

# SN5497, SN7497 SYNCHRONOUS 6-BIT BINARY RATE MULTIPLIERS

SDLS130 – DECEMBER 1972 – REVISED MARCH 1988

- Perform Fixed-Rate or Variable-Rate Frequency Division
- For Applications in Arithmetic, Radar, Digital-to-Analog (D/A), Analog-to-Digital (A/D), and other Conversion Operations
- Typical Maximum Clock Frequency . . . 32 Megahertz

### description

These monolithic, fully synchronous, programmable counters utilize Series 54/74 TTL circuitry to achieve 32-megahertz typical maximum operating frequencies. These six-bit serial binary counters feature buffered clock, clear, and enable inputs to control the operation of the counter, and a strobe input to enable or inhibit the rate input/decoding AND-OR-INVERT gates. The outputs have additional gating for cascading and transferring unity-count rates.

|                        |   |    |           |
|------------------------|---|----|-----------|
| SN5497 . . . J PACKAGE |   |    |           |
| SN7497 . . . N PACKAGE |   |    |           |
| (TOP VIEW)             |   |    |           |
|                        |   |    |           |
| B1                     | 1 | 16 | VCC       |
| B4                     | 2 | 15 | B3        |
| B5                     | 3 | 14 | B2        |
| BO                     | 4 | 13 | CLR       |
| Z                      | 5 | 12 | UNITY/CAS |
| Y                      | 6 | 11 | EN in     |
| EN out                 | 7 | 10 | STRB      |
| GND                    | 8 | 9  | CLK       |

The counter is enabled when the clear, strobe, and enable inputs are low. With the counter enabled, the output frequency is equal to the input frequency multiplied by the rate input M and divided by 64, i.e.:

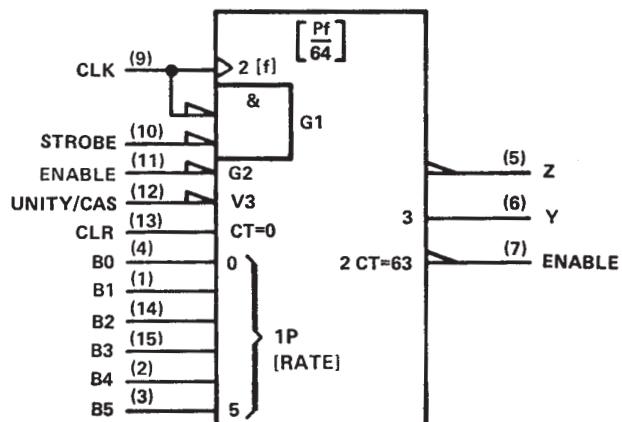
$$f_{out} = \frac{M \cdot f_{in}}{64}$$

where:  $M = F \cdot 2^5 + E \cdot 2^4 + D \cdot 2^3 + C \cdot 2^2 + B \cdot 2^1 + A \cdot 2^0$

When the rate input is binary 0 (all rate inputs low), Z remains high. In order to cascade devices to perform 12-bit rate multiplication, the enable output is connected to the enable and strobe inputs of the next stage, the Z output of each stage is connected to the unity/cascade input of the other stage, and the sub-multiple frequency is taken from the Y output.

The unity/cascade input, when connected to the clock input, may be utilized to pass the clock frequency (inverted) to the Y output when the rate input/decoding gates are inhibited by the strobe. The unity/cascade input may also be used as a control for the Y output.

### logic symbol†



<sup>†</sup>This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

**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.

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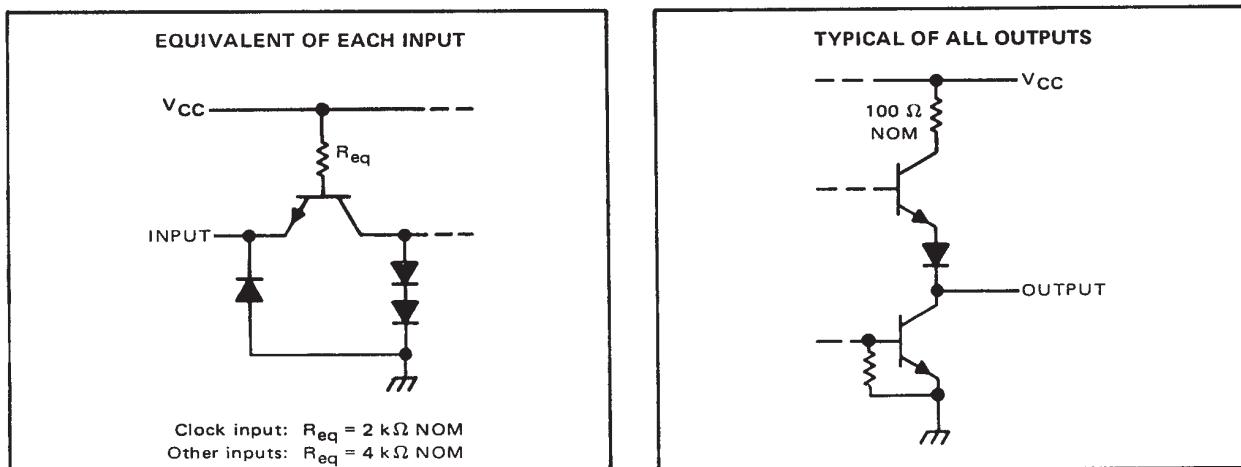
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# SN5497, SN7497 SYNCHRONOUS 6-BIT BINARY RATE MULTIPLIERS

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## schematics of inputs and outputs



STATE AND/OR RATE FUNCTION TABLE (See Note A)

| CLEAR | ENABLE | STROBE | BINARY RATE | INPUTS |    | NUMBER OF<br>CLOCK PULSES | UNITY/<br>CASCADE | OUTPUTS                            |    |        | NOTES |  |  |  |
|-------|--------|--------|-------------|--------|----|---------------------------|-------------------|------------------------------------|----|--------|-------|--|--|--|
|       |        |        |             |        |    |                           |                   | LOGIC LEVEL OR<br>NUMBER OF PULSES |    |        |       |  |  |  |
|       |        |        |             | X      | X  |                           |                   | Y                                  | Z  | ENABLE |       |  |  |  |
| H     | X      | H      | X X X X X X |        | X  | H                         | H                 | L                                  | H  | H      | B     |  |  |  |
| L     | L      | L      | L L L L L L |        | 64 | H                         | H                 | L                                  | H  | 1      | C     |  |  |  |
| L     | L      | L      | L L L L L H |        | 64 | H                         | H                 | 1                                  | 1  | 1      | C     |  |  |  |
| L     | L      | L      | L L L L H L |        | 64 | H                         | H                 | 2                                  | 2  | 1      | C     |  |  |  |
| L     | L      | L      | L L L H L L |        | 64 | H                         | H                 | 4                                  | 4  | 1      | C     |  |  |  |
| L     | L      | L      | L L H L L L |        | 64 | H                         | H                 | 8                                  | 8  | 1      | C     |  |  |  |
| L     | L      | L      | L H L L L L |        | 64 | H                         | H                 | 16                                 | 16 | 1      | C     |  |  |  |
| L     | L      | L      | H L L L L L |        | 64 | H                         | H                 | 32                                 | 32 | 1      | C     |  |  |  |
| L     | L      | L      | H H H H H H |        | 64 | H                         | H                 | 63                                 | 63 | 1      | C     |  |  |  |
| L     | L      | L      | H H H H H H |        | 64 | L                         | H                 | 63                                 |    | 1      | D     |  |  |  |
| L     | L      | L      | H L H L L L |        | 64 | H                         | 40                | 40                                 |    | 1      | E     |  |  |  |

NOTES: A. H = high level, L = low level, X = irrelevant. All remaining entries are numeric counts.

B. This is a simplified illustration of the clear function. The states of clock and strobe can affect the logic level of Y and Z. A low unity/cascade will cause output Y to remain high.

C. Each rate illustrated assumes a constant value at rate inputs; however, these illustrations in no way prohibit variable-rate inputs.

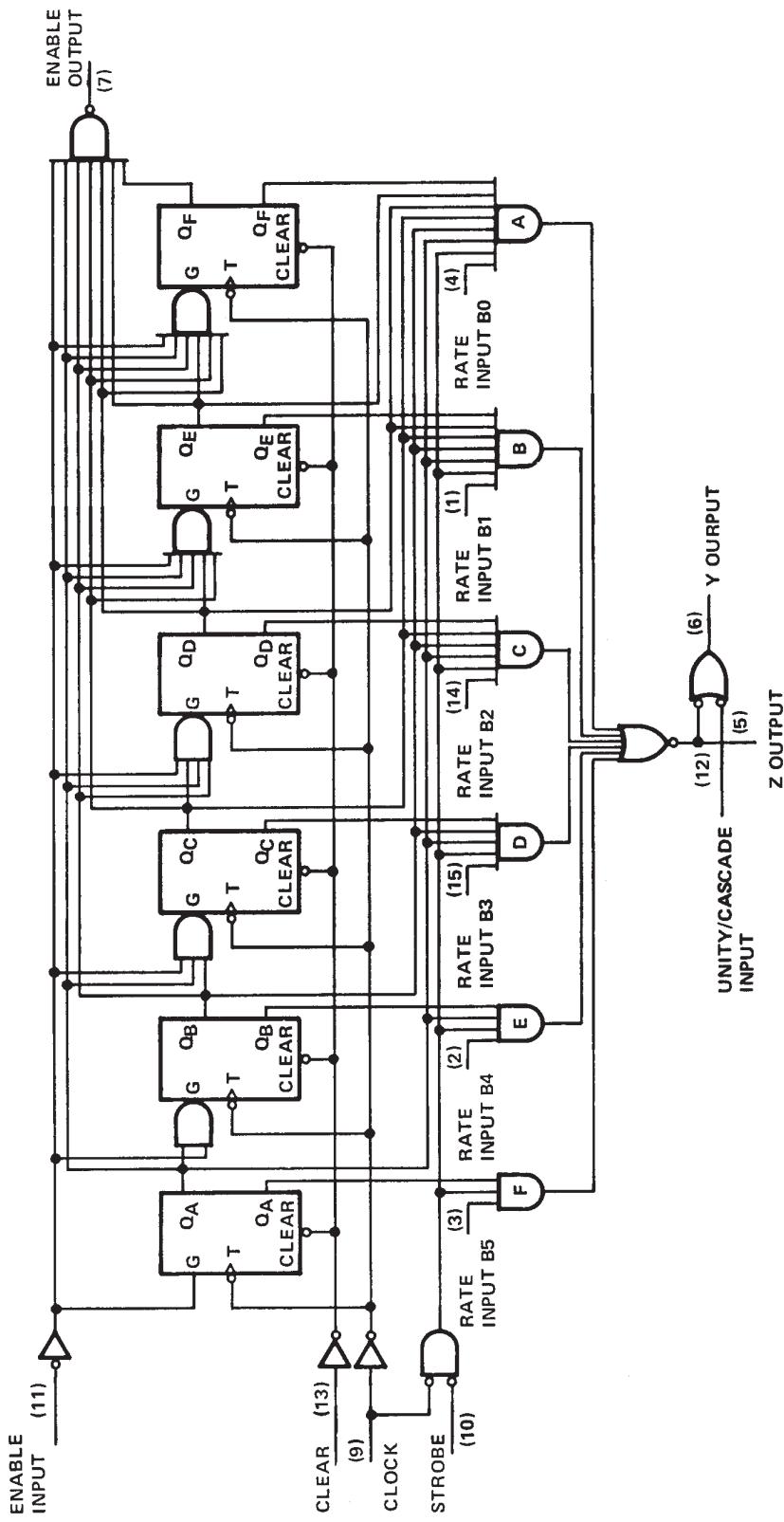
D. Unity/cascade is used to inhibit output Y.

$$E. f_{out} = \frac{M \cdot f_{in}}{64} = \frac{(8 + 32) f_{in}}{64} = \frac{40 f_{in}}{64} = 0.625 f_{in}$$

SN5497, SN7497  
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logic diagram (positive logic)



# SN5497, SN7497 SYNCHRONOUS 6-BIT BINARY RATE MULTIPLIERS

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

|   |                |
|---|----------------|
| Supply voltage, $V_{CC}$ (see Note 1)                     | 7 V            |
| Input voltage   | 5.5 V          |
| Operating free-air temperature range: SN5497 (see Note 2) | -55°C to 125°C |
| SN7497  | 0°C to 70°C    |
| Storage temperature range                                 | -65°C to 150°C |

recommended operating conditions

|  | SN5497         |                   |                   | SN7497 |                   |      | UNIT |
|--|----------------|-------------------|-------------------|--------|-------------------|------|------|
|  | MIN            | NOM               | MAX               | MIN    | NOM               | MAX  |      |
| Supply voltage, $V_{CC}$   | 4.5            | 5                 | 5.5               | 4.75   | 5                 | 5.25 | V    |
| High-level output current, $I_{OH}$  |                |                   | -400              |        |                   | -400 | μA   |
| Low-level output current, $I_{OL}$   |                |                   | 16                |        |                   | 16   | mA   |
| Clock frequency, $f_{clock}$   | 0              |                   | 25                | 0      |                   | 25   | MHz  |
| Width of clock pulse, $t_w(clock)$   | 20             |                   |                   | 20     |                   |      | ns   |
| Width of clear pulse, $t_w(clear)$   | 15             |                   |                   | 15     |                   |      | ns   |
| Enable setup time, $t_{su}$ :<br>Before positive-going transition of clock pulse<br>Before negative-going transition of previous clock pulse | (See Figure 1) | 25                |                   | 25     |                   |      | ns   |
|  | 0              | $t_w(clock) - 10$ |                   | 0      | $t_w(clock) - 10$ |      |      |
| Enable hold time, $t_h$ :<br>After positive-going transition of clock pulse<br>After negative-going transition of previous clock pulse       | (See Figure 1) | 0                 | $t_w(clock) - 10$ | 0      | $t_w(clock) - 10$ |      | ns   |
|  | 20             | $t_{cp} - 10$     |                   | 20     | $t_{cp} - 10$     |      |      |
| Operating free-air temperature, $T_A$ (See Note 2)   | -55            |                   | 125               | 0      |                   | 70   | °C   |

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

| PARAMETER  | TEST CONDITIONS <sup>†</sup>   |   | MIN | TYP <sup>‡</sup> | MAX  | UNIT |
|--|--|---|-----|------------------|------|------|
| $V_{IH}$ High-level input voltage                  |  |   |     | 2                |      | V    |
| $V_{IL}$ Low-level input voltage                   |  |   |     | 0.8              |      | V    |
| $V_{IK}$ Input clamp voltage                       | $V_{CC} = \text{MIN}$ , $I_I = -12 \text{ mA}$   |   |     |                  | -1.5 | V    |
| $V_{OH}$ High-level output voltage                 | $V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ ,<br>$V_{IL} = 0.8 \text{ V}$ , $I_{OH} = -400 \mu\text{A}$ |   | 2.4 | 3.4              |      | V    |
| $V_{OL}$ Low-level output voltage                  | $V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ ,<br>$V_{IL} = 0.8 \text{ V}$ , $I_{OL} = 16 \text{ mA}$    |   |     | 0.2              | 0.4  | V    |
| $I_I$ Input current at maximum input voltage       | $V_{CC} = \text{MAX}$ , $V_I = 5.5 \text{ V}$  |   |     | 1                |      | mA   |
| $I_{IH}$ High-level input current                  | clock input<br>other inputs  | $V_{CC} = \text{MAX}$ , $V_I = 2.4 \text{ V}$ |     | 80               |      | μA   |
|  |  |   |     | 40               |      |      |
| $I_{IL}$ Low-level input current                   | clock input<br>other inputs  | $V_{CC} = \text{MAX}$ , $V_I = 0.4 \text{ V}$ |     | -3.2             |      | mA   |
|  |  |   |     | -1.6             |      |      |
| $I_{OS}$ Short circuit output current <sup>§</sup> |  | $V_{CC} = \text{MAX}$                         | -18 | -55              |      | mA   |
| $I_{CCH}$ Supply current, outputs high             |  | $V_{CC} = \text{MAX}$ , See Note 3            |     | 58               |      | mA   |
| $I_{CCL}$ Supply current, outputs low              |  | $V_{CC} = \text{MAX}$ , See Note 4            |     | 80               | 120  | mA   |

<sup>†</sup>For test conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

<sup>‡</sup>All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

<sup>§</sup>Not more than one output should be shorted at a time.

NOTES: 1. Voltage values are with respect to network ground terminal.

2. An SN5497 in the W package operating at free-air temperatures above  $118^\circ\text{C}$  requires a heat sink that provides a thermal resistance from case to free-air,  $R_{\theta CA}$ , of not more than  $55^\circ\text{C}/\text{W}$ .

3.  $I_{CCH}$  is measured with outputs open and all inputs grounded.

4.  $I_{CCL}$  is measured with outputs open and all inputs at  $4.5 \text{ V}$ .



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switching characteristics,  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ ,  $N = 10$

| PARAMETER <sup>†</sup> | FROM<br>INPUT  | TO<br>OUTPUT | TEST CONDITIONS   | MIN | TYP | MAX | UNIT |
|------------------------|----------------|--------------|---|-----|-----|-----|------|
| $f_{max}$              |                |              |   | 25  | 32  |     | MHz  |
| $t_{PLH}$              | Enable         | Enable       |   | 13  | 20  |     | ns   |
| $t_{PHL}$              |                |              |   | 14  | 21  |     |      |
| $t_{PLH}$              | Strobe         | Z            |   | 12  | 18  |     | ns   |
| $t_{PHL}$              |                |              |   | 15  | 23  |     |      |
| $t_{PLH}$              | Clock          | Y            |   | 26  | 39  |     | ns   |
| $t_{PHL}$              |                |              |   | 20  | 30  |     |      |
| $t_{PLH}$              | Clock          | Z            |   | 12  | 18  |     | ns   |
| $t_{PHL}$              |                |              |   | 17  | 26  |     |      |
| $t_{PLH}$              | Rate           | Z            | $C_L = 15 \text{ pF}$ ,<br>$R_L = 400 \Omega$ ,<br>See Figure 1 | 6   | 10  |     | ns   |
| $t_{PHL}$              |                |              |   | 9   | 14  |     |      |
| $t_{PLH}$              | Unity/Cascade  | Y            |   | 9   | 14  |     | ns   |
| $t_{PHL}$              |                |              |   | 6   | 10  |     |      |
| $t_{PLH}$              | Strobe         | Y            |   | 19  | 30  |     | ns   |
| $t_{PHL}$              |                |              |   | 22  | 33  |     |      |
| $t_{PLH}$              | Clock          | Enable       |   | 19  | 30  |     | ns   |
| $t_{PHL}$              |                |              |   | 22  | 33  |     |      |
| $t_{PLH}$              | Clear          | Y            |   | 24  | 36  |     | ns   |
| $t_{PHL}$              |                | Z            |   | 15  | 23  |     |      |
| $t_{PLH}$              | Any Rate Input | Y            |   | 15  | 23  |     | ns   |
| $t_{PHL}$              |                |              |   | 15  | 23  |     |      |

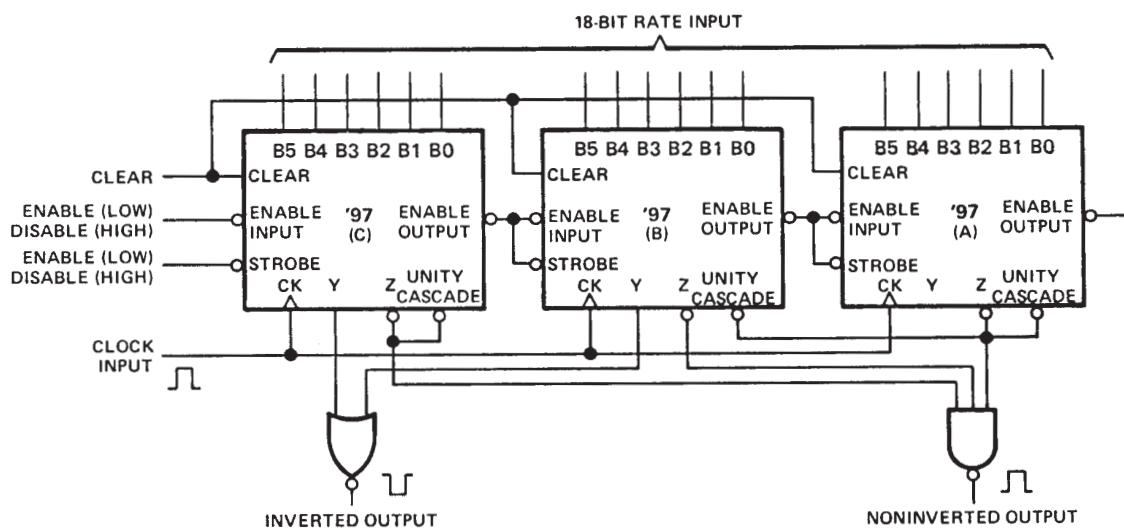
<sup>†</sup> $f_{max}$  ≡ maximum clock frequency.

$t_{PLH}$  ≡ propagation delay time, low-to-high-level output.

$t_{PHL}$  ≡ propagation delay time, high-to-low-level output.

## TYPICAL APPLICATION DATA

This application demonstrates how the '97 can be cascaded to perform 18-bit rate multiplication. This scheme is expandable to  $n$ -bits by extending the pattern illustrated.

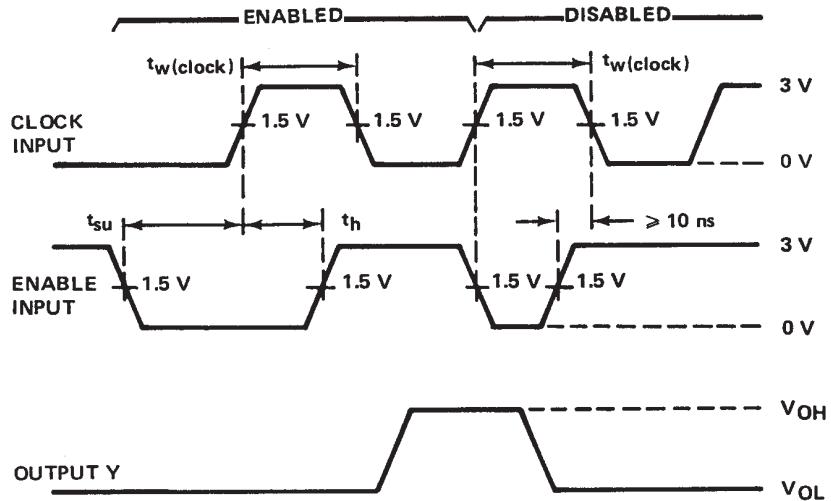


As illustrated, two of the 6-bit multipliers can be cascaded by connecting the Z output of unit A to the unity cascade input of unit B, in which case, a two-input NOR gate is used to cascade the remaining multipliers. Alternatively, all three Y outputs can be cascaded with a 3-input NOR gate. The three unused unity cascade inputs can be conveniently terminated by connecting each to its Z output.

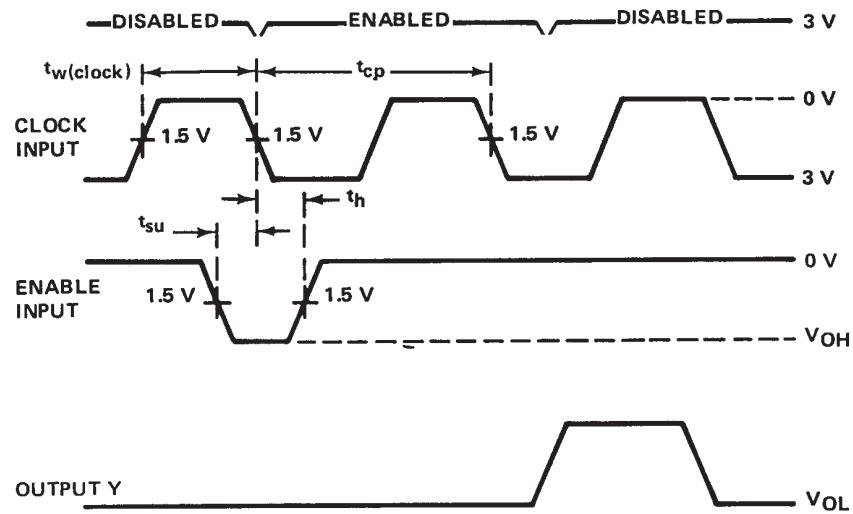
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## PARAMETER MEASUREMENT INFORMATION



ENABLING FROM POSITIVE-GOING  
TRANSITION OF CLOCK PULSE



ENABLING FROM NEGATIVE-GOING  
TRANSITION OF PREVIOUS CLOCK PULSE

1. Unity/Cascade and pin 2 (rate input), other inputs are low. Clear the counter and apply clock and enable pulse as illustrated.
2. Setup and hold times are illustrated for enabling a single clock pulse (count). Continued application of the enable function will enable subsequent clock pulse (counts) until disabling occurs (enable goes high). The total number of counts will be determined by the total number of positive-going clock transition enabled.

NOTES: A. The input pulse generator has the following characteristics:  $t_{w(clock)} = 20$  ns,  $t_{TLH} \leq 10$  ns,  $t_{THL} \leq 10$  ns, PRR = 1 MHz,  $Z_{out} \approx 50 \Omega$ .  
 B.  $C_L$  includes probe and jig capacitance.  
 C. All diodes are 1N3064 or equivalent.

FIGURE 1—SWITCHING TIMES

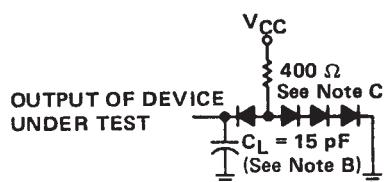


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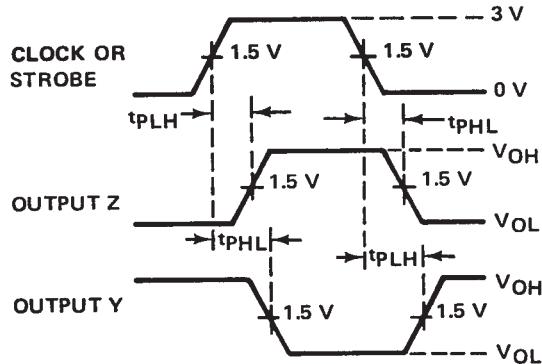
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PARAMETER MEASUREMENT INFORMATION



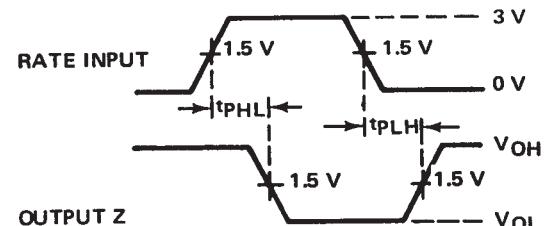
All three outputs are loaded during testing.

LOAD CIRCUIT



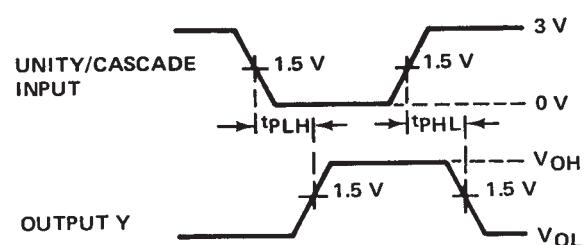
Unity/cascade and rate inputs are high, other inputs are low, and flip-flops are at any count other than maximum.

PROPAGATION DELAY TIMES, CLOCK TO Z AND Y,  
AND STROBE INPUT TO Z AND Y



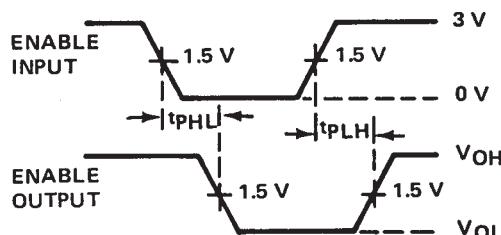
Flip-flops are at a count so that all other inputs to the gate under test are high and all other inputs, including other rate inputs, are low.

PROPAGATION DELAY TIMES,  
RATE INPUT TO Z



Output Z is high.

PROPAGATION DELAY TIMES,  
UNITY/CASCADE INPUT TO Y



Flip-flops are at the maximum count. Other inputs are low.

PROPAGATION DELAY TIMES,  
ENABLE INPUT TO ENABLE OUTPUT

NOTES: A. The input pulse generator has the following characteristics:  $t_{w(clock)} = 20\ ns$ ,  $t_{TLH} \leq 10\ ns$ ,  $t_{THL} \leq 10\ ns$ ,  $PRR = 1\ MHz$ ,  $Z_{out} \approx 50\ \Omega$ .  
B.  $C_L$  includes probe and jig capacitance.  
C. All diodes are 1N3064 or equivalent.

FIGURE 1—SWITCHING TIMES (CONTINUED)

**PACKAGING INFORMATION**

| Orderable part number | Status<br>(1) | Material type<br>(2) | Package   Pins | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|-----------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| SN5497J               | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SN5497J             |
| SN5497J.A             | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SN5497J             |
| SN7497N               | Active        | Production           | PDIP (N)   16  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | SN7497N             |
| SN7497N.A             | Active        | Production           | PDIP (N)   16  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | SN7497N             |
| SNJ5497J              | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SNJ5497J            |
| SNJ5497J.A            | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SNJ5497J            |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts 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.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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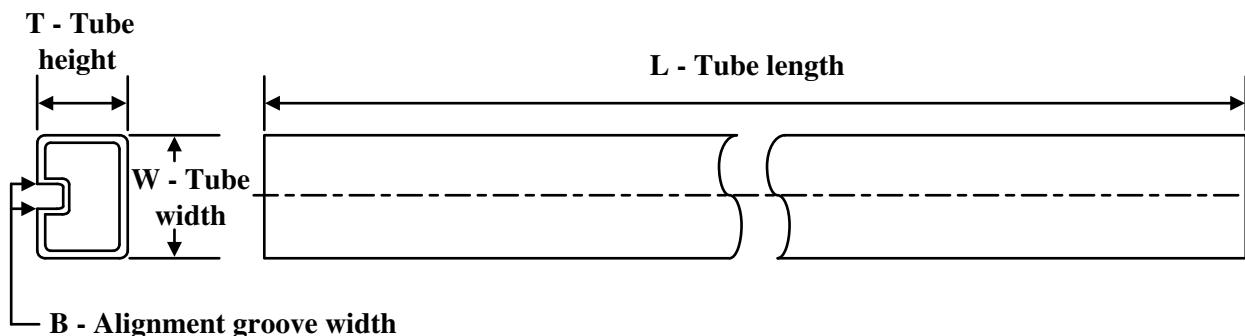
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**OTHER QUALIFIED VERSIONS OF SN5497, SN7497 :**

- Catalog : [SN7497](#)
- Military : [SN5497](#)

**NOTE: Qualified Version Definitions:**

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

**TUBE**


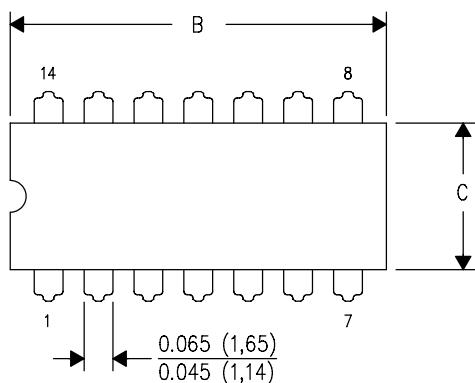
\*All dimensions are nominal

| Device    | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T ( $\mu$ m) | B (mm) |
|-----------|--------------|--------------|------|-----|--------|--------|--------------|--------|
| SN7497N   | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230        | 4.32   |
| SN7497N   | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230        | 4.32   |
| SN7497N.A | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230        | 4.32   |
| SN7497N.A | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230        | 4.32   |

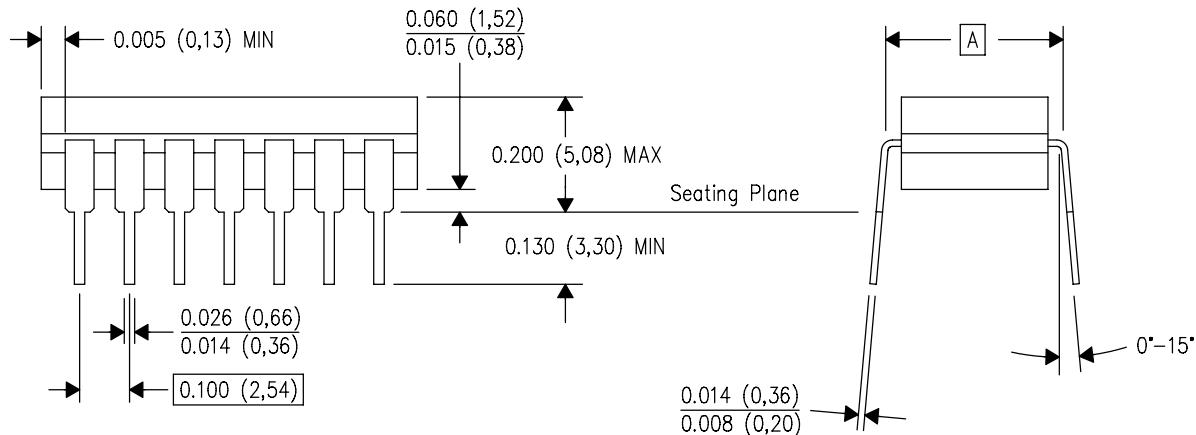
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14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| PINS **<br>DIM | 14                     | 16                     | 18                     | 20                     |
|----------------|------------------------|------------------------|------------------------|------------------------|
| A              | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC |
| B MAX          | 0.785<br>(19,94)       | .840<br>(21,34)        | 0.960<br>(24,38)       | 1.060<br>(26,92)       |
| B MIN          | —                      | —                      | —                      | —                      |
| C MAX          | 0.300<br>(7,62)        | 0.300<br>(7,62)        | 0.310<br>(7,87)        | 0.300<br>(7,62)        |
| C MIN          | 0.245<br>(6,22)        | 0.245<br>(6,22)        | 0.220<br>(5,59)        | 0.245<br>(6,22)        |



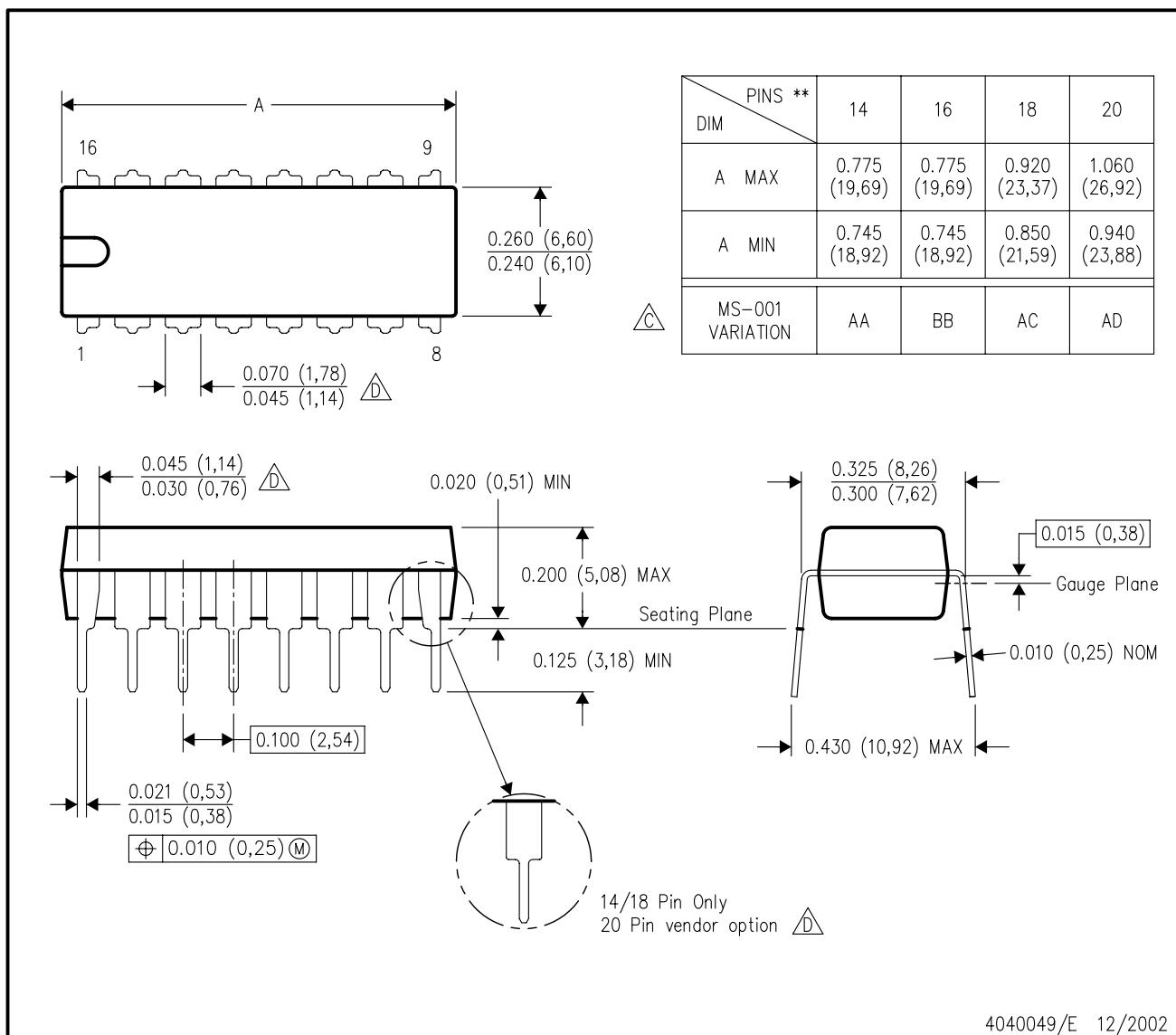
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NOTES: A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.  
C. This package is hermetically sealed with a ceramic lid using glass frit.  
D. Index point is provided on cap for terminal identification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

## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.

△ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).

△ The 20 pin end lead shoulder width is a vendor option, either half or full width.

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