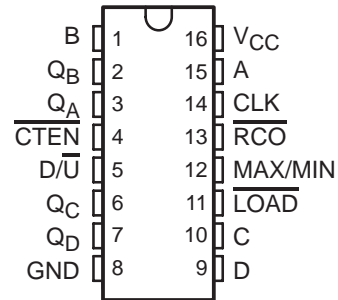


SN54HC191, SN74HC191 4-BIT SYNCHRONOUS UP/DOWN BINARY COUNTERS

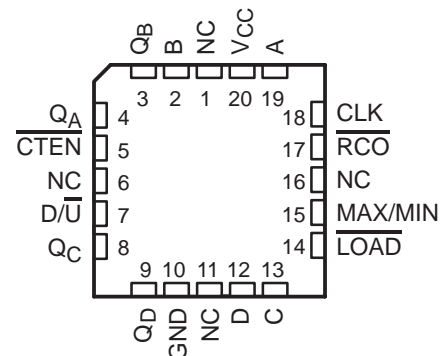
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- Wide Operating Voltage Range of 2 V to 6 V
- Outputs Can Drive Up To 10 LSTTL Loads
- Low Power Consumption, 80- μ A Max I_{CC}
- Typical $t_{pd} = 13$ ns
- ± 4 -mA Output Drive at 5 V
- Low Input Current of 1 μ A Max
- Single Down/Up Count-Control Line
- Look-Ahead Circuitry Enhances Speed of Cascaded Counters
- Fully Synchronous in Count Modes
- Asynchronously Presetable With Load Control

SN54HC191 . . . J OR W PACKAGE
SN74HC191 . . . D, N, OR NS PACKAGE
(TOP VIEW)



SN54HC191 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description/ordering information

The 'HC191 devices are 4-bit synchronous, reversible, up/down binary counters. Synchronous counting operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident with each other when instructed by the steering logic. This mode of operation eliminates the output counting spikes normally associated with asynchronous (ripple-clock) counters.

The outputs of the four flip-flops are triggered on a low- to high-level transition of the clock (CLK) input if the count-enable (\overline{CTEN}) input is low. A high at \overline{CTEN} inhibits counting. The direction of the count is determined by the level of the down/up (D/\overline{U}) input. When D/\overline{U} is low, the counter counts up, and when D/\overline{U} is high, it counts down.

ORDERING INFORMATION

| TA | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|--------------|--------------|-----------------------|------------------|
| -40°C to 85°C | PDIP – N | Tube of 25 | SN74HC191N | SN74HC191N |
| | SOIC – D | Tube of 40 | SN74HC191D | HC191 |
| | | Reel of 2500 | SN74HC191DR | |
| | | Reel of 250 | SN74HC191DT | |
| SOP – NS | Reel of 2000 | SN74HC191NSR | HC191 | |
| -55°C to 125°C | CDIP – J | Tube of 25 | SNJ54HC191J | SNJ54HC191J |
| | CFP – W | Tube of 150 | SNJ54HC191W | SNJ54HC191W |
| | LCCC – FK | Tube of 55 | SNJ54HC191FK | SNJ54HC191FK |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS
INSTRUMENTS**

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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

SN54HC191, SN74HC191

4-BIT SYNCHRONOUS UP/DOWN BINARY COUNTERS

SCLS121D – DECEMBER 1982 – REVISED OCTOBER 2003

description/ordering information (continued)

These counters feature a fully independent clock circuit. Change at the control (\overline{CTEN} and D/\overline{U}) inputs that modifies the operating mode have no effect on the contents of the counter until clocking occurs. The function of the counter is dictated solely by the condition meeting the stable setup and hold times.

These counters are fully programmable; that is, each of the outputs can be preset to either level by placing a low on the load (\overline{LOAD}) input and entering the desired data at the data inputs. The output changes to agree with the data inputs independently of the level of CLK. This feature allows the counters to be used as modulo-N dividers simply by modifying the count length with the preset inputs.

Two outputs are available to perform the cascading function: ripple clock (\overline{RCO}) and maximum/minimum (MAX/MIN) count. MAX/MIN produces a high-level output pulse with a duration approximately equal to one complete cycle of the clock while the count is zero (all outputs low) counting down, or maximum (9 or 15) counting up. \overline{RCO} produces a low-level output pulse under those same conditions, but only while CLK is low. The counters can be cascaded easily by feeding \overline{RCO} to \overline{CTEN} of the succeeding counter if parallel clocking is used, or to CLK if parallel enabling is used. MAX/MIN can be used to accomplish look ahead for high-speed operation.

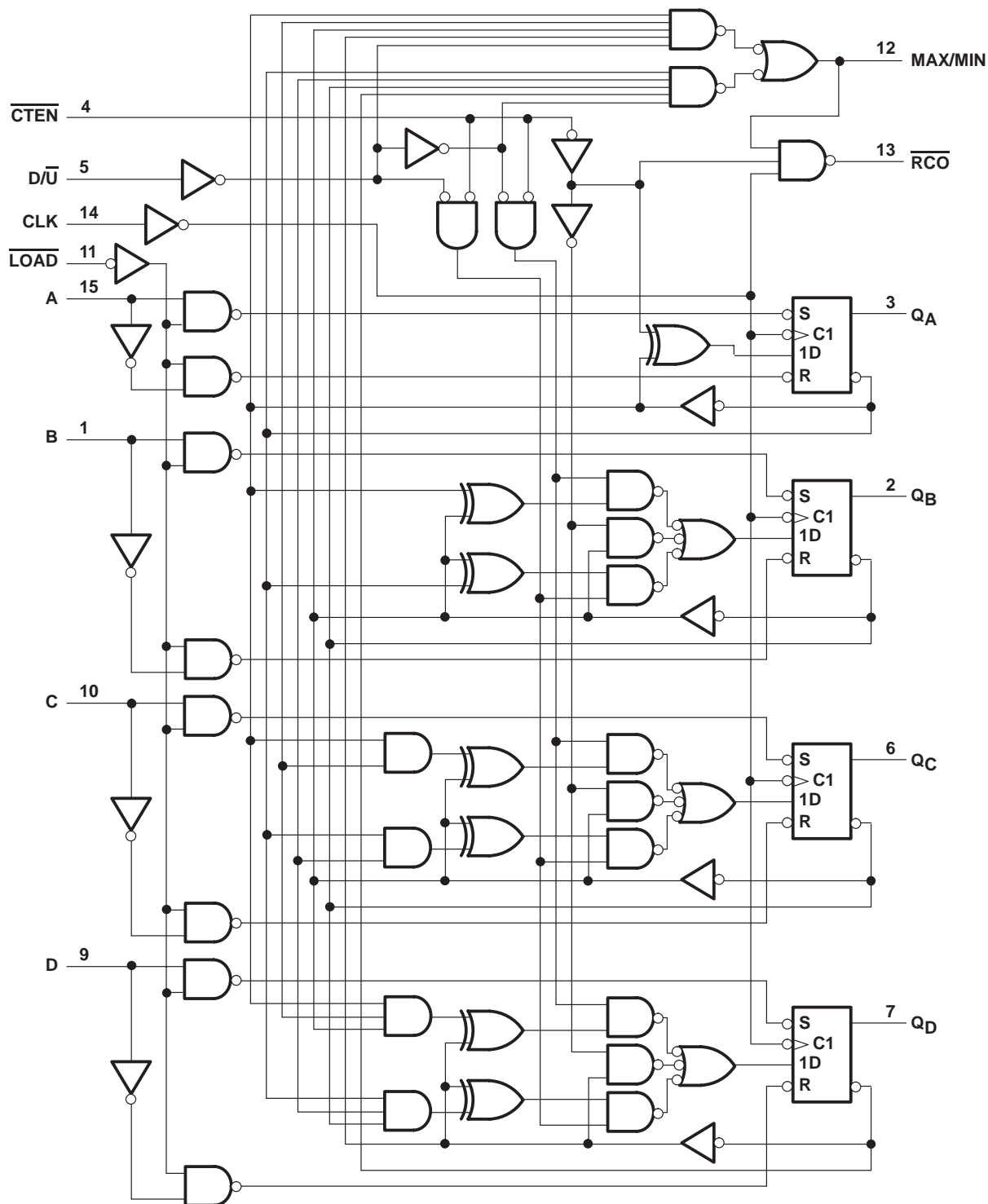


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SN54HC191, SN74HC191 4-BIT SYNCHRONOUS UP/DOWN BINARY COUNTERS

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logic diagram (positive logic)



Pin numbers shown are for the D, J, N, NS, and W packages.

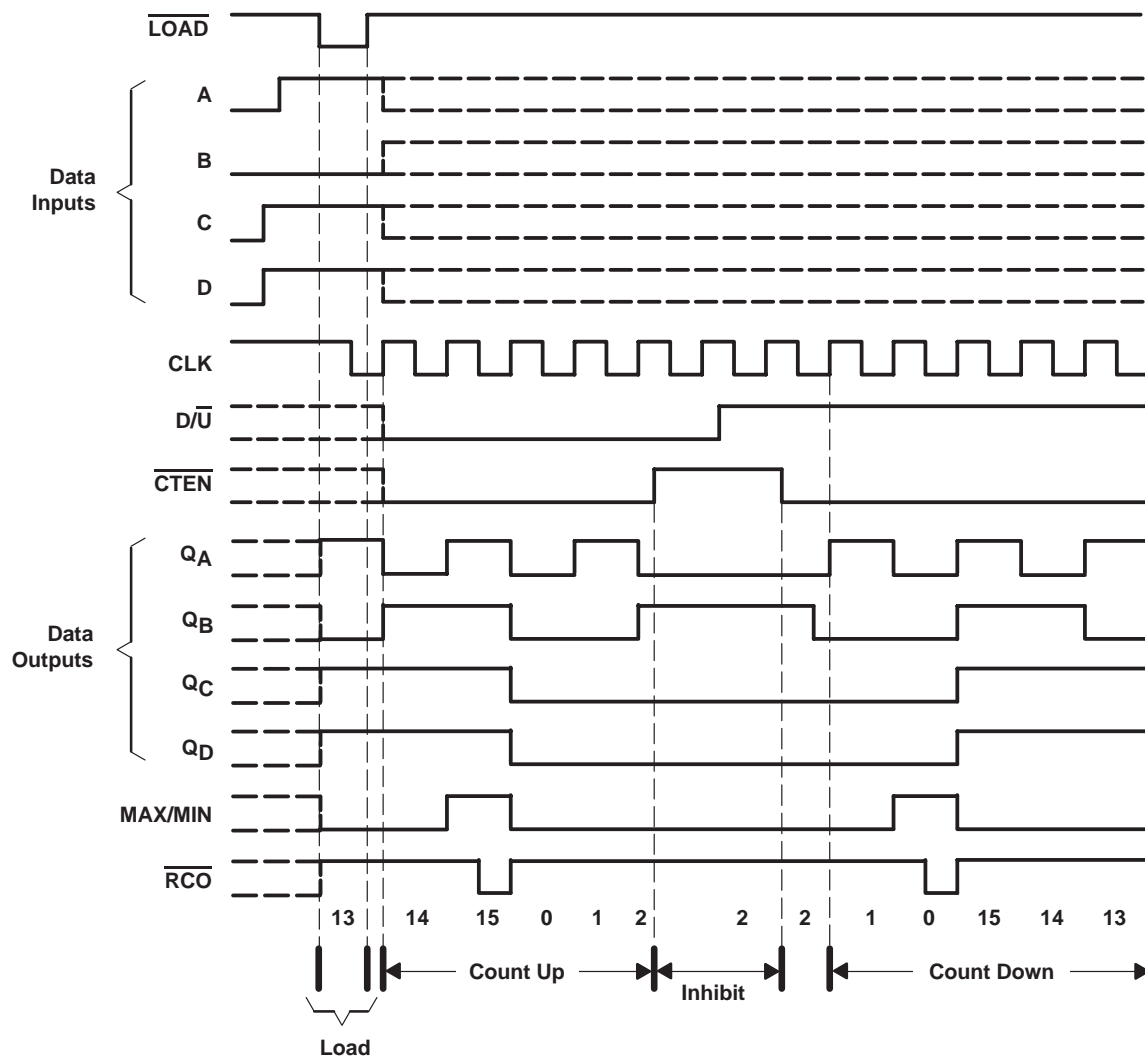
SN54HC191, SN74HC191 4-BIT SYNCHRONOUS UP/DOWN BINARY COUNTERS

SCLS121D – DECEMBER 1982 – REVISED OCTOBER 2003

typical load, count, and inhibit sequence

The following sequence is illustrated below:

1. Load (preset) to binary 13
2. Count up to 14, 15 (maximum), 0, 1, and 2
3. Inhibit
4. Count down to 1, 0 (minimum), 15, 14, and 13



SN54HC191, SN74HC191

4-BIT SYNCHRONOUS UP/DOWN BINARY COUNTERS

SCLS121D – DECEMBER 1982 – REVISED OCTOBER 2003

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

| | |
|---|----------------|
| Supply voltage range, V_{CC} | –0.5 V to 7 V |
| Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$) (see Note 1) | ±20 mA |
| Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) (see Note 1) | ±20 mA |
| Continuous output current, I_O ($V_O = 0$ to V_{CC}) | ±25 mA |
| Continuous current through V_{CC} or GND | ±50 mA |
| Package thermal impedance, θ_{JA} (see Note 2): D package | 73°C/W |
| N package | 67°C/W |
| NS package | 64°C/W |
| 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.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
 2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 3)

| | | SN54HC191 | | | SN74HC191 | | | UNIT |
|-----------------------|---------------------------------|------------------|-----|----------|------------------|------------------|----------|------|
| | | MIN | NOM | MAX | MIN | NOM | MAX | |
| V_{CC} | Supply voltage | 2 | 5 | 6 | 2 | 5 | 6 | V |
| V_{IH} | High-level input voltage | $V_{CC} = 2$ V | | 1.5 | $V_{CC} = 2$ V | | 1.5 | V |
| | | $V_{CC} = 4.5$ V | | 3.15 | $V_{CC} = 4.5$ V | | 3.15 | |
| | | $V_{CC} = 6$ V | | 4.2 | $V_{CC} = 6$ V | | 4.2 | |
| V_{IL} | Low-level input voltage | $V_{CC} = 2$ V | | | 0.5 | $V_{CC} = 2$ V | | 0.5 |
| | | $V_{CC} = 4.5$ V | | | 1.35 | $V_{CC} = 4.5$ V | | 1.35 |
| | | $V_{CC} = 6$ V | | | 1.8 | $V_{CC} = 6$ V | | 1.8 |
| V_I | Input voltage | 0 | | V_{CC} | 0 | | V_{CC} | V |
| V_O | Output voltage | 0 | | V_{CC} | 0 | | V_{CC} | V |
| $\Delta t/\Delta v$ ‡ | Input transition rise/fall time | $V_{CC} = 2$ V | | | 1000 | $V_{CC} = 2$ V | | 1000 |
| | | $V_{CC} = 4.5$ V | | | 500 | $V_{CC} = 4.5$ V | | 500 |
| | | $V_{CC} = 6$ V | | | 400 | $V_{CC} = 6$ V | | 400 |
| T_A | Operating free-air temperature | –55 | | 125 | –40 | | 85 | °C |

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

‡ If this device is used in the threshold region (from $V_{ILmax} = 0.5$ V to $V_{IHmin} = 1.5$ V), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at $t_f = 1000$ ns and $V_{CC} = 2$ V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.



SN54HC191, SN74HC191

4-BIT SYNCHRONOUS UP/DOWN BINARY COUNTERS

SCLS121D – DECEMBER 1982 – REVISED OCTOBER 2003

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | | V _{CC} | T _A = 25°C | | | SN54HC191 | | SN74HC191 | | UNIT |
|-----------------|---|---------------------------|-----------------|-----------------------|-------|------|-----------|-------|-----------|-------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| V _{OH} | V _I = V _{IH} or V _{IL} | I _{OH} = -20 μA | 2 V | 1.9 | 1.998 | | 1.9 | | 1.9 | V | |
| | | | 4.5 V | 4.4 | 4.499 | | 4.4 | | 4.4 | | |
| | | | 6 V | 5.9 | 5.999 | | 5.9 | | 5.9 | | |
| | | I _{OH} = -4 mA | 4.5 V | 3.98 | 4.3 | | 3.7 | | 3.84 | | |
| | | I _{OH} = -5.2 mA | 6 V | 5.48 | 5.8 | | 5.2 | | 5.34 | | |
| V _{OL} | V _I = V _{IH} or V _{IL} | I _{OL} = 20 μA | 2 V | | 0.002 | 0.1 | | 0.1 | | 0.1 | V |
| | | | 4.5 V | | 0.001 | 0.1 | | 0.1 | | 0.1 | |
| | | | 6 V | | 0.001 | 0.1 | | 0.1 | | 0.1 | |
| | | I _{OL} = 4 mA | 4.5 V | | 0.17 | 0.26 | | 0.4 | | 0.33 | |
| | | I _{OL} = 5.2 mA | 6 V | | 0.15 | 0.26 | | 0.4 | | 0.33 | |
| I _I | V _I = V _{CC} or 0 | | 6 V | | ±0.1 | ±100 | | ±1000 | | ±1000 | nA |
| I _{CC} | V _I = V _{CC} or 0, I _O = 0 | | 6 V | | | 8 | | 160 | | 80 | μA |
| C _i | | | 2 V to 6 V | | 3 | 10 | | 10 | | 10 | pF |



SN54HC191, SN74HC191

4-BIT SYNCHRONOUS UP/DOWN BINARY COUNTERS

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timing requirements over recommended operating free-air temperature range (unless otherwise noted)

| | | V _{CC} | T _A = 25°C | | SN54HC191 | | SN74HC191 | | UNIT |
|--------------------|--|-----------------|-----------------------|-----|-----------|-----|-----------|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| f _{clock} | Clock frequency | 2 V | 4.2 | | 2.8 | | 3.3 | | MHz |
| | | 4.5 V | 21 | | 14 | | 17 | | |
| | | 6 V | 24 | | 16 | | 19 | | |
| t _w | LOAD low | 2 V | 120 | | 180 | | 150 | ns | |
| | | 4.5 V | 24 | | 36 | | 30 | | |
| | | 6 V | 21 | | 31 | | 26 | | |
| | CLK high or low | 2 V | 120 | | 180 | | 150 | | |
| | | 4.5 V | 24 | | 36 | | 30 | | |
| | | 6 V | 21 | | 31 | | 26 | | |
| t _{su} | Data before $\overline{\text{LOAD}}\uparrow$ | 2 V | 150 | | 230 | | 188 | ns | |
| | | 4.5 V | 30 | | 46 | | 38 | | |
| | | 6 V | 25 | | 38 | | 32 | | |
| | $\overline{\text{CTEN}}$ before CLK \uparrow | 2 V | 205 | | 306 | | 255 | | |
| | | 4.5 V | 41 | | 61 | | 51 | | |
| | | 6 V | 35 | | 53 | | 44 | | |
| | D/ $\overline{\text{U}}$ before CLK \uparrow | 2 V | 205 | | 306 | | 255 | | |
| | | 4.5 V | 41 | | 61 | | 51 | | |
| | | 6 V | 35 | | 53 | | 44 | | |
| | LOAD inactive before CLK \uparrow | 2 V | 150 | | 225 | | 190 | | |
| | | 4.5 V | 30 | | 45 | | 38 | | |
| | | 6 V | 25 | | 38 | | 32 | | |
| t _h | Data after $\overline{\text{LOAD}}\uparrow$ | 2 V | 5 | | 5 | | 5 | ns | |
| | | 4.5 V | 5 | | 5 | | 5 | | |
| | | 6 V | 5 | | 5 | | 5 | | |
| | $\overline{\text{CTEN}}$ after CLK \uparrow | 2 V | 5 | | 5 | | 5 | | |
| | | 4.5 V | 5 | | 5 | | 5 | | |
| | | 6 V | 5 | | 5 | | 5 | | |
| | D/ $\overline{\text{U}}$ after CLK \uparrow | 2 V | 5 | | 5 | | 5 | | |
| | | 4.5 V | 5 | | 5 | | 5 | | |
| | | 6 V | 5 | | 5 | | 5 | | |

SN54HC191, SN74HC191

4-BIT SYNCHRONOUS UP/DOWN BINARY COUNTERS

SCLS121D – DECEMBER 1982 – REVISED OCTOBER 2003

switching characteristics over recommended operating free-air temperature range, $C_L = 50$ pF (unless otherwise noted) (see Figure 1)

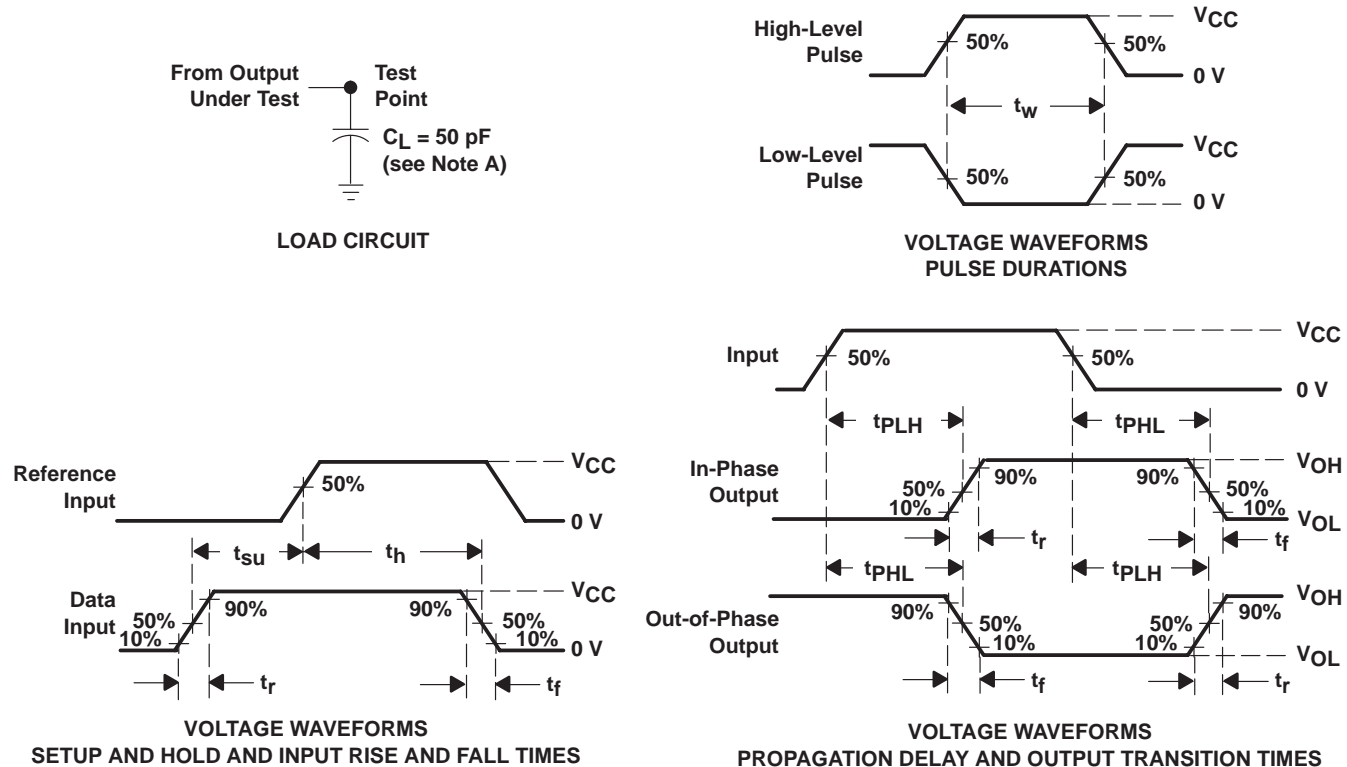
| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CC} | T _A = 25°C | | | SN54HC191 | | SN74HC191 | | UNIT | |
|------------------|--------------------------|--|-------------------------|-----------------------|-----|-----|-----------|-----|-----------|-----|------|-----|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | | |
| f _{max} | | | 2 V | 4.2 | 8 | | 2.8 | | 3.3 | MHz | | |
| | | | 4.5 V | 21 | 42 | | 14 | | 17 | | | |
| | | | 6 V | 24 | 48 | | 16 | | 19 | | | |
| t _{pd} | $\overline{\text{LOAD}}$ | Any Q | 2 V | | 130 | 264 | | 396 | | 330 | ns | |
| | | | 4.5 V | | 40 | 53 | | 79 | | 66 | | |
| | | | 6 V | | 33 | 45 | | 67 | | 56 | | |
| | A, B, C, or D | Q _A , Q _B , Q _C , or Q _D | 2 V | | 135 | 240 | | 360 | | 300 | | |
| | | | 4.5 V | | 36 | 48 | | 72 | | 60 | | |
| | | | 6 V | | 30 | 41 | | 61 | | 51 | | |
| | CLK | $\overline{\text{RCO}}$ | 2 V | | 58 | 120 | | 180 | | 150 | | |
| | | | 4.5 V | | 17 | 24 | | 36 | | 30 | | |
| | | | 6 V | | 14 | 21 | | 31 | | 26 | | |
| | | Any Q | 2 V | | 107 | 192 | | 288 | | 240 | | |
| | | | 4.5 V | | 31 | 38 | | 58 | | 48 | | |
| | | | 6 V | | 26 | 32 | | 49 | | 41 | | |
| | | MAX/MIN | 2 V | | 123 | 252 | | 378 | | 315 | | |
| | | | 4.5 V | | 39 | 50 | | 76 | | 63 | | |
| | | | 6 V | | 32 | 43 | | 65 | | 54 | | |
| | | D/ $\overline{\text{U}}$ | $\overline{\text{RCO}}$ | 2 V | | 102 | 228 | | 342 | | | 285 |
| | | | | 4.5 V | | 29 | 46 | | 68 | | | 57 |
| | | | | 6 V | | 24 | 38 | | 59 | | | 49 |
| | MAX/MIN | | 2 V | | 86 | 192 | | 288 | | 240 | | |
| | | | 4.5 V | | 24 | 38 | | 58 | | 48 | | |
| | | | 6 V | | 20 | 32 | | 49 | | 41 | | |
| | $\overline{\text{CTEN}}$ | $\overline{\text{RCO}}$ | 2 V | | 50 | 132 | | 198 | | 165 | | |
| | | | 4.5 V | | 15 | 26 | | 40 | | 33 | | |
| | | | 6 V | | 13 | 23 | | 34 | | 28 | | |
| t _t | | Any | 2 V | | 38 | 75 | | 110 | | 95 | ns | |
| | | | 4.5 V | | 8 | 15 | | 22 | | 19 | | |
| | | | 6 V | | 6 | 13 | | 19 | | 16 | | |

operating characteristics, T_A = 25°C

| PARAMETER | TEST CONDITIONS | TYP | UNIT |
|---|-----------------|-----|------|
| C _{pd} Power dissipation capacitance | No load | 50 | pF |



PARAMETER MEASUREMENT INFORMATION



- NOTES:
- C_L includes probe and test-fixture capacitance.
 - Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r = 6 \text{ ns}$, $t_f = 6 \text{ ns}$.
 - For clock inputs, f_{max} is measured when the input duty cycle is 50%.
 - The outputs are measured one at a time with one input transition per measurement.
 - t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 5962-86891012A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 5962-8689101EA | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| SN54HC191J | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| SN74HC191D | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74HC191DE4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74HC191DG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74HC191DR | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74HC191DRE4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74HC191DRG4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74HC191DT | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74HC191DTE4 | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74HC191DTG4 | ACTIVE | SOIC | D | 16 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74HC191N | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74HC191N3 | OBSOLETE | PDIP | N | 16 | | TBD | Call TI | Call TI |
| SN74HC191NE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74HC191NSR | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74HC191NSRE4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74HC191NSRG4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SNJ54HC191FK | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| SNJ54HC191J | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | 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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74HC191DR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74HC191NSR | 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) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74HC191DR | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| SN74HC191NSR | SO | NS | 16 | 2000 | 346.0 | 346.0 | 33.0 |

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.

FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a metal lid.
 - D. The terminals are gold plated.
 - E. Falls within JEDEC MS-004

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN

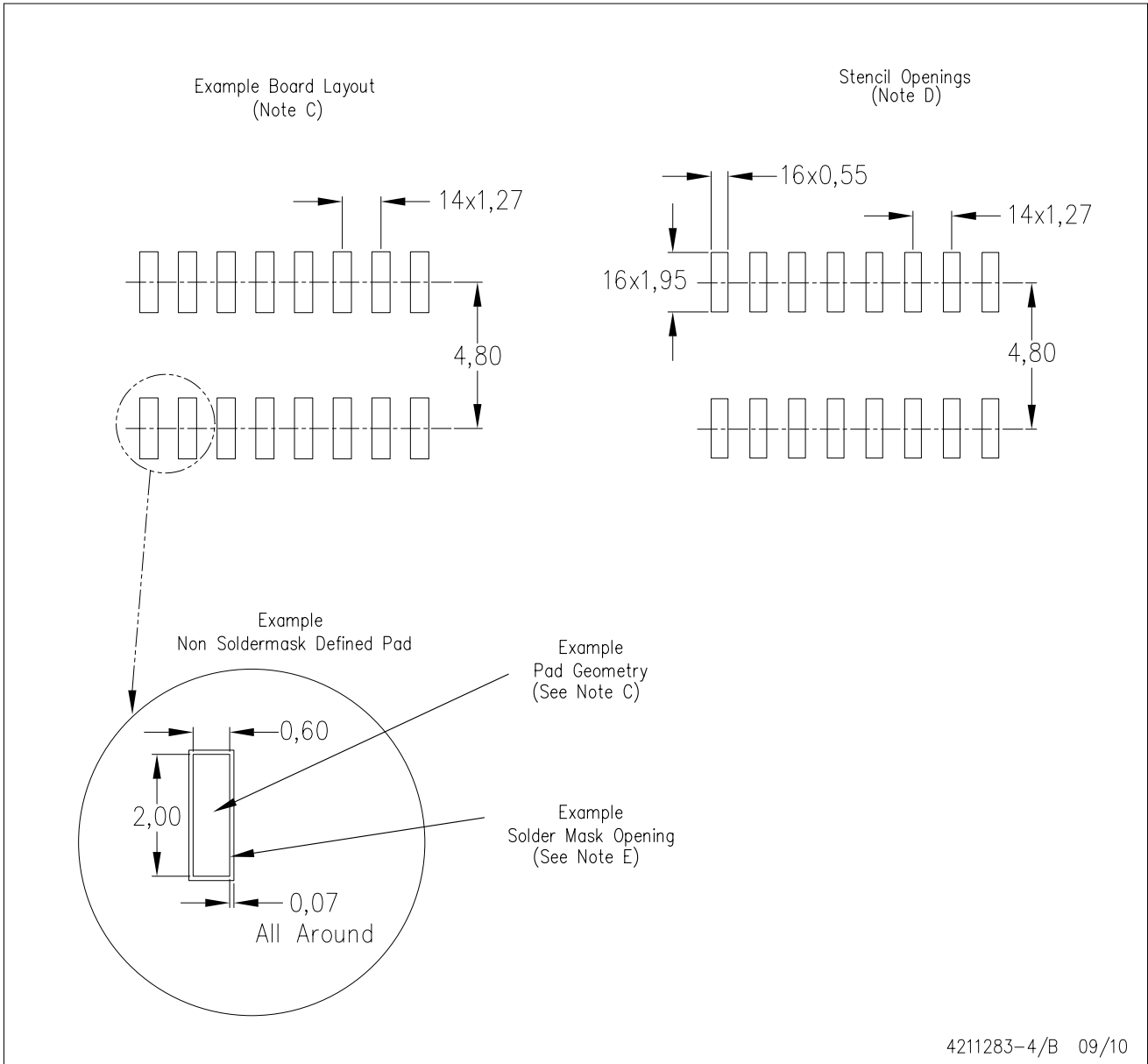


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - D The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- 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.

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.

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