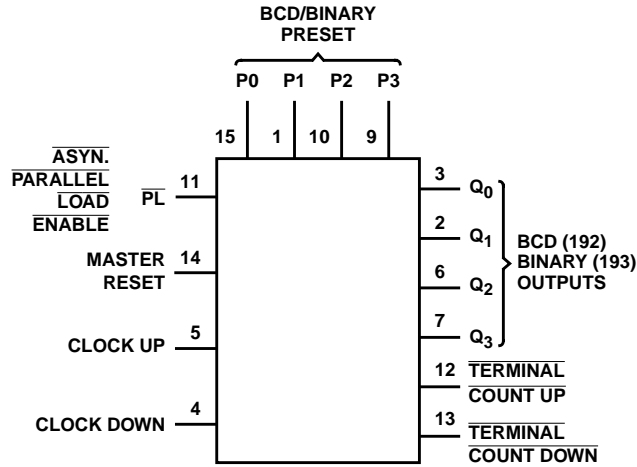
If a decade counter is preset to an illegal state or assumes an illegal state when power is applied, it will return to the normal sequence in one count as shown in state diagram.

Ordering Information

| PART NUMBER | TEMP. RANGE (°C) | PACKAGE |
|---------------|------------------|--------------|
| CD54HC192F3A | -55 to 125 | 16 Ld CERDIP |
| CD54HC193F3A | -55 to 125 | 16 Ld CERDIP |
| CD54HCT193F3A | -55 to 125 | 16 Ld CERDIP |
| CD74HC192E | -55 to 125 | 16 Ld PDIP |
| CD74HC192NSR | -55 to 125 | 16 Ld SOP |
| CD74HC192PW | -55 to 125 | 16 Ld TSSOP |
| CD74HC192PWR | -55 to 125 | 16 Ld TSSOP |
| CD74HC192PWT | -55 to 125 | 16 Ld TSSOP |
| CD74HC193E | -55 to 125 | 16 Ld PDIP |
| CD74HC193M | -55 to 125 | 16 Ld SOIC |
| CD74HC193MT | -55 to 125 | 16 Ld SOIC |
| CD74HC193M96 | -55 to 125 | 16 Ld SOIC |
| CD74HCT193E | -55 to 125 | 16 Ld PDIP |

NOTE: When ordering, use the entire part number. The suffixes 96 and R denote tape and reel. The suffix T denotes a small-quantity reel of 250.

Functional Diagram



TRUTH TABLE

| CLOCK UP | CLOCK DOWN | RESET | PARALLEL LOAD | FUNCTION |
|----------|------------|-------|---------------|--------------------|
| ↑ | H | L | H | Count Up |
| H | ↑ | L | H | Count Down |
| X | X | H | X | Reset |
| X | X | L | L | Load Preset Inputs |

H = High Voltage Level, L = Low Voltage Level, X = Don't Care, ↑ = Transition from Low to High Level

CD54/74HC192, CD54/74HC193, CD54/74HCT193

Absolute Maximum Ratings

| | |
|--|-------------|
| DC Supply Voltage, V_{CC} | -0.5V to 7V |
| DC Input Diode Current, I_{IK} | |
| For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$ | $\pm 20mA$ |
| DC Output Diode Current, I_{OK} | |
| For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$ | $\pm 20mA$ |
| DC Output Source or Sink Current per Output Pin, I_O | |
| For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$ | $\pm 25mA$ |
| DC V_{CC} or Ground Current, I_{CC} or I_{GND} | $\pm 50mA$ |

Thermal Information

| | |
|--|----------------|
| Package Thermal Impedance, θ_{JA} (see Note 1): | |
| E (PDIP) Package | 67°C/W |
| M (SOIC) Package | 73°C/W |
| NS (SOP) Package | 64°C/W |
| PW (TSSOP) Package | 108°C/W |
| Maximum Junction Temperature | 150°C |
| Maximum Storage Temperature Range | -65°C to 150°C |
| Maximum Lead Temperature (Soldering 10s) | 300°C |
| (SOIC - Lead Tips Only) | |

Operating Conditions

| | |
|---|----------------|
| Temperature Range (T_A) | -55°C to 125°C |
| Supply Voltage Range, V_{CC} | |
| HC Types | .2V to 6V |
| HCT Types | 4.5V to 5.5V |
| DC Input or Output Voltage, V_I , V_O | 0V to V_{CC} |
| Input Rise and Fall Time | |
| 2V | 1000ns (Max) |
| 4.5V | 500ns (Max) |
| 6V | 400ns (Max) |

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

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

DC Electrical Specifications

| PARAMETER | SYMBOL | TEST CONDITIONS | | | 25°C | | | -40°C TO 85°C | | -55°C TO 125°C | | UNITS |
|---|----------|-------------------------|------------|--------------|------|-----|-----------|---------------|---------|----------------|---------|---------|
| | | V_I (V) | I_O (mA) | V_{CC} (V) | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| HC TYPES | | | | | | | | | | | | |
| High Level Input Voltage | V_{IH} | - | - | 2 | 1.5 | - | - | 1.5 | - | 1.5 | - | V |
| | | | | 4.5 | 3.15 | - | - | 3.15 | - | 3.15 | - | V |
| | | | | 6 | 4.2 | - | - | 4.2 | - | 4.2 | - | V |
| Low Level Input Voltage | V_{IL} | - | - | 2 | - | - | 0.5 | - | 0.5 | - | 0.5 | V |
| | | | | 4.5 | - | - | 1.35 | - | 1.35 | - | 1.35 | V |
| | | | | 6 | - | - | 1.8 | - | 1.8 | - | 1.8 | V |
| High Level Output Voltage CMOS Loads | V_{OH} | V_{IH} or V_{IL} | -0.02 | 2 | 1.9 | - | - | 1.9 | - | 1.9 | - | V |
| | | | -0.02 | 4.5 | 4.4 | - | - | 4.4 | - | 4.4 | - | V |
| High Level Output Voltage TTL Loads | V_{OH} | V_{IH} or V_{IL} | -0.02 | 6 | 5.9 | - | - | 5.9 | - | 5.9 | - | V |
| | | | -4 | 4.5 | 3.98 | - | - | 3.84 | - | 3.7 | - | V |
| Low Level Output Voltage CMOS Loads | V_{OL} | V_{IH} or V_{IL} | 0.02 | 2 | - | - | 0.1 | - | 0.1 | - | 0.1 | V |
| | | | 0.02 | 4.5 | - | - | 0.1 | - | 0.1 | - | 0.1 | V |
| Low Level Output Voltage TTL Loads | V_{OL} | V_{IH} or V_{IL} | 0.02 | 6 | - | - | 0.1 | - | 0.1 | - | 0.1 | V |
| | | | 4 | 4.5 | - | - | 0.26 | - | 0.33 | - | 0.4 | V |
| Input Leakage Current | I_I | V_{CC} or GND | 0 | 6 | - | - | 0.26 | - | 0.33 | - | 0.4 | V |
| | | | 5.2 | 6 | - | - | 0.26 | - | 0.33 | - | 0.4 | V |
| Input Leakage Current | I_I | V_{CC} or GND | - | 6 | - | - | ± 0.1 | - | ± 1 | - | ± 1 | μA |
| Quiescent Device Current | I_{CC} | V_{CC} or GND | 0 | 6 | - | - | 8 | - | 80 | - | 160 | μA |

CD54/74HC192, CD54/74HC193, CD54/74HCT193

DC Electrical Specifications (Continued)

| PARAMETER | SYMBOL | TEST CONDITIONS | | | 25°C | | | -40°C TO 85°C | | -55°C TO 125°C | | UNITS |
|--|---------------------------|------------------------------------|---------------------|---------------------|------|-----|------|---------------|------|----------------|-----|-------|
| | | V _I (V) | I _O (mA) | V _{CC} (V) | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| HCT TYPES | | | | | | | | | | | | |
| High Level Input Voltage | V _{IH} | - | - | 4.5 to 5.5 | 2 | - | - | 2 | - | 2 | - | V |
| Low Level Input Voltage | V _{IL} | - | - | 4.5 to 5.5 | - | - | 0.8 | - | 0.8 | - | 0.8 | V |
| High Level Output Voltage CMOS Loads | V _{OH} | V _{IH} or V _{IL} | -0.02 | 4.5 | 4.4 | - | - | 4.4 | - | 4.4 | - | V |
| High Level Output Voltage TTL Loads | | | -4 | 4.5 | 3.98 | - | - | 3.84 | - | 3.7 | - | V |
| Low Level Output Voltage CMOS Loads | V _{OL} | V _{IH} or V _{IL} | 0.02 | 4.5 | - | - | 0.1 | - | 0.1 | - | 0.1 | V |
| Low Level Output Voltage TTL Loads | | | 4 | 4.5 | - | - | 0.26 | - | 0.33 | - | 0.4 | V |
| Input Leakage Current | I _I | V _{CC} to GND | - | 5.5 | - | - | ±0.1 | - | ±1 | - | ±1 | μA |
| Quiescent Device Current | I _{CC} | V _{CC} or GND | - | 5.5 | - | - | 8 | - | 80 | - | 160 | μA |
| Additional Quiescent Device Current Per Input Pin: 1 Unit Load | ΔI _{CC} (Note 2) | V _{CC} - 2.1 | - | 4.5 to 5.5 | - | 100 | 360 | - | 450 | - | 490 | μA |

NOTE:

- For dual-supply systems theoretical worst case (V_I = 2.4V, V_{CC} = 5.5V) specification is 1.8mA.

HCT Input Loading Table

| INPUT | UNIT LOADS |
|----------|------------|
| P0-P3 | 0.4 |
| MR | 1.45 |
| PL | 0.85 |
| CPU, CPD | 1.45 |

NOTE: Unit Load is ΔI_{CC} limit specified in DC Electrical Specifications table, e.g. 360μA max at 25°C.

CD54/74HC192, CD54/74HC193, CD54/74HCT193

Prerequisite For Switching Specifications

| PARAMETER | SYMBOL | V _{CC} (V) | 25°C | | | -40°C TO 85°C | | -55°C TO 125°C | | UNITS |
|--|------------------|------------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
| | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| HC TYPES | | | | | | | | | | |
| Pulse Width CPU, CPD 192 | t _W | 2 | 115 | - | - | 145 | - | 175 | - | ns |
| | | 4.5 | 23 | - | - | 29 | - | 35 | - | ns |
| | | 6 | 20 | - | - | 25 | - | 30 | - | ns |
| CPU, CPD 193 | t _W | 2 | 100 | - | - | 125 | - | 150 | - | ns |
| | | 4.5 | 20 | - | - | 25 | - | 30 | - | ns |
| | | 6 | 17 | - | - | 21 | - | 26 | - | ns |
| \overline{PL} | t _W | 2 | 80 | - | - | 100 | - | 120 | - | ns |
| | | 4.5 | 16 | - | - | 20 | - | 24 | - | ns |
| | | 6 | 14 | - | - | 17 | - | 20 | - | ns |
| MR | t _W | 2 | 100 | - | - | 125 | - | 150 | - | ns |
| | | 4.5 | 20 | - | - | 25 | - | 30 | - | ns |
| | | 6 | 17 | - | - | 21 | - | 26 | - | ns |
| Set-up Time Pn to \overline{PL} | t _{SU} | 2 | 80 | - | - | 100 | - | 120 | - | ns |
| | | 4.5 | 16 | - | - | 20 | - | 24 | - | ns |
| | | 6 | 14 | - | - | 17 | - | 20 | - | ns |
| Hold Time Pn to \overline{PL} | t _H | 2 | 0 | - | - | 0 | - | 0 | - | ns |
| | | 4.5 | 0 | - | - | 0 | - | 0 | - | ns |
| | | 6 | 0 | - | - | 0 | - | 0 | - | ns |
| Hold Time CPD to CPU or CPU to CPD | t _H | 2 | 80 | - | - | 100 | - | 120 | - | ns |
| | | 4.5 | 16 | - | - | 20 | - | 24 | - | ns |
| | | 6 | 14 | - | - | 17 | - | 20 | - | ns |
| Recovery Time \overline{PL} to CPU, CPD | t _{REC} | 2 | 80 | - | - | 100 | - | 120 | - | ns |
| | | 4.5 | 16 | - | - | 20 | - | 24 | - | ns |
| | | 6 | 14 | - | - | 17 | - | 20 | - | ns |
| MR to CPU, CPD | t _{REC} | 2 | 5 | - | - | 5 | - | 5 | - | ns |
| | | 4.5 | 5 | - | - | 5 | - | 5 | - | ns |
| | | 6 | 5 | - | - | 5 | - | 5 | - | ns |
| Maximum Frequency CPU, CPD 192 | f _{MAX} | 2 | 5 | - | - | 4 | - | 3 | - | MHz |
| | | 4.5 | 22 | - | - | 18 | - | 15 | - | MHz |
| | | 6 | 24 | - | - | 21 | - | 18 | - | MHz |
| CPU, CPD 193 | f _{MAX} | 2 | 5 | - | - | 4 | - | 3 | - | MHz |
| | | 4.5 | 25 | - | - | 20 | - | 17 | - | MHz |
| | | 6 | 29 | - | - | 24 | - | 20 | - | MHz |
| HCT TYPES | | | | | | | | | | |
| Pulse Width CPU, CPD 192 | t _W | 2 | - | - | - | - | - | - | - | ns |
| | | 4.5 | 23 | - | - | 29 | - | 35 | - | ns |
| | | 6 | - | - | - | - | - | - | - | ns |
| CPU, CPD 193 | t _W | 2 | - | - | - | - | - | - | - | ns |
| | | 4.5 | 23 | - | - | 29 | - | 35 | - | ns |
| | | 6 | - | - | - | - | - | - | - | ns |

CD54/74HC192, CD54/74HC193, CD54/74HCT193

Prerequisite For Switching Specifications (Continued)

| PARAMETER | SYMBOL | V _{CC} (V) | 25°C | | | -40°C TO 85°C | | -55°C TO 125°C | | UNITS |
|--|------------------|------------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
| | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| \overline{PL} | t _W | 2 | - | - | - | - | - | - | - | ns |
| | | 4.5 | 16 | - | - | 20 | - | 24 | - | ns |
| | | 6 | - | - | - | - | - | - | - | ns |
| MR | t _W | 2 | - | - | - | - | - | - | - | ns |
| | | 4.5 | 20 | - | - | 25 | - | 30 | - | ns |
| | | 6 | - | - | - | - | - | - | - | ns |
| Set-up Time P _n to \overline{PL} | t _{SU} | 2 | - | - | - | - | - | - | - | ns |
| | | 4.5 | 15 | - | - | 19 | - | 22 | - | ns |
| | | 6 | - | - | - | - | - | - | - | ns |
| Hold Time P _n to \overline{PL} | t _H | 2 | - | - | - | - | - | - | - | ns |
| | | 4.5 | 0 | - | - | 0 | - | 0 | - | ns |
| | | 6 | - | - | - | - | - | - | - | ns |
| Hold Time CPD to CPU or CPU to CPD | t _H | 2 | - | - | - | - | - | - | - | ns |
| | | 4.5 | 16 | - | - | 20 | - | 24 | - | ns |
| | | 6 | - | - | - | - | - | - | - | ns |
| Recovery Time \overline{PL} to CPU, CPD | t _{REC} | 2 | - | - | - | - | - | - | - | ns |
| | | 4.5 | 15 | - | - | 19 | - | 22 | - | ns |
| | | 6 | - | - | - | - | - | - | - | ns |
| MR to CPU, CPD | t _{REC} | 2 | - | - | - | - | - | - | - | ns |
| | | 4.5 | 5 | - | - | 5 | - | 5 | - | ns |
| | | 6 | - | - | - | - | - | - | - | ns |
| Maximum Frequency CPU, CPD 192 | f _{MAX} | 2 | - | - | - | - | - | - | - | MHz |
| | | 4.5 | 22 | - | - | 18 | - | 15 | - | MHz |
| | | 6 | - | - | - | - | - | - | - | MHz |
| CPU, CPD 193 | f _{MAX} | 2 | - | - | - | - | - | - | - | MHz |
| | | 4.5 | 22 | - | - | 18 | - | 15 | - | MHz |
| | | 6 | - | - | - | - | - | - | - | MHz |

Switching Specifications Input t_r, t_f = 6ns

| PARAMETER | SYMBOL | TEST CONDITIONS | V _{CC} (V) | 25°C | | | -40°C TO 85°C | | -55°C TO 125°C | | UNITS |
|--|-------------------------------------|-----------------------|------------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| HC TYPES | | | | | | | | | | | |
| Propagation Delay CPU to \overline{TCU} | t _{PLH} , t _{PHL} | C _L = 50pF | 2 | - | - | 125 | - | 155 | - | 190 | ns |
| | | C _L = 50pF | 4.5 | - | - | 25 | - | 31 | - | 38 | ns |
| | | C _L = 15pF | 5 | - | 10 | - | - | - | - | - | ns |
| | | C _L = 50pF | 6 | - | - | 21 | - | 26 | - | 32 | ns |
| CPD to \overline{TCD} | t _{PLH} , t _{PHL} | C _L = 50pF | 2 | - | - | 125 | - | 155 | - | 190 | ns |
| | | C _L = 50pF | 4.5 | - | - | 25 | - | 31 | - | 38 | ns |
| | | C _L = 15pF | 5 | - | 10 | - | - | - | - | - | ns |
| | | C _L = 50pF | 6 | - | - | 21 | - | 26 | - | 32 | ns |
| CPU to Q _n | t _{PLH} , t _{PHL} | C _L = 50pF | 2 | - | - | 220 | - | 270 | - | 325 | ns |
| | | C _L = 50pF | 4.5 | - | - | 43 | - | 54 | - | 65 | ns |
| | | C _L = 15pF | 5 | - | 18 | - | - | - | - | - | ns |
| | | C _L = 50pF | 6 | - | - | 37 | - | 46 | - | 55 | ns |

CD54/74HC192, CD54/74HC193, CD54/74HCT193

Switching Specifications Input $t_r, t_f = 6\text{ns}$ (Continued)

| PARAMETER | SYMBOL | TEST CONDITIONS | V _{CC} (V) | 25°C | | | -40°C TO 85°C | | -55°C TO 125°C | | UNITS |
|---|-------------------------------------|-----------------------|---------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| CPD to Q _n | t _{PLH} , t _{PHL} | C _L = 50pF | 2 | - | - | 220 | - | 270 | - | 325 | ns |
| | | C _L = 50pF | 4.5 | - | - | 43 | - | 54 | - | 65 | ns |
| | | C _L = 15pF | 5 | - | 18 | - | - | - | - | - | ns |
| | | C _L = 50pF | 6 | - | - | 37 | - | 46 | - | 55 | ns |
| P _L to Q _n | t _{PLH} , t _{PHL} | C _L = 50pF | 2 | - | - | 220 | - | 275 | - | 330 | ns |
| | | C _L = 50pF | 4.5 | - | - | 44 | - | 55 | - | 66 | ns |
| | | C _L = 15pF | 5 | - | 18 | - | - | - | - | - | ns |
| | | C _L = 50pF | 6 | - | - | 37 | - | 47 | - | 56 | ns |
| MR to Q _n | t _{PHL} | C _L = 50pF | 2 | - | - | 200 | - | 250 | - | 300 | ns |
| | | C _L = 50pF | 4.5 | - | - | 40 | - | 50 | - | 60 | ns |
| | | C _L = 15pF | 5 | - | 17 | - | - | - | - | - | ns |
| | | C _L = 50pF | 6 | - | - | 34 | - | 43 | - | 51 | ns |
| Transition Time Q, TCU, TCD | t _{TLH} , t _{THL} | C _L = 50pF | 2 | - | - | 75 | - | 95 | - | 110 | ns |
| | | | 4.5 | - | - | 15 | - | 19 | - | 22 | ns |
| | | | 6 | - | - | 13 | - | 16 | - | 19 | ns |
| Input Capacitance | C _{IN} | C _L = 50pF | - | - | - | 10 | - | 10 | - | 10 | pF |
| Power Dissipation Capacitance (Notes 3, 4) | C _{PD} | C _L = 15pF | 5 | - | 40 | - | - | - | - | - | pF |
| HCT TYPES | | | | | | | | | | | |
| Propagation Delay CPU to TCU | t _{PLH} , t _{PHL} | C _L = 50pF | 4.5 | - | - | 27 | - | 34 | - | 41 | ns |
| | | C _L = 15pF | 5 | - | 11 | - | - | - | - | - | ns |
| CPU to TCD | t _{PLH} , t _{PHL} | C _L = 50pF | 4.5 | - | - | 27 | - | 34 | - | 41 | ns |
| | | C _L = 15pF | 5 | - | 11 | - | - | - | - | - | ns |
| CPU to Q _n | t _{PLH} , t _{PHL} | C _L = 50pF | 4.5 | - | - | 40 | - | 50 | - | 60 | ns |
| | | C _L = 15pF | 5 | - | 17 | - | - | - | - | - | ns |
| CPD to Q _n | t _{PLH} , t _{PHL} | C _L = 50pF | 4.5 | - | - | 40 | - | 50 | - | 60 | ns |
| | | C _L = 15pF | 5 | - | 17 | - | - | - | - | - | ns |
| P _L to Q _n | t _{PLH} , t _{PHL} | C _L = 50pF | 4.5 | - | - | 46 | - | 58 | - | 69 | ns |
| | | C _L = 15pF | 5 | - | 21 | - | - | - | - | - | ns |
| MR to Q _n | t _{PHL} | C _L = 50pF | 4.5 | - | - | 43 | - | 54 | - | 65 | ns |
| | | C _L = 15pF | 5 | - | 18 | - | - | - | - | - | ns |
| Transition Time Q, TCU, TCD | t _{TLH} , t _{THL} | C _L = 50pF | 2 | - | - | 75 | - | 95 | - | 110 | ns |
| | | | 4.5 | - | - | 15 | - | 19 | - | 22 | ns |
| Input Capacitance | C _{IN} | C _L = 50pF | - | - | - | 10 | - | 10 | - | 10 | pF |
| Power Dissipation Capacitance (Notes 3, 4) | C _{PD} | C _L = 15pF | 5 | - | 50 | - | - | - | - | - | pF |

NOTES:

- C_{PD} is used to determine the dynamic power consumption, per gate.
- $P_D = V_{CC}^2 f_i + \sum (C_L V_{CC}^2)$ where f_i = Input Frequency, C_L = Output Load Capacitance, V_{CC} = Supply Voltage.

Test Circuits and Waveforms

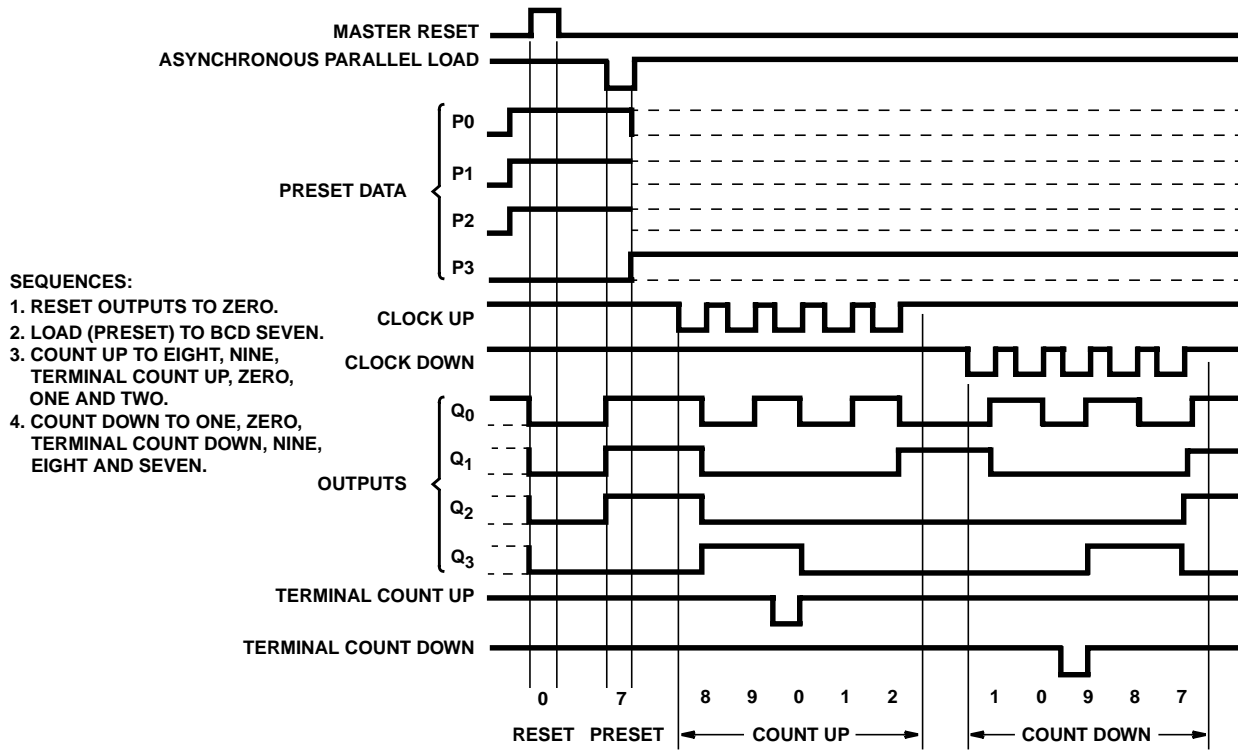


FIGURE 1. 'HC192 SYNCHRONOUS DECADE COUNTERS, TYPICAL RESET, PRESET AND COUNT SEQUENCES

Test Circuits and Waveforms (Continued)

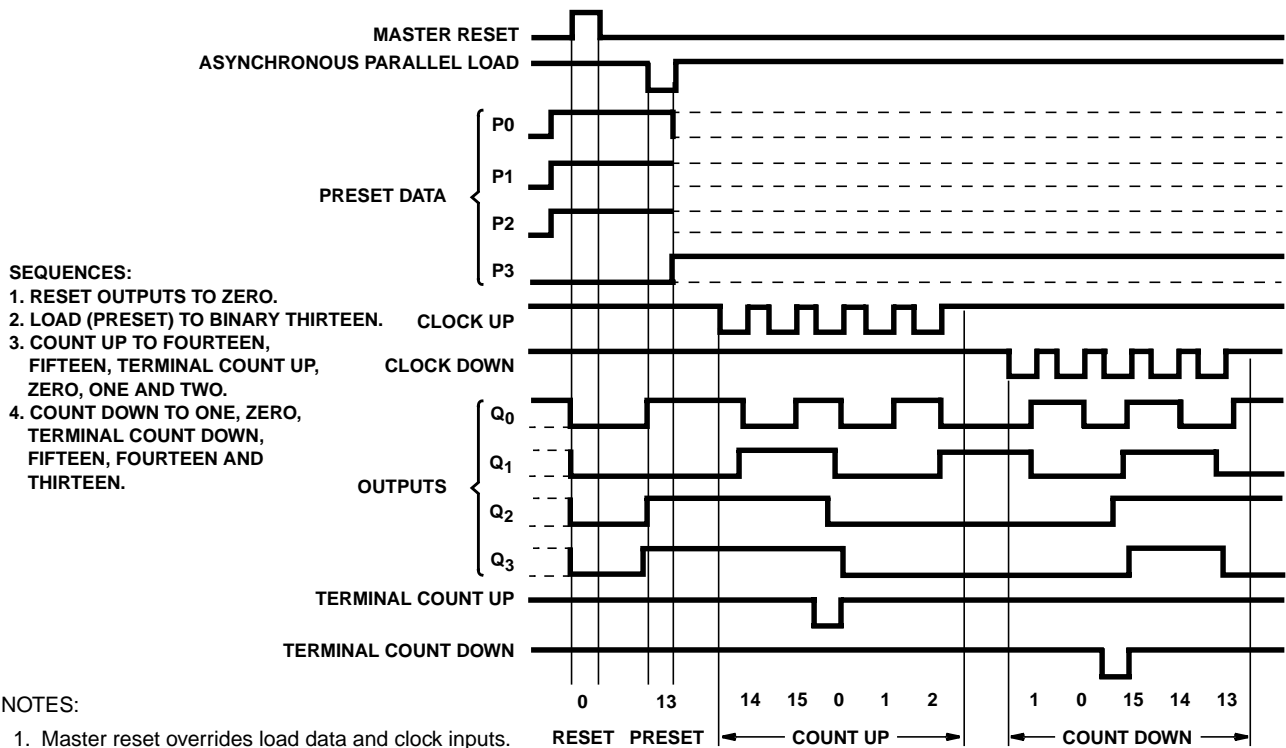


FIGURE 2. 'HC193 SYNCHRONOUS BINARY COUNTERS, TYPICAL RESET, PRESET AND COUNT SEQUENCES

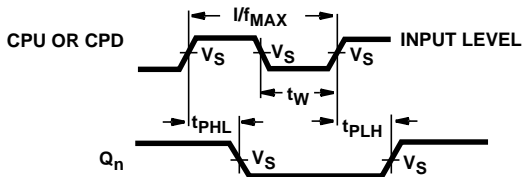


FIGURE 3. CLOCK TO OUTPUT DELAYS AND CLOCK PULSE WIDTH

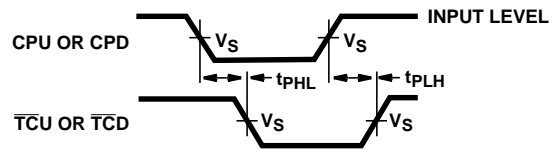


FIGURE 4. CLOCK TO TERMINAL COUNT DELAYS

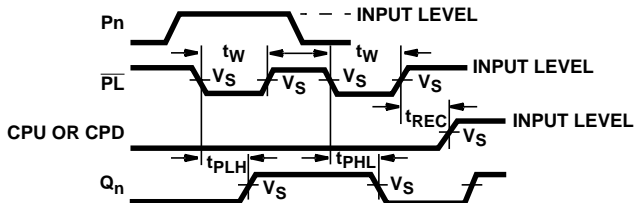


FIGURE 5. PARALLEL LOAD PULSE WIDTH, PARALLEL LOAD TO OUTPUT DELAYS, AND PARALLEL LOAD TO CLOCK RECOVERY TIME

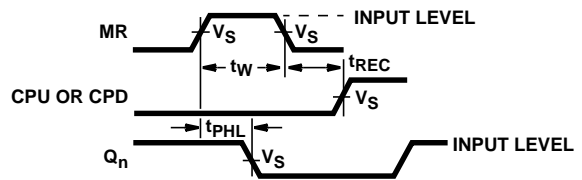


FIGURE 6. MASTER RESET PULSE WIDTH, MASTER RESET TO OUTPUT DELAY AND MASTER RESET TO CLOCK RECOVERY TIME

Test Circuits and Waveforms (Continued)

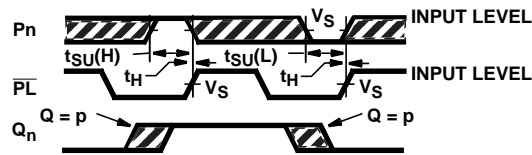


FIGURE 7. SET-UP AND HOLD TIMES DATA TO PARALLEL LOAD (PL)

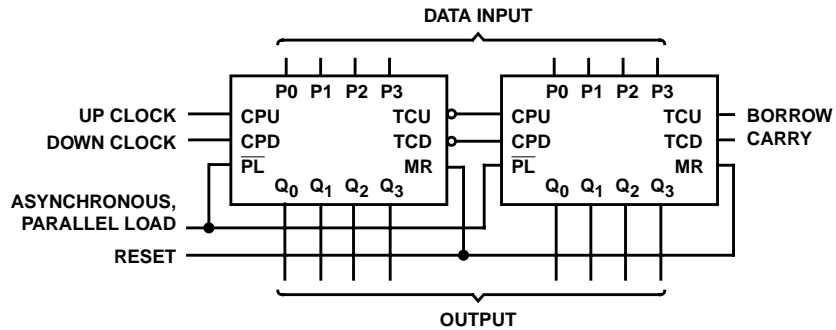
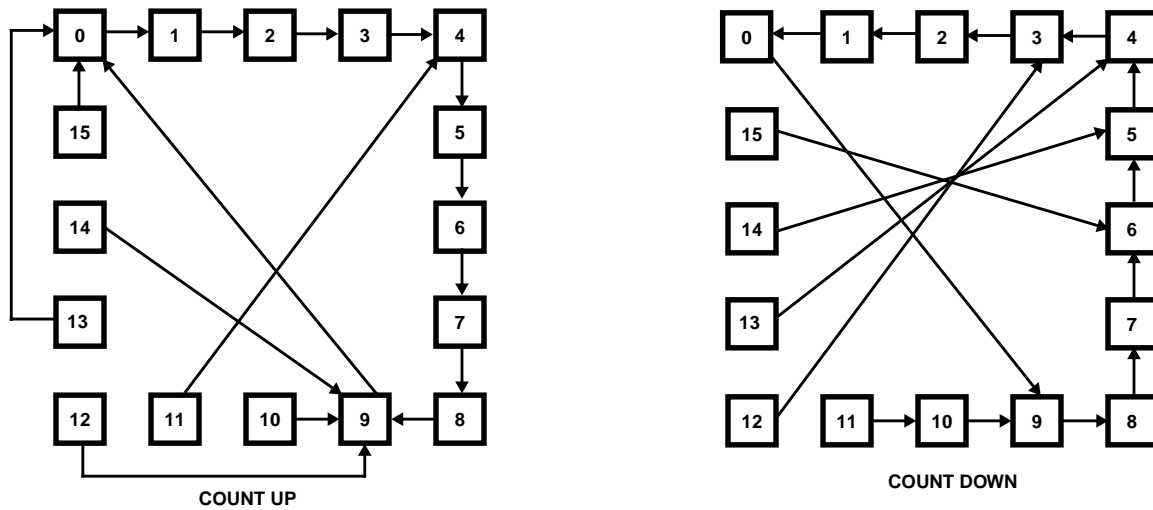


FIGURE 8. CASCADED UP/DOWN COUNTER WITH PARALLEL LOAD



NOTE: Illegal states in BCD counters corrected in one count.

NOTE: Illegal states in BCD counters corrected in one or two counts.

FIGURE 9. 'HC192, 'HCT193 STATE DIAGRAMS

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 5962-8780801EA | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| 5962-9084801MEA | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| 9084801MEAS2035 | OBSOLETE | CDIP | J | 16 | | TBD | Call TI | Call TI |
| CD54HC192F3A | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| CD54HC193F3A | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| CD54HCT193F3A | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| CD74HC192E | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| CD74HC192EE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| CD74HC192NSR | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC192NSRE4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC192NSRG4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC192PWE4 | ACTIVE | TSSOP | PW | 16 | | TBD | Call TI | Call TI |
| CD74HC192PWG4 | ACTIVE | TSSOP | PW | 16 | | TBD | Call TI | Call TI |
| CD74HC192PWR | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC192PWRE4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC192PWRG4 | ACTIVE | TSSOP | PW | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC192PWT | ACTIVE | TSSOP | PW | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC192PWTE4 | ACTIVE | TSSOP | PW | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC192PWTG4 | ACTIVE | TSSOP | PW | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC193E | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| CD74HC193EE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| CD74HC193M | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC193M96 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC193M96E4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC193M96G4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC193ME4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC193MG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC193MT | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CD74HC193MTE4 | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HC193MTG4 | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD74HCT193E | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| CD74HCT193EE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |

⁽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



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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CD74HC192NSR | SO | NS | 16 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| CD74HC192PWR | TSSOP | PW | 16 | 2000 | 330.0 | 12.4 | 7.0 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| CD74HC193M96 | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 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) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CD74HC192NSR | SO | NS | 16 | 2000 | 346.0 | 346.0 | 33.0 |
| CD74HC192PWR | TSSOP | PW | 16 | 2000 | 346.0 | 346.0 | 29.0 |
| CD74HC193M96 | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



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

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- 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**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| 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) |

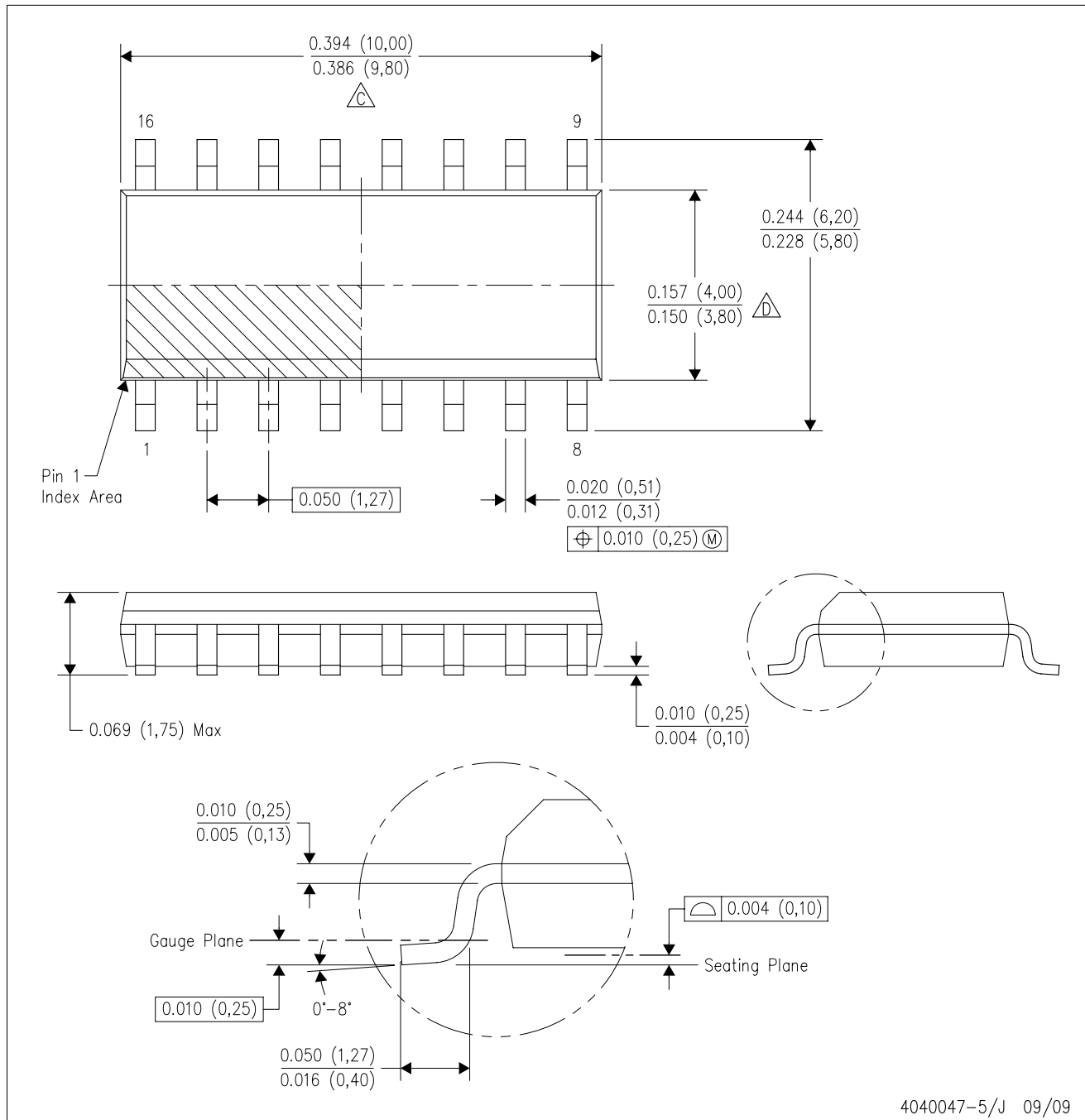


4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package is hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

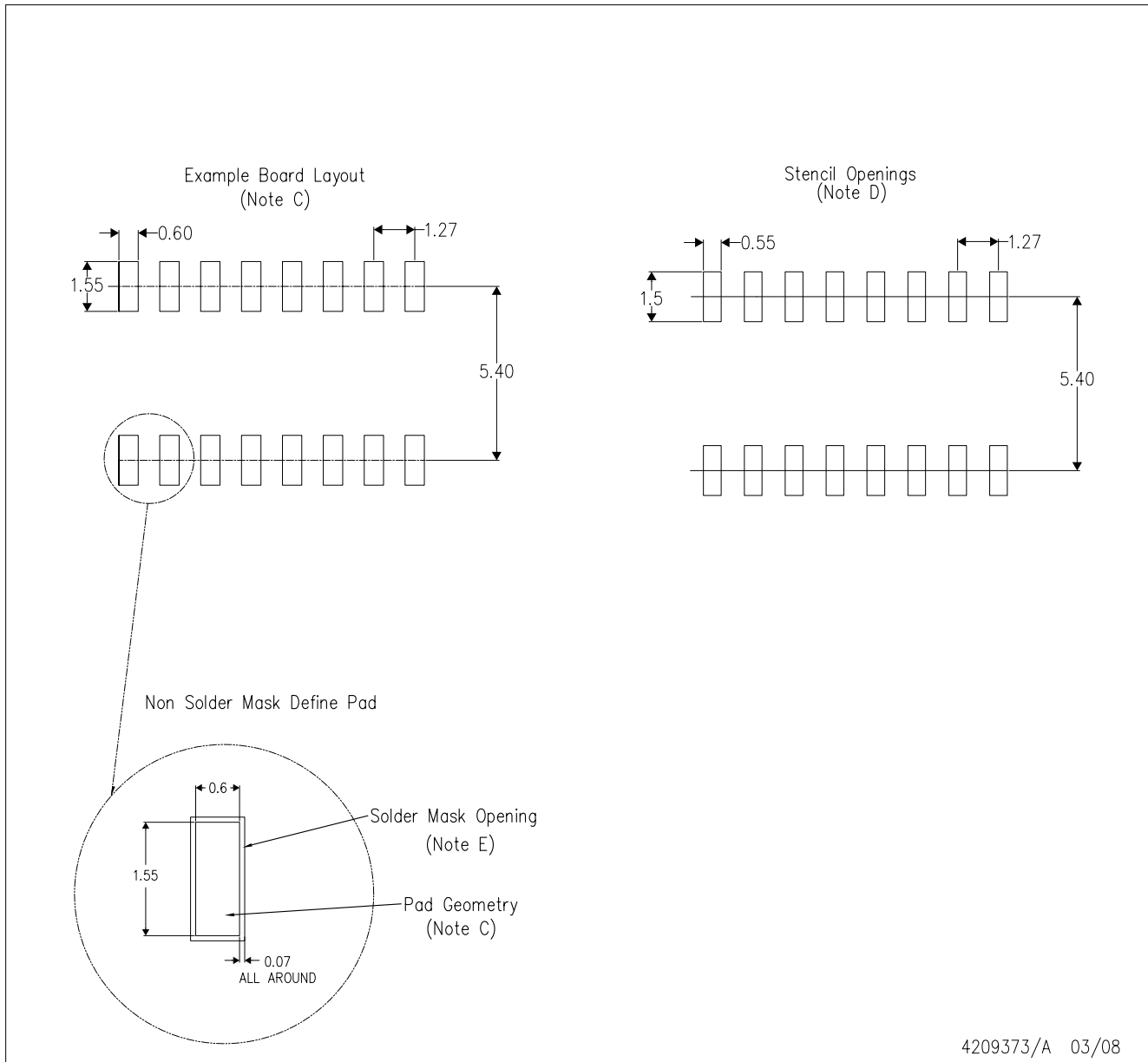
D (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



- 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 .006 (0,15) per end.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
 - E. Reference JEDEC MS-012 variation AC.

D(R-PDSO-G16)



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Refer to IPC7351 for alternate board design.
 - 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
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



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

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