

# SN54LS292, SN54LS294, SN74LS292, SN74LS294 PROGRAMMABLE FREQUENCY DIVIDERS/DIGITAL TIMERS

SDLS153 – D2628, JANUARY 1981 – REVISED MARCH 1988

- **Count Divider Chain**
- **Digitally Programmable from  $2^2$  to  $2^n$**   
( $n = 31$  for 'LS292,  $n = 15$  for 'LS294)
- **Useable Frequency Range from DC to 30 MHz**
- **Easily Expandable**
- **Applications**
  - Frequency Division
  - Digital Timing

## description

These programmable frequency dividers/digital timers contain 31 flip-flops plus 30 gates ('LS292) or 15 flip-flops plus 29 gates ('LS294) on a single chip. The count modulo is under digital control of the inputs provided.

Both types feature an active-low clear input to initialize the state of all flip-flops. To facilitate incoming inspection, test points are provided (TP1, TP2, and TP3 on the 'LS292 and TP on the 'LS294). These test points are not intended to drive system loads. Both types feature two clock inputs; either one may be used for clock gating. (See the function table below.)

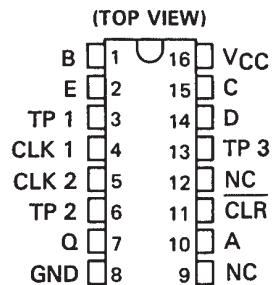
A brief look at the digital timing capabilities of the 'LS292 will show that with a 1-MHz input frequency, programming for  $2^{10}$  will give a period of 1.024 ms, and  $2^{20}$  will give a period of 1.05 sec,  $2^{26}$  will give a period of 1.12 min, and  $2^{31}$  will give a period of 35.79 min.

These devices are easily cascadable giving limitless possibilities to timing delays that can be achieved.

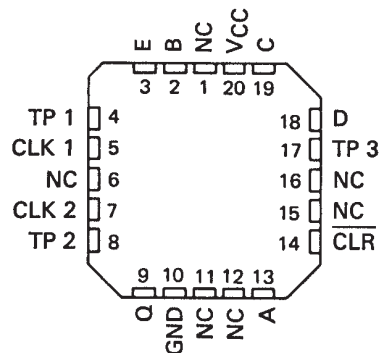
FUNCTION TABLE

| CLEAR | CLK 1 | CLK 2 | Q OUTPUT MODE |
|-------|-------|-------|---------------|
| L     | X     | X     | Cleared to L  |
| H     | ↑     | L     | Count         |
| H     | L     | ↑     | Count         |
| H     | H     | X     | Inhibit       |
| H     | X     | H     | Inhibit       |

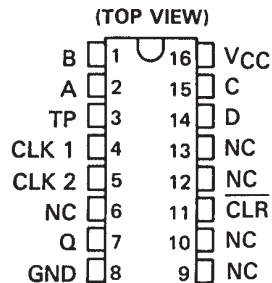
SN54LS292 . . . J OR W PACKAGE  
SN74LS292 . . . N PACKAGE



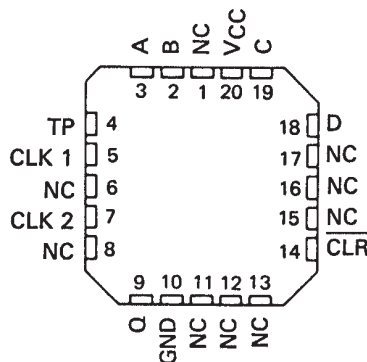
SN54LS292 . . . FK PACKAGE  
(TOP VIEW)



SN54LS294 . . . J OR W PACKAGE  
SN74LS294 . . . N PACKAGE



SN54LS294 . . . FK PACKAGE  
(TOP VIEW)



NC — No internal connection.

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**

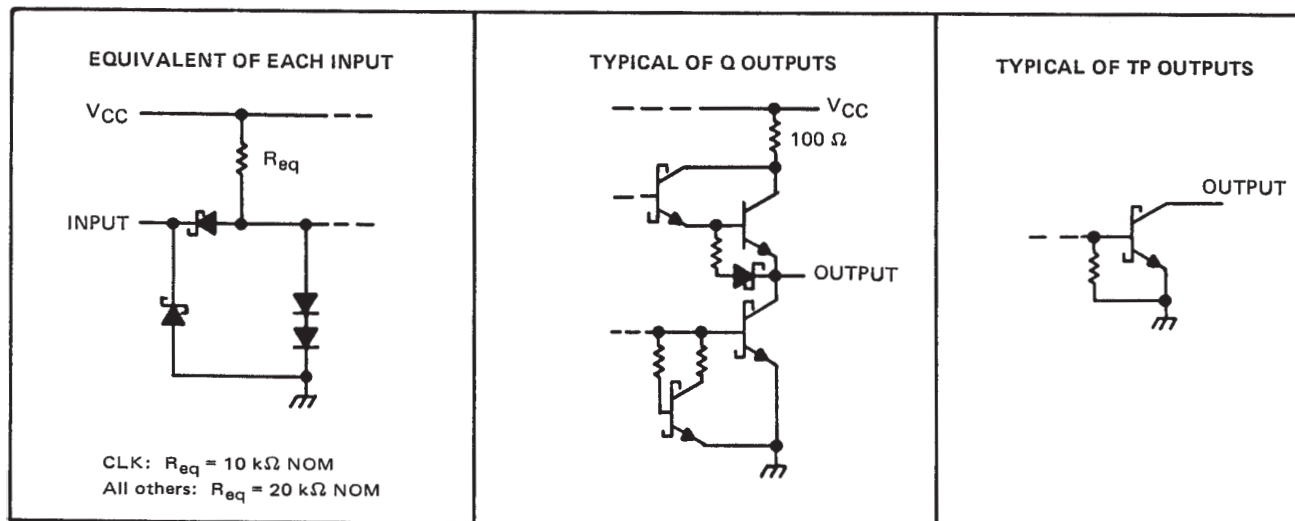
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1988, Texas Instruments Incorporated

# SN54LS292, SN54LS294, SN74LS292, SN74LS294 PROGRAMMABLE FREQUENCY DIVIDERS/DIGITAL TIMERS

SDLS153 – D2628, JANUARY 1981 – REVISED MARCH 1988

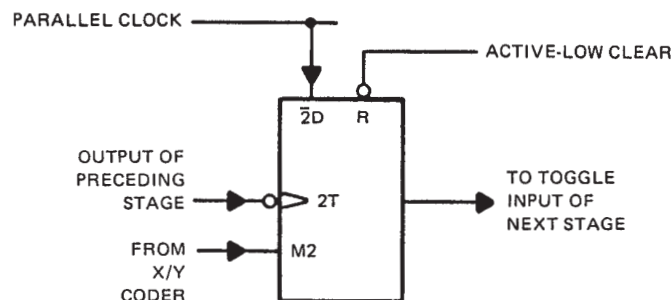
## schematics of inputs and outputs



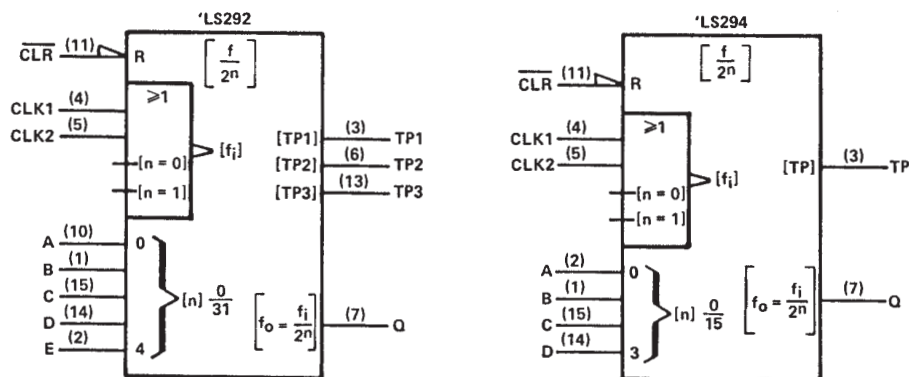
## operation

The functional block diagram shows that the count modulo is controlled by an X/Y decoder connected to the mode control inputs of several flip-flops. These flip-flops with mode controls each have a "D" input connected to the parallel clock line and a "T" input driven by the preceding stage. The parallel clock frequency is always the input frequency divided by four.

The X/Y decoder output selected by the programming inputs goes low. While a mode control is low, the "D" input of that flip-flop is enabled, and the signal from the parallel clock line ( $f_{in} \div 4$ ) is passed to the "T" input of the following stage. All the other mode controls are high enabling the "T" inputs and causing each flip-flop in turn to divide by two.



## logic symbols†



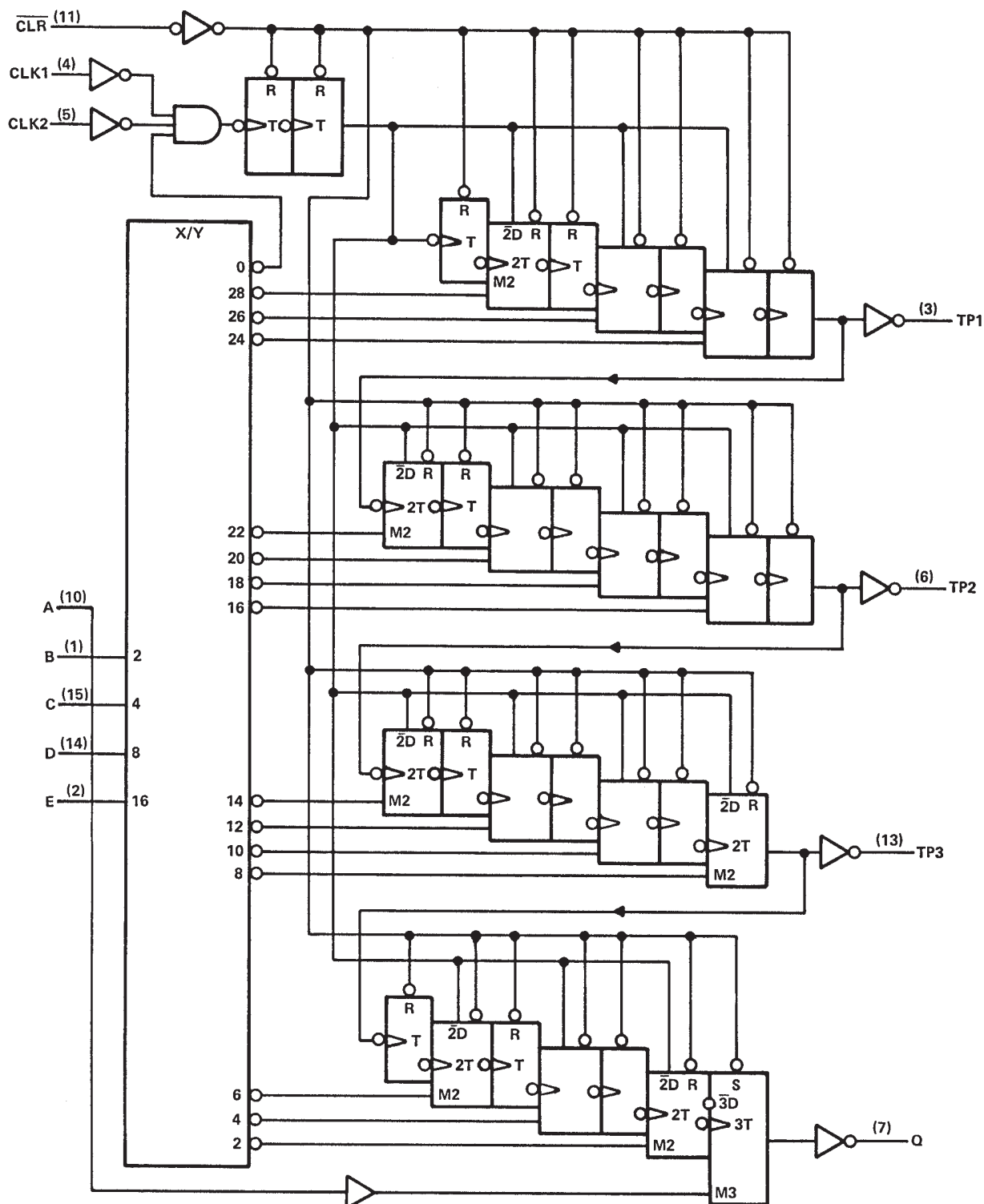
†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.  
Pin numbers shown are for J, N, and W packages.

# SN54LS292, SN54LS294, SN74LS292, SN74LS294 PROGRAMMABLE FREQUENCY DIVIDERS/DIGITAL TIMERS

SDLS153 – D2628, JANUARY 1981 – REVISED MARCH 1988

logic diagram (positive logic)

'LS292



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

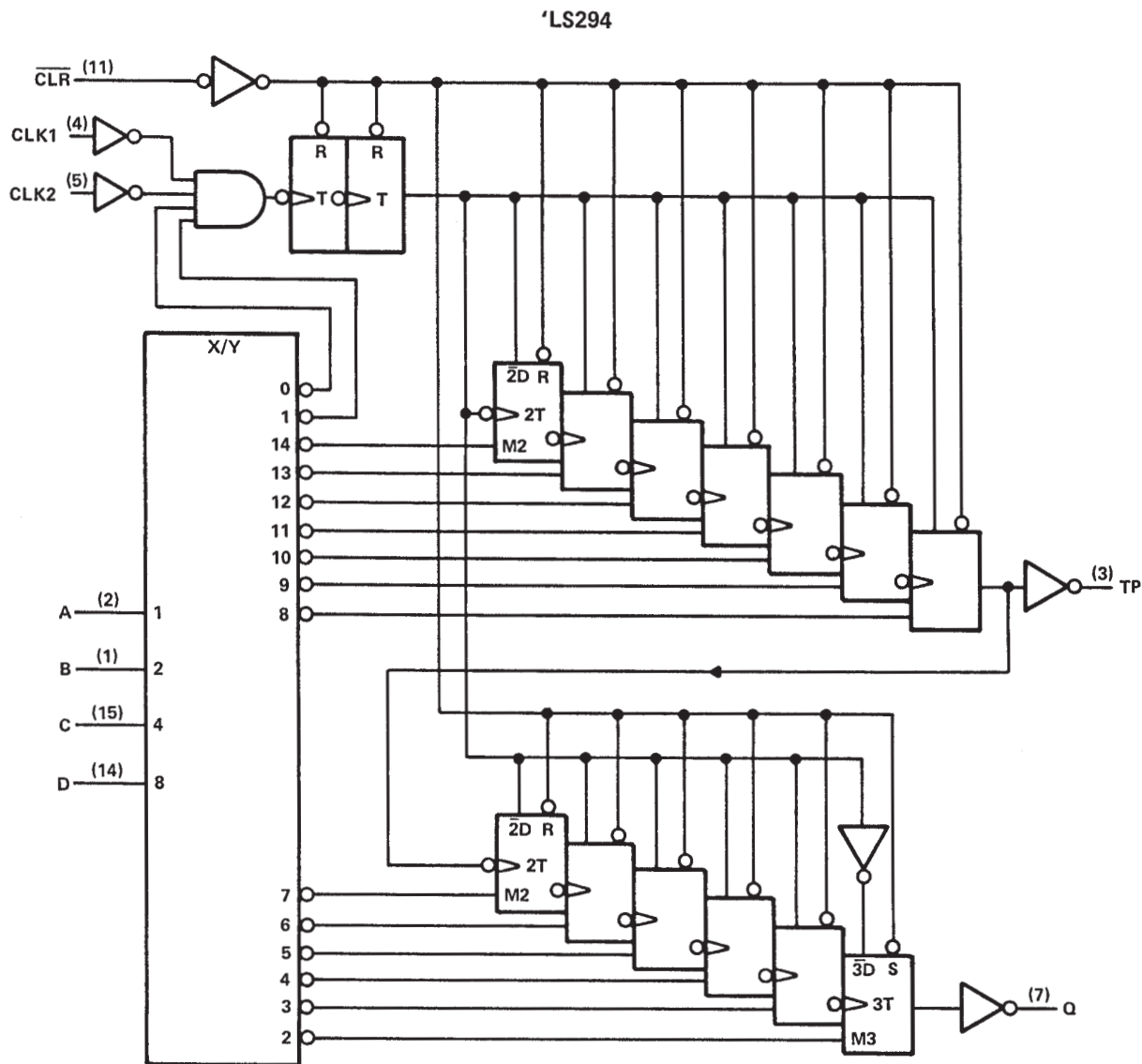


POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN54LS292, SN54LS294, SN74LS292, SN74LS294  
PROGRAMMABLE FREQUENCY DIVIDERS/DIGITAL TIMERS

SDLS153 – D2628, JANUARY 1981 – REVISED MARCH 1988

logic diagram (positive logic)



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

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

|                                                            |                                                |
|------------------------------------------------------------|------------------------------------------------|
| Supply voltage, $V_{CC}$ (see Note 1)                      | 7 V                                            |
| Input voltage                                              | 7 V                                            |
| Operating free-air temperature range: SN54LS292, SN54LS294 | $-55^{\circ}\text{C}$ to $125^{\circ}\text{C}$ |
| SN74LS292, SN74LS294                                       | $0^{\circ}\text{C}$ to $70^{\circ}\text{C}$    |
| Storage temperature range                                  | $-65^{\circ}\text{C}$ to $150^{\circ}\text{C}$ |

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



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

# SN54LS292, SN54LS294, SN74LS292, SN74LS294 PROGRAMMABLE FREQUENCY DIVIDERS/DIGITAL TIMERS

SDLS153 – D2628, JANUARY 1981 – REVISED MARCH 1988

## recommended operating conditions

|                    |                                    |        | SN54LS' |     |     | SN74LS' |     |      | UNIT |
|--------------------|------------------------------------|--------|---------|-----|-----|---------|-----|------|------|
|                    |                                    |        | MIN     | NOM | MAX | MIN     | NOM | MAX  |      |
| V <sub>CC</sub>    | Supply voltage                     |        | 4.5     | 5   | 5.5 | 4.75    | 5   | 5.25 | V    |
| V <sub>IH</sub>    | High-level input voltage           |        | 2       |     |     | 2       |     |      | V    |
| V <sub>IL</sub>    | Low-level input voltage            |        | 0.7     |     |     | 0.8     |     |      | V    |
| I <sub>OH</sub>    | High-level output current (Q only) |        | − 1.2   |     |     | − 1.2   |     |      | mA   |
| I <sub>OL</sub>    | Low-level output current (Q only)  |        | 12      |     |     | 24      |     |      | mA   |
| f <sub>clock</sub> | Clock frequency                    |        | 0       |     | 30  | 0       |     | 30   | MHz  |
| t <sub>w</sub>     | Duration of clock input pulse      |        | 16      |     |     | 16      |     |      | ns   |
| t <sub>w</sub>     | Duration of clear pulse            | 'LS292 | 55      |     |     | 55      |     |      | ns   |
|                    |                                    | 'LS294 | 35      |     |     | 35      |     |      |      |
| t <sub>su</sub>    | Clear inactive-state setup time    |        | 15      |     |     | 15      |     |      | ns   |
| T <sub>A</sub>     | Operating free-air temperature     |        | − 55    |     | 125 | 0       |     | 70   | °C   |

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

| PARAMETER         |            | TEST CONDITIONS†                                                                                |                          | SN54LS' |      |       | SN74LS' |      |       | UNIT |
|-------------------|------------|-------------------------------------------------------------------------------------------------|--------------------------|---------|------|-------|---------|------|-------|------|
|                   |            |                                                                                                 |                          | MIN     | TYP‡ | MAX   | MIN     | TYP‡ | MAX   |      |
| V <sub>IK</sub>   |            | V <sub>CC</sub> = MIN, I <sub>I</sub> = – 18 mA                                                 |                          |         |      | – 1.5 |         |      | – 1.5 | V    |
| V <sub>OH</sub>   | Q          | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, I <sub>OH</sub> = – 1.2 mA, V <sub>IL</sub> = MAX |                          | 2.4     | 3.4  |       | 2.4     | 3.4  |       | V    |
| V <sub>OL</sub>   | Q          | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX                             | I <sub>OL</sub> = 12 mA  |         | 0.25 | 0.4   |         | 0.25 | 0.4   | V    |
|                   |            |                                                                                                 | I <sub>OL</sub> = 24 mA  |         |      |       |         | 0.35 | 0.5   |      |
|                   | TP¶        |                                                                                                 | I <sub>OL</sub> = 0.5 mA |         |      |       |         | 0.25 | 0.4   |      |
| I <sub>I</sub>    |            | V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V                                                     |                          |         |      | 0.1   |         |      | 0.1   | mA   |
| I <sub>IH</sub>   |            | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V                                                   |                          |         |      | 20    |         |      | 20    | μA   |
| I <sub>IL</sub>   | CLK1, CLK2 | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V                                                   |                          |         |      | – 0.8 |         |      | – 0.8 | mA   |
|                   | All others |                                                                                                 |                          |         |      | – 0.4 |         |      | – 0.4 |      |
| I <sub>OS</sub> § | Q          | V <sub>CC</sub> = MAX                                                                           |                          | – 30    |      | – 130 | – 30    |      | – 130 | mA   |
| I <sub>CC</sub>   | 'LS292     | V <sub>CC</sub> = MAX, All inputs grounded, All outputs open                                    |                          |         | 40   | 75    |         | 40   | 75    | mA   |
|                   | 'LS294     |                                                                                                 |                          |         | 30   | 50    |         | 30   | 50    |      |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

§ The duration of the short-circuit should not exceed one second.

¶ The TP output or outputs are not intended to drive external loads but are solely provided for test points.



# SN54LS292, SN54LS294, SN74LS292, SN74LS294

## PROGRAMMABLE FREQUENCY DIVIDERS/DIGITAL TIMERS

SDLS153 – D2628, JANUARY 1981 – REVISED MARCH 1988

switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ ,  $R_L = 667\ \Omega$ ,  $C_L = 45\text{ pF}$  (see Figure 1)

| PARAMETER†       | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS                                                            | 'LS292 |     |     | 'LS294 |     |     | UNIT |
|------------------|-----------------|----------------|----------------------------------------------------------------------------|--------|-----|-----|--------|-----|-----|------|
|                  |                 |                |                                                                            | MIN    | TYP | MAX | MIN    | TYP | MAX |      |
| $f_{\text{max}}$ | CLK1 or 2       |                |                                                                            | 30     | 50  |     | 30     | 50  |     | MHz  |
| $t_{\text{PLH}}$ |                 | Q              | Modulo set at 22,<br>A thru E = LLLHL ('LS292)<br>A thru D = LLHL ('LS294) |        | 55  | 90  |        | 55  | 90  | ns   |
| $t_{\text{PHL}}$ |                 | Q              |                                                                            |        | 80  | 120 |        | 80  | 120 | ns   |
| $t_{\text{PHL}}$ | CLR             | Q              |                                                                            |        | 85  | 130 |        | 35  | 65  | ns   |

† $f_{\text{MAX}}$  = maximum clock frequency

$t_{\text{PLH}}$  = Propagation delay time, low-to-high-level output

$t_{\text{PHL}}$  = Propagation delay time, high-to-low-level output

NOTE 2: Load circuits and voltage waveforms are shown in Section 1. To be used on TP outputs only.

'LS292 FUNCTION TABLE

| PROGRAMMING<br>INPUTS |   |   |   |   | FREQUENCY DIVISION |               |                |         |                 |         |                 |            |
|-----------------------|---|---|---|---|--------------------|---------------|----------------|---------|-----------------|---------|-----------------|------------|
|                       |   |   |   |   | Q                  |               | TP1            |         | TP2             |         | TP3             |            |
| E                     | D | C | B | A | BINARY             | DECIMAL       | BINARY         | DECIMAL | BINARY          | DECIMAL | BINARY          | DECIMAL    |
| L                     | L | L | L | L | Inhibit            | Inhibit       | Inhibit        | Inhibit | Inhibit         | Inhibit | Inhibit         | Inhibit    |
| L                     | L | L | L | H | Inhibit            | Inhibit       | Inhibit        | Inhibit | Inhibit         | Inhibit | Inhibit         | Inhibit    |
| L                     | L | L | H | L | 2 <sup>2</sup>     | 4             | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                     | L | L | H | H | 2 <sup>3</sup>     | 8             | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                     | L | H | L | L | 2 <sup>4</sup>     | 16            | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                     | L | H | L | H | 2 <sup>5</sup>     | 32            | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                     | L | H | H | L | 2 <sup>6</sup>     | 64            | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                     | L | H | H | H | 2 <sup>7</sup>     | 128           | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| L                     | H | L | L | L | 2 <sup>8</sup>     | 256           | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>2</sup>  | 4          |
| L                     | H | L | L | H | 2 <sup>9</sup>     | 512           | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>2</sup>  | 4          |
| L                     | H | L | H | L | 2 <sup>10</sup>    | 1,024         | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>4</sup>  | 16         |
| L                     | H | L | H | H | 2 <sup>11</sup>    | 2,048         | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>4</sup>  | 16         |
| L                     | H | H | L | L | 2 <sup>12</sup>    | 4,096         | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>6</sup>  | 64         |
| L                     | H | H | L | H | 2 <sup>13</sup>    | 8,192         | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>6</sup>  | 64         |
| L                     | H | H | H | L | 2 <sup>14</sup>    | 16,384        | 2 <sup>9</sup> | 512     | Disabled Low    |         | 2 <sup>8</sup>  | 256        |
| L                     | H | H | H | H | 2 <sup>15</sup>    | 32,768        | 2 <sup>9</sup> | 512     | Disabled Low    |         | 2 <sup>8</sup>  | 256        |
| H                     | L | L | L | L | 2 <sup>16</sup>    | 65,536        | 2 <sup>9</sup> | 512     | 2 <sup>3</sup>  | 8       | 2 <sup>10</sup> | 1,024      |
| H                     | L | L | L | H | 2 <sup>17</sup>    | 131,072       | 2 <sup>9</sup> | 512     | 2 <sup>3</sup>  | 8       | 2 <sup>10</sup> | 1,024      |
| H                     | L | L | H | L | 2 <sup>18</sup>    | 262,144       | 2 <sup>9</sup> | 512     | 2 <sup>5</sup>  | 32      | 2 <sup>12</sup> | 4,096      |
| H                     | L | L | H | H | 2 <sup>19</sup>    | 524,288       | 2 <sup>9</sup> | 512     | 2 <sup>5</sup>  | 32      | 2 <sup>12</sup> | 4,096      |
| H                     | L | H | L | L | 2 <sup>20</sup>    | 1,048,576     | 2 <sup>9</sup> | 512     | 2 <sup>7</sup>  | 128     | 2 <sup>14</sup> | 16,384     |
| H                     | L | H | L | H | 2 <sup>21</sup>    | 2,097,152     | 2 <sup>9</sup> | 512     | 2 <sup>7</sup>  | 128     | 2 <sup>14</sup> | 16,384     |
| H                     | L | H | H | L | 2 <sup>22</sup>    | 4,194,304     | Disabled Low   |         | 2 <sup>9</sup>  | 512     | 2 <sup>16</sup> | 65,536     |
| H                     | L | H | H | H | 2 <sup>23</sup>    | 8,388,608     | Disabled Low   |         | 2 <sup>9</sup>  | 512     | 2 <sup>16</sup> | 65,536     |
| H                     | H | L | L | L | 2 <sup>24</sup>    | 16,777,216    | 2 <sup>3</sup> | 8       | 2 <sup>11</sup> | 2,048   | 2 <sup>18</sup> | 262,144    |
| H                     | H | L | L | H | 2 <sup>25</sup>    | 33,554,432    | 2 <sup>3</sup> | 8       | 2 <sup>11</sup> | 2,048   | 2 <sup>18</sup> | 262,144    |
| H                     | H | L | H | L | 2 <sup>26</sup>    | 67,108,864    | 2 <sup>5</sup> | 32      | 2 <sup>13</sup> | 8,192   | 2 <sup>20</sup> | 1,048,576  |
| H                     | H | L | H | H | 2 <sup>27</sup>    | 134,217,728   | 2 <sup>5</sup> | 32      | 2 <sup>13</sup> | 8,192   | 2 <sup>20</sup> | 1,048,576  |
| H                     | H | H | L | L | 2 <sup>28</sup>    | 268,435,456   | 2 <sup>7</sup> | 128     | 2 <sup>15</sup> | 32,768  | 2 <sup>22</sup> | 4,194,304  |
| H                     | H | H | L | H | 2 <sup>29</sup>    | 536,870,912   | 2 <sup>7</sup> | 128     | 2 <sup>15</sup> | 32,768  | 2 <sup>22</sup> | 4,194,304  |
| H                     | H | H | H | L | 2 <sup>30</sup>    | 1,073,741,824 | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |
| H                     | H | H | H | H | 2 <sup>31</sup>    | 2,147,483,648 | 2 <sup>9</sup> | 512     | 2 <sup>17</sup> | 131,072 | 2 <sup>24</sup> | 16,777,216 |

# SN54LS292, SN54LS294, SN74LS292, SN74LS294 PROGRAMMABLE FREQUENCY DIVIDERS/DIGITAL TIMERS

SDLS153 – D2628, JANUARY 1981 – REVISED MARCH 1988

'LS294 FUNCTION TABLE

| PROGRAMMING INPUTS |   |   |   | FREQUENCY DIVISION |         |                |         |
|--------------------|---|---|---|--------------------|---------|----------------|---------|
|                    |   |   |   | Q                  |         | TP             |         |
| D                  | C | B | A | BINARY             | DECIMAL | BINARY         | DECIMAL |
| L                  | L | L | L | Inhibit            | Inhibit | Inhibit        | Inhibit |
| L                  | L | L | H | Inhibit            | Inhibit | Inhibit        | Inhibit |
| L                  | L | H | L | 2 <sup>2</sup>     | 4       | 2 <sup>9</sup> | 512     |
| L                  | L | H | H | 2 <sup>3</sup>     | 8       | 2 <sup>9</sup> | 512     |
| L                  | H | L | L | 2 <sup>4</sup>     | 16      | 2 <sup>9</sup> | 512     |
| L                  | H | L | H | 2 <sup>5</sup>     | 32      | 2 <sup>9</sup> | 512     |
| L                  | H | H | L | 2 <sup>6</sup>     | 64      | 2 <sup>9</sup> | 512     |
| L                  | H | H | H | 2 <sup>7</sup>     | 128     | Disabled Low   |         |
| H                  | L | L | L | 2 <sup>8</sup>     | 256     | 2 <sup>2</sup> | 4       |
| H                  | L | L | H | 2 <sup>9</sup>     | 512     | 2 <sup>3</sup> | 8       |
| H                  | L | H | L | 2 <sup>10</sup>    | 1,024   | 2 <sup>4</sup> | 16      |
| H                  | L | H | H | 2 <sup>11</sup>    | 2,048   | 2 <sup>5</sup> | 32      |
| H                  | H | L | L | 2 <sup>12</sup>    | 4,096   | 2 <sup>6</sup> | 64      |
| H                  | H | L | H | 2 <sup>13</sup>    | 8,192   | 2 <sup>7</sup> | 128     |
| H                  | H | H | L | 2 <sup>14</sup>    | 16,384  | 2 <sup>8</sup> | 256     |
| H                  | H | H | H | 2 <sup>15</sup>    | 32,768  | 2 <sup>9</sup> | 512     |

switching loads

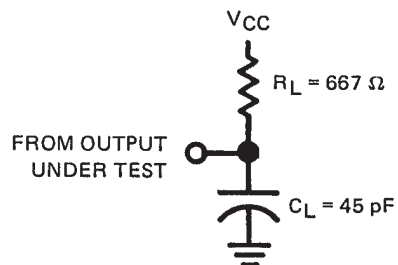
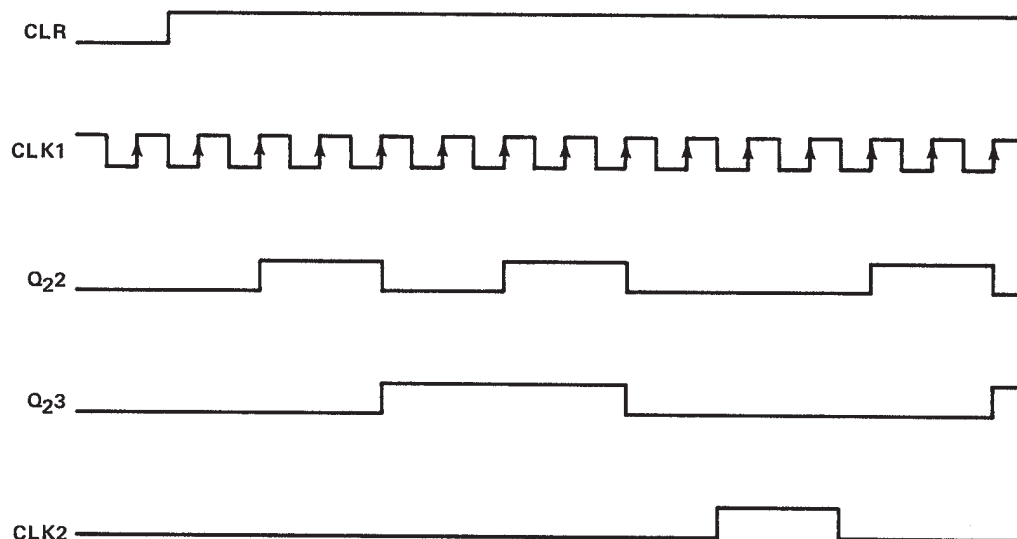


FIGURE 1

'LS292 and 'LS294 timing diagram



## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

|                    |                                                                    |
|--------------------|--------------------------------------------------------------------|
| Amplifiers         | <a href="http://amplifier.ti.com">amplifier.ti.com</a>             |
| Data Converters    | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>     |
| DSP                | <a href="http://dsp.ti.com">dsp.ti.com</a>                         |
| Interface          | <a href="http://interface.ti.com">interface.ti.com</a>             |
| Logic              | <a href="http://logic.ti.com">logic.ti.com</a>                     |
| Power Mgmt         | <a href="http://power.ti.com">power.ti.com</a>                     |
| Microcontrollers   | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> |
| Low Power Wireless | <a href="http://www.ti.com/lpw">www.ti.com/lpw</a>                 |

### Applications

|                    |                                                                          |
|--------------------|--------------------------------------------------------------------------|
| Audio              | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                   |
| Automotive         | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>         |
| Broadband          | <a href="http://www.ti.com/broadband">www.ti.com/broadband</a>           |
| Digital Control    | <a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a> |
| Military           | <a href="http://www.ti.com/military">www.ti.com/military</a>             |
| Optical Networking | <a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a> |
| Security           | <a href="http://www.ti.com/security">www.ti.com/security</a>             |
| Telephony          | <a href="http://www.ti.com/telephony">www.ti.com/telephony</a>           |
| Video & Imaging    | <a href="http://www.ti.com/video">www.ti.com/video</a>                   |
| Wireless           | <a href="http://www.ti.com/wireless">www.ti.com/wireless</a>             |

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2007, Texas Instruments Incorporated

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

|                  |                                                                    |
|------------------|--------------------------------------------------------------------|
| Amplifiers       | <a href="http://amplifier.ti.com">amplifier.ti.com</a>             |
| Data Converters  | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>     |
| DSP              | <a href="http://dsp.ti.com">dsp.ti.com</a>                         |
| Interface        | <a href="http://interface.ti.com">interface.ti.com</a>             |
| Logic            | <a href="http://logic.ti.com">logic.ti.com</a>                     |
| Power Mgmt       | <a href="http://power.ti.com">power.ti.com</a>                     |
| Microcontrollers | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> |
| Low Power        | <a href="http://www.ti.com/lpw">www.ti.com/lpw</a>                 |
| Wireless         |                                                                    |

### Applications

|                    |                                                                          |
|--------------------|--------------------------------------------------------------------------|
| Audio              | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                   |
| Automotive         | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>         |
| Broadband          | <a href="http://www.ti.com/broadband">www.ti.com/broadband</a>           |
| Digital Control    | <a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a> |
| Military           | <a href="http://www.ti.com/military">www.ti.com/military</a>             |
| Optical Networking | <a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a> |
| Security           | <a href="http://www.ti.com/security">www.ti.com/security</a>             |
| Telephony          | <a href="http://www.ti.com/telephony">www.ti.com/telephony</a>           |
| Video & Imaging    | <a href="http://www.ti.com/video">www.ti.com/video</a>                   |
| Wireless           | <a href="http://www.ti.com/wireless">www.ti.com/wireless</a>             |

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2007, Texas Instruments Incorporated

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

|                    |                                                                    |
|--------------------|--------------------------------------------------------------------|
| Amplifiers         | <a href="http://amplifier.ti.com">amplifier.ti.com</a>             |
| Data Converters    | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>     |
| DSP                | <a href="http://dsp.ti.com">dsp.ti.com</a>                         |
| Interface          | <a href="http://interface.ti.com">interface.ti.com</a>             |
| Logic              | <a href="http://logic.ti.com">logic.ti.com</a>                     |
| Power Mgmt         | <a href="http://power.ti.com">power.ti.com</a>                     |
| Microcontrollers   | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> |
| Low Power Wireless | <a href="http://www.ti.com/lpw">www.ti.com/lpw</a>                 |

### Applications

|                    |                                                                          |
|--------------------|--------------------------------------------------------------------------|
| Audio              | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                   |
| Automotive         | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>         |
| Broadband          | <a href="http://www.ti.com/broadband">www.ti.com/broadband</a>           |
| Digital Control    | <a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a> |
| Military           | <a href="http://www.ti.com/military">www.ti.com/military</a>             |
| Optical Networking | <a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a> |
| Security           | <a href="http://www.ti.com/security">www.ti.com/security</a>             |
| Telephony          | <a href="http://www.ti.com/telephony">www.ti.com/telephony</a>           |
| Video & Imaging    | <a href="http://www.ti.com/video">www.ti.com/video</a>                   |
| Wireless           | <a href="http://www.ti.com/wireless">www.ti.com/wireless</a>             |

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2007, Texas Instruments Incorporated

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

|                    |                                                                    |
|--------------------|--------------------------------------------------------------------|
| Amplifiers         | <a href="http://amplifier.ti.com">amplifier.ti.com</a>             |
| Data Converters    | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>     |
| DSP                | <a href="http://dsp.ti.com">dsp.ti.com</a>                         |
| Interface          | <a href="http://interface.ti.com">interface.ti.com</a>             |
| Logic              | <a href="http://logic.ti.com">logic.ti.com</a>                     |
| Power Mgmt         | <a href="http://power.ti.com">power.ti.com</a>                     |
| Microcontrollers   | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> |
| Low Power Wireless | <a href="http://www.ti.com/lpw">www.ti.com/lpw</a>                 |

### Applications

|                    |                                                                          |
|--------------------|--------------------------------------------------------------------------|
| Audio              | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                   |
| Automotive         | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>         |
| Broadband          | <a href="http://www.ti.com/broadband">www.ti.com/broadband</a>           |
| Digital Control    | <a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a> |
| Military           | <a href="http://www.ti.com/military">www.ti.com/military</a>             |
| Optical Networking | <a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a> |
| Security           | <a href="http://www.ti.com/security">www.ti.com/security</a>             |
| Telephony          | <a href="http://www.ti.com/telephony">www.ti.com/telephony</a>           |
| Video & Imaging    | <a href="http://www.ti.com/video">www.ti.com/video</a>                   |
| Wireless           | <a href="http://www.ti.com/wireless">www.ti.com/wireless</a>             |

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2007, Texas Instruments Incorporated

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

|                    |                                                                    |
|--------------------|--------------------------------------------------------------------|
| Amplifiers         | <a href="http://amplifier.ti.com">amplifier.ti.com</a>             |
| Data Converters    | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>     |
| DSP                | <a href="http://dsp.ti.com">dsp.ti.com</a>                         |
| Interface          | <a href="http://interface.ti.com">interface.ti.com</a>             |
| Logic              | <a href="http://logic.ti.com">logic.ti.com</a>                     |
| Power Mgmt         | <a href="http://power.ti.com">power.ti.com</a>                     |
| Microcontrollers   | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> |
| Low Power Wireless | <a href="http://www.ti.com/lpw">www.ti.com/lpw</a>                 |

### Applications

|                    |                                                                          |
|--------------------|--------------------------------------------------------------------------|
| Audio              | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                   |
| Automotive         | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>         |
| Broadband          | <a href="http://www.ti.com/broadband">www.ti.com/broadband</a>           |
| Digital Control    | <a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a> |
| Military           | <a href="http://www.ti.com/military">www.ti.com/military</a>             |
| Optical Networking | <a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a> |
| Security           | <a href="http://www.ti.com/security">www.ti.com/security</a>             |
| Telephony          | <a href="http://www.ti.com/telephony">www.ti.com/telephony</a>           |
| Video & Imaging    | <a href="http://www.ti.com/video">www.ti.com/video</a>                   |
| Wireless           | <a href="http://www.ti.com/wireless">www.ti.com/wireless</a>             |

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2007, Texas Instruments Incorporated

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

|                    |                                                                    |
|--------------------|--------------------------------------------------------------------|
| Amplifiers         | <a href="http://amplifier.ti.com">amplifier.ti.com</a>             |
| Data Converters    | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>     |
| DSP                | <a href="http://dsp.ti.com">dsp.ti.com</a>                         |
| Interface          | <a href="http://interface.ti.com">interface.ti.com</a>             |
| Logic              | <a href="http://logic.ti.com">logic.ti.com</a>                     |
| Power Mgmt         | <a href="http://power.ti.com">power.ti.com</a>                     |
| Microcontrollers   | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> |
| Low Power Wireless | <a href="http://www.ti.com/lpw">www.ti.com/lpw</a>                 |

### Applications

|                    |                                                                          |
|--------------------|--------------------------------------------------------------------------|
| Audio              | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                   |
| Automotive         | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>         |
| Broadband          | <a href="http://www.ti.com/broadband">www.ti.com/broadband</a>           |
| Digital Control    | <a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a> |
| Military           | <a href="http://www.ti.com/military">www.ti.com/military</a>             |
| Optical Networking | <a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a> |
| Security           | <a href="http://www.ti.com/security">www.ti.com/security</a>             |
| Telephony          | <a href="http://www.ti.com/telephony">www.ti.com/telephony</a>           |
| Video & Imaging    | <a href="http://www.ti.com/video">www.ti.com/video</a>                   |
| Wireless           | <a href="http://www.ti.com/wireless">www.ti.com/wireless</a>             |

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2007, Texas Instruments Incorporated

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74LS292N       | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74LS292N3      | OBSOLETE              | PDIP         | N               | 16   |             | TBD                     | Call TI          | Call TI                      |
| SN74LS292N3      | OBSOLETE              | PDIP         | N               | 16   |             | TBD                     | Call TI          | Call TI                      |
| SN74LS292NE4     | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74LS292NE4     | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74LS294N       | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74LS294N       | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74LS294NE4     | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| SN74LS294NE4     | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

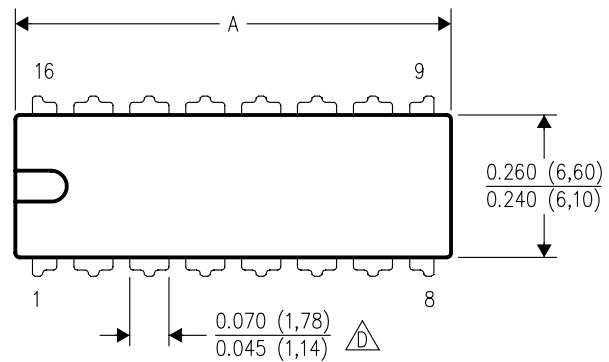
**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

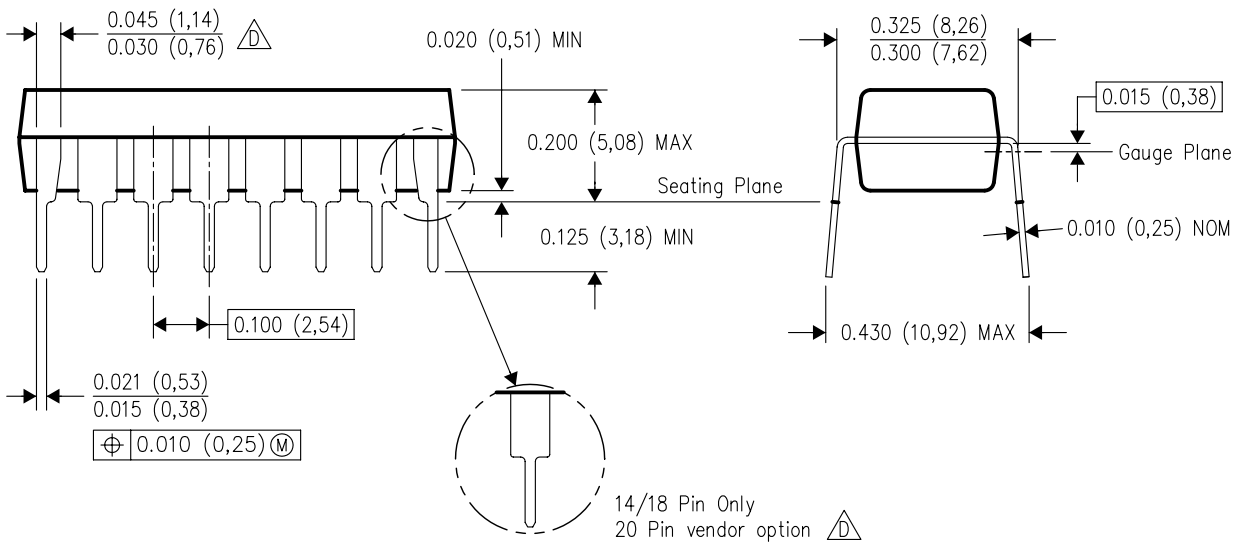
## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



| PINS **             | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| DIM                 |                  |                  |                  |                  |
| A MAX               | 0.775<br>(19,69) | 0.775<br>(19,69) | 0.920<br>(23,37) | 1.060<br>(26,92) |
| A MIN               | 0.745<br>(18,92) | 0.745<br>(18,92) | 0.850<br>(21,59) | 0.940<br>(23,88) |
| MS-001<br>VARIATION | AA               | BB               | AC               | AD               |



4040049/E 12/2002

- 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.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

|                             |                                                                    |
|-----------------------------|--------------------------------------------------------------------|
| Amplifiers                  | <a href="http://amplifier.ti.com">amplifier.ti.com</a>             |
| Data Converters             | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>     |
| DSP                         | <a href="http://dsp.ti.com">dsp.ti.com</a>                         |
| Clocks and Timers           | <a href="http://www.ti.com/clocks">www.ti.com/clocks</a>           |
| Interface                   | <a href="http://interface.ti.com">interface.ti.com</a>             |
| Logic                       | <a href="http://logic.ti.com">logic.ti.com</a>                     |
| Power Mgmt                  | <a href="http://power.ti.com">power.ti.com</a>                     |
| Microcontrollers            | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> |
| RFID                        | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>               |
| RF/IF and ZigBee® Solutions | <a href="http://www.ti.com/lprf">www.ti.com/lprf</a>               |

### Applications

|                    |                                                                          |
|--------------------|--------------------------------------------------------------------------|
| Audio              | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                   |
| Automotive         | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>         |
| Broadband          | <a href="http://www.ti.com/broadband">www.ti.com/broadband</a>           |
| Digital Control    | <a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a> |
| Medical            | <a href="http://www.ti.com/medical">www.ti.com/medical</a>               |
| Military           | <a href="http://www.ti.com/military">www.ti.com/military</a>             |
| Optical Networking | <a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a> |
| Security           | <a href="http://www.ti.com/security">www.ti.com/security</a>             |
| Telephony          | <a href="http://www.ti.com/telephony">www.ti.com/telephony</a>           |
| Video & Imaging    | <a href="http://www.ti.com/video">www.ti.com/video</a>                   |
| Wireless           | <a href="http://www.ti.com/wireless">www.ti.com/wireless</a>             |

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2008, Texas Instruments Incorporated