

## SN54HC191-DIE 4-Bit Synchronous Up/Down Binary Counter

### 1 Features

- Wide Operating Voltage Range
- Low Power Consumption
- Low Input Current
- Single Down/Up Count-Control Line
- Look-Ahead Circuitry Enhances Speed of Cascaded Counters
- Fully Synchronous in Count Modes
- Asynchronously Presetable With Load Control

### 2 Description

The SN54HC191-DIE is a 4-bit synchronous, reversible, up/down binary counter. 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.

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 (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 (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. 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 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.

### Ordering Information<sup>(1)</sup>

| PRODUCT   | PACKAGE DESIGNATOR | PACKAGE                                | ORDERABLE PART NUMBER | PACKAGE QUANTITY |
|-----------|--------------------|--|-----------------------|------------------|
| SN54HC191 | TD                 | Bare die in waffle pack <sup>(2)</sup> | SN54HC191TDE1         | 154              |
|           |                    |  | SN54HC191TDE2         | 10               |

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at [www.ti.com](http://www.ti.com).

(2) Processing is per the Texas Instruments space production baseline and is in compliance with the Texas Instruments Quality Control System in effect at the time of manufacture. Electrical screening consists of DC parametric and functional testing at room temperature only. Unless otherwise specified by Texas Instruments AC performance and performance over temperature is not warranted. Visual Inspection is performed in accordance with MIL-STD-883 Test Method 2010 Condition B at 75X minimum.



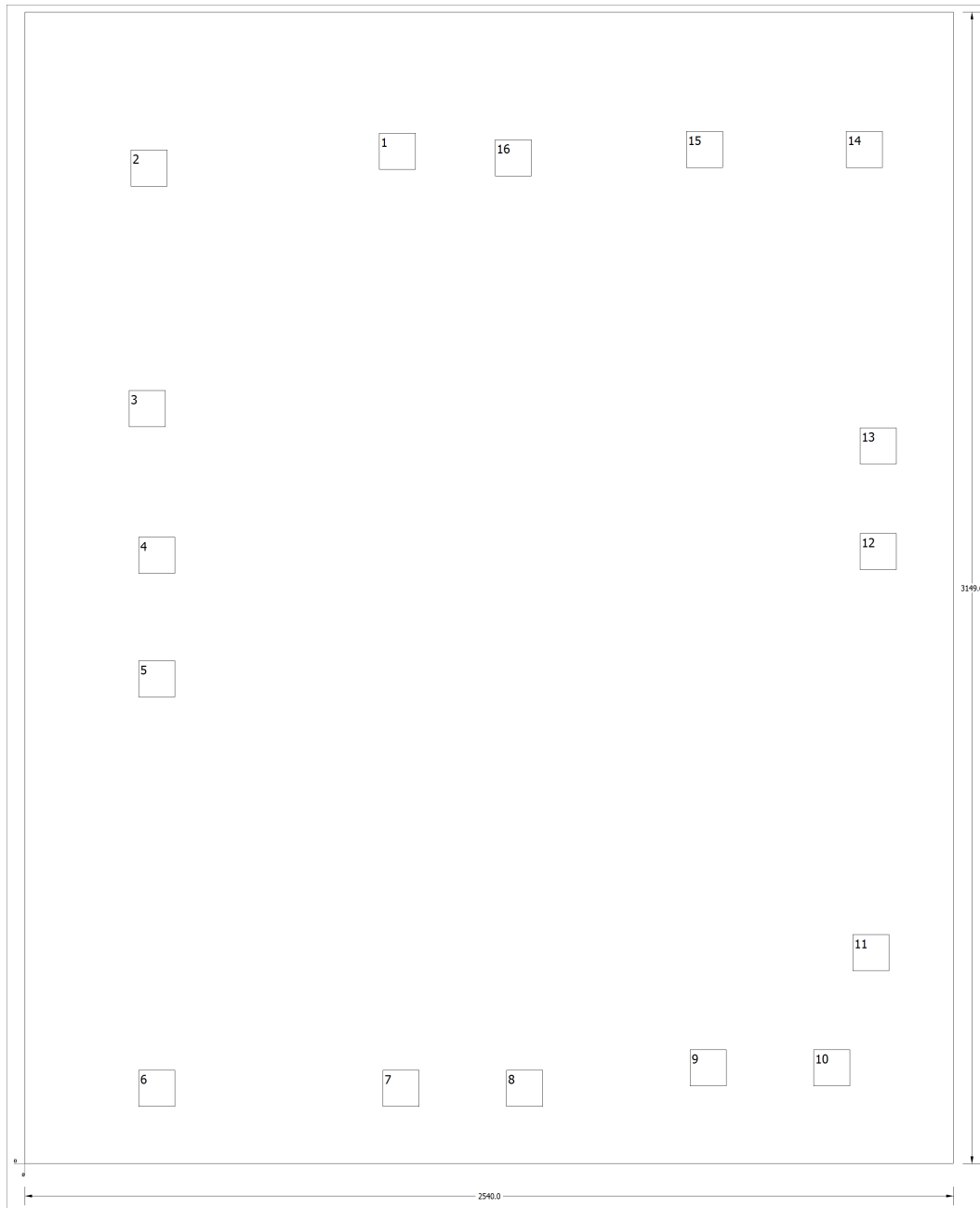


This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 3 Bare Die Information

| DIE THICKNESS | BACKSIDE FINISH        | BACKSIDE POTENTIAL | BOND PAD METALLIZATION COMPOSITION | BOND PAD THICKNESS |
|---------------|------------------------|--------------------|------------------------------------|--------------------|
| 10.5 mils.    | Silicon with backgrind | Floating           | TiW/AlCu2%                         | 1199 nm            |



**Bond Pad Coordinates in Microns**

| DESCRIPTION                   | PAD NUMBER | X MIN    | Y MIN    | X MAX    | Y MAX    |
|-------------------------------|------------|----------|----------|----------|----------|
| B                             | 1          | 968.527  | 2718.587 | 1068.553 | 2818.613 |
| QB                            | 2          | 290.347  | 2672.867 | 390.373  | 2772.893 |
| QA                            | 3          | 285.267  | 2015.007 | 385.293  | 2115.033 |
| $\overline{\text{CTEN}}$      | 4          | 310.667  | 1613.687 | 410.693  | 1713.713 |
| $\text{D}\overline{\text{U}}$ | 5          | 310.667  | 1275.867 | 410.693  | 1375.893 |
| QC                            | 6          | 310.667  | 155.727  | 410.693  | 255.753  |
| QD                            | 7          | 978.687  | 155.727  | 1078.713 | 255.753  |
| GND                           | 8          | 1316.507 | 155.727  | 1416.533 | 255.753  |
| D                             | 9          | 1819.427 | 211.607  | 1919.453 | 311.633  |
| C                             | 10         | 2157.247 | 211.607  | 2257.273 | 311.633  |
| $\overline{\text{LOAD}}$      | 11         | 2263.927 | 526.567  | 2363.953 | 626.593  |
| MAX/MIN                       | 12         | 2284.247 | 1623.847 | 2384.273 | 1723.873 |
| $\overline{\text{RCO}}$       | 13         | 2284.247 | 1913.407 | 2384.273 | 2013.433 |
| CLK                           | 14         | 2246.147 | 2723.667 | 2346.173 | 2823.693 |
| A                             | 15         | 1809.267 | 2723.667 | 1909.293 | 2823.693 |
| VCC                           | 16         | 1286.027 | 2700.807 | 1386.053 | 2800.833 |

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---------|
| SN54HC191TDE1    | ACTIVE        |              |                 | 0    | 154         | RoHS & Green    | Call TI                              | N / A for Pkg Type   | 25 to 25     |                         | Samples |
| SN54HC191TDE2    | ACTIVE        |              |                 | 0    | 10          | RoHS & Green    | Call TI                              | N / A for Pkg Type   | 25 to 25     |                         | Samples |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
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