

# SN5490A, SN5492A, SN5493A, SN54LS90, SN54LS92, SN54LS93 SN7490A, SN7492A, SN7493A, SN74LS90, SN74LS92, SN74LS93 DECADE, DIVIDE-BY-TWELVE AND BINARY COUNTERS

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'90A, 'LS90 . . . Decade Counters

'92A, 'LS92 . . . Divide By-Twelve Counters

'93A, 'LS93 . . . 4-Bit Binary Counters

| TYPES               | TYPICAL<br>POWER DISSIPATION |
|---------------------|------------------------------|
| '90A                | 145 mW                       |
| '92A, '93A          | 130 mW                       |
| 'LS90, 'LS92, 'LS93 | 45 mW                        |

## description

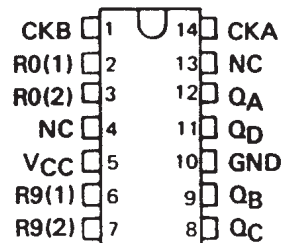
Each of these monolithic counters contains four master-slave flip-flops and additional gating to provide a divide-by-two counter and a three-stage binary counter for which the count cycle length is divide-by-five for the '90A and 'LS90, divide-by-six for the '92A and 'LS92, and the divide-by-eight for the '93A and 'LS93.

All of these counters have a gated zero reset and the '90A and 'LS90 also have gated set-to-nine inputs for use in BCD nine's complement applications.

To use their maximum count length (decade, divide-by-twelve, or four-bit binary) of these counters, the CKB input is connected to the  $Q_A$  output. The input count pulses are applied to CKA input and the outputs are as described in the appropriate function table. A symmetrical divide-by-ten count can be obtained from the '90A or 'LS90 counters by connecting the  $Q_D$  output to the CKA input and applying the input count to the CKB input which gives a divide-by-ten square wave at output  $Q_A$ .

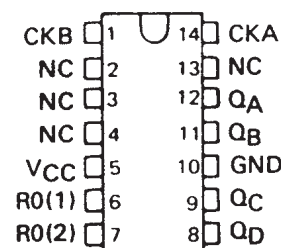
SN5490A, SN54LS90 . . . J OR W PACKAGE  
SN7490A . . . N PACKAGE  
SN74LS90 . . . D OR N PACKAGE

(TOP VIEW)



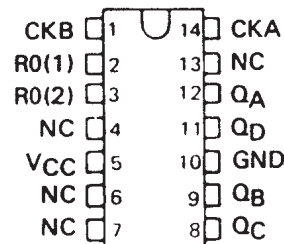
SN5492A, SN54LS92 . . . J OR W PACKAGE  
SN7492A . . . N PACKAGE  
SN74LS92 . . . D OR N PACKAGE

(TOP VIEW)



SN5493A, SN54LS93 . . . J OR W PACKAGE  
SN7493 . . . N PACKAGE  
SN74LS93 . . . D OR N PACKAGE

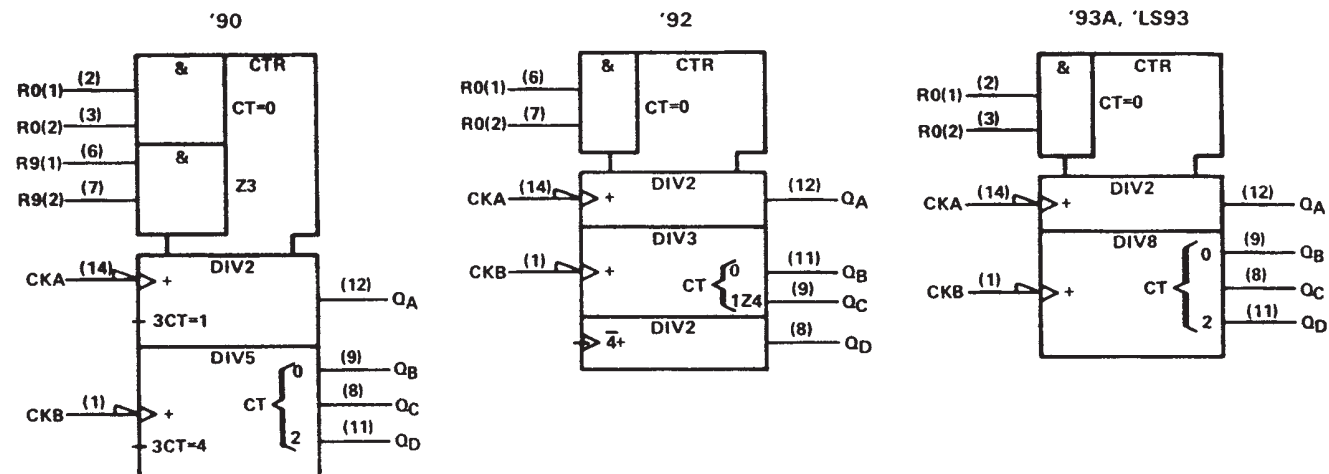
(TOP VIEW)



**SN5490A, SN5492A, SN5493A, SN54LS90, SN54LS92, SN54LS93  
SN7490A, SN7492A, SN7493A, SN74LS90, SN74LS92, SN74LS93  
DECADE, DIVIDE-BY-TWELVE AND BINARY COUNTERS**

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**logic symbols†**



†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

SN5490A, SN5492A, SN5493A, SN54LS90, SN54LS92, SN54LS93  
 SN7490A, SN7492A, SN7493A, SN74LS90, SN74LS92, SN74LS93  
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'90A, 'LS90  
 BCD COUNT SEQUENCE  
 (See Note A)

| COUNT | OUTPUT         |                |                |                |
|-------|----------------|----------------|----------------|----------------|
|       | Q <sub>D</sub> | Q <sub>C</sub> | Q <sub>B</sub> | Q <sub>A</sub> |
| 0     | L              | L              | L              | L              |
| 1     | L              | L              | L              | H              |
| 2     | L              | L              | H              | L              |
| 3     | L              | L              | H              | H              |
| 4     | L              | H              | L              | L              |
| 5     | L              | H              | L              | H              |
| 6     | L              | H              | H              | L              |
| 7     | L              | H              | H              | H              |
| 8     | H              | L              | L              | L              |
| 9     | H              | L              | L              | H              |

'90A, 'LS90  
 BI-QUINARY (5-2)  
 (See Note B)

| COUNT | OUTPUT         |                |                |                |
|-------|----------------|----------------|----------------|----------------|
|       | Q <sub>A</sub> | Q <sub>D</sub> | Q <sub>C</sub> | Q <sub>B</sub> |
| 0     | L              | L              | L              | L              |
| 1     | L              | L              | L              | H              |
| 2     | L              | L              | H              | L              |
| 3     | L              | L              | H              | H              |
| 4     | L              | H              | L              | L              |
| 5     | H              | L              | L              | L              |
| 6     | H              | L              | L              | H              |
| 7     | H              | L              | H              | L              |
| 8     | H              | L              | H              | H              |
| 9     | H              | H              | L              | L              |

'92A, 'LS92  
 COUNT SEQUENCE  
 (See Note C)

| COUNT | OUTPUT         |                |                |                |
|-------|----------------|----------------|----------------|----------------|
|       | Q <sub>D</sub> | Q <sub>C</sub> | Q <sub>B</sub> | Q <sub>A</sub> |
| 0     | L              | L              | L              | L              |
| 1     | L              | L              | L              | H              |
| 2     | L              | L              | H              | L              |
| 3     | L              | L              | H              | H              |
| 4     | L              | H              | L              | L              |
| 5     | L              | H              | L              | H              |
| 6     | H              | L              | L              | L              |
| 7     | H              | L              | L              | H              |
| 8     | H              | L              | H              | L              |
| 9     | H              | L              | H              | H              |
| 10    | H              | H              | L              | L              |
| 11    | H              | H              | L              | H              |

'90A, 'LS90  
 RESET/COUNT FUNCTION TABLE

| RESET INPUTS       |                    |                    |                    | OUTPUT         |                |                |                |
|--------------------|--------------------|--------------------|--------------------|----------------|----------------|----------------|----------------|
| R <sub>0</sub> (1) | R <sub>0</sub> (2) | R <sub>9</sub> (1) | R <sub>9</sub> (2) | Q <sub>D</sub> | Q <sub>C</sub> | Q <sub>B</sub> | Q <sub>A</sub> |
| H                  | H                  | L                  | X                  | L              | L              | L              | L              |
| H                  | H                  | X                  | L                  | L              | L              | L              | L              |
| X                  | X                  | H                  | H                  | H              | L              | L              | H              |
| X                  | L                  | X                  | L                  | COUNT          |                |                |                |
| L                  | X                  | L                  | X                  | COUNT          |                |                |                |
| L                  | X                  | X                  | L                  | COUNT          |                |                |                |
| X                  | L                  | L                  | X                  | COUNT          |                |                |                |

'93A, 'LS93  
 COUNT SEQUENCE  
 (See Note C)

| COUNT | OUTPUT         |                |                |                |
|-------|----------------|----------------|----------------|----------------|
|       | Q <sub>D</sub> | Q <sub>C</sub> | Q <sub>B</sub> | Q <sub>A</sub> |
| 0     | L              | L              | L              | L              |
| 1     | L              | L              | L              | H              |
| 2     | L              | L              | H              | L              |
| 3     | L              | L              | H              | H              |
| 4     | L              | H              | L              | L              |
| 5     | L              | H              | L              | H              |
| 6     | L              | H              | H              | L              |
| 7     | L              | H              | H              | H              |
| 8     | H              | L              | L              | L              |
| 9     | H              | L              | L              | H              |
| 10    | H              | L              | H              | L              |
| 11    | H              | L              | H              | H              |
| 12    | H              | H              | L              | L              |
| 13    | H              | H              | L              | H              |
| 14    | H              | H              | H              | L              |
| 15    | H              | H              | H              | H              |

'92A, 'LS92, '93A, 'LS93  
 RESET/COUNT FUNCTION TABLE

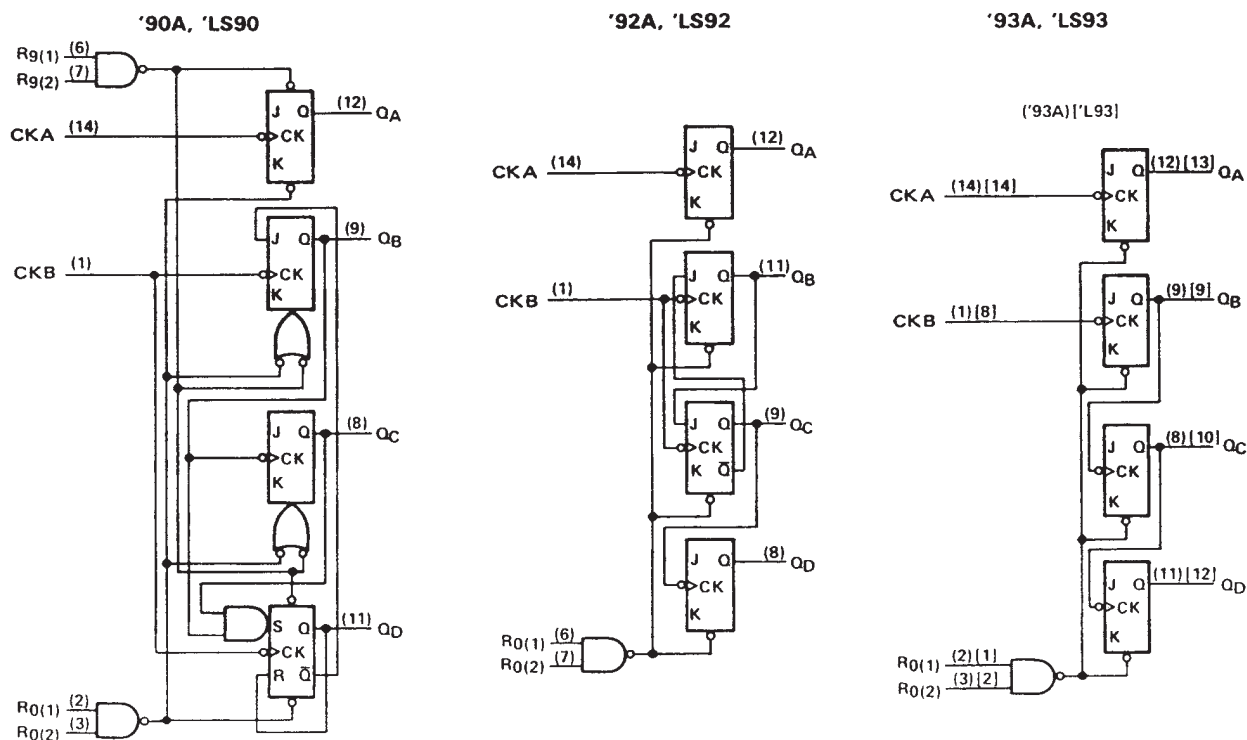
| RESET INPUTS       |                    | OUTPUT         |                |                |                |
|--------------------|--------------------|----------------|----------------|----------------|----------------|
| R <sub>0</sub> (1) | R <sub>0</sub> (2) | Q <sub>D</sub> | Q <sub>C</sub> | Q <sub>B</sub> | Q <sub>A</sub> |
| H                  | H                  | L              | L              | L              | L              |
| L                  | X                  | COUNT          |                |                |                |
| X                  | L                  | COUNT          |                |                |                |

- NOTES: A. Output Q<sub>A</sub> is connected to input CKB for BCD count.  
 B. Output Q<sub>D</sub> is connected to input CKA for bi-quinary count.  
 C. Output Q<sub>A</sub> is connected to input CKB.  
 D. H = high level, L = low level, X = irrelevant

# SN5490A, SN5492A, SN5493A, SN54LS90, SN54LS92, SN54LS93 SN7490A, SN7492A, SN7493A, SN74LS90, SN74LS92, SN74LS93 DECADE, DIVIDE-BY-TWELVE AND BINARY COUNTERS

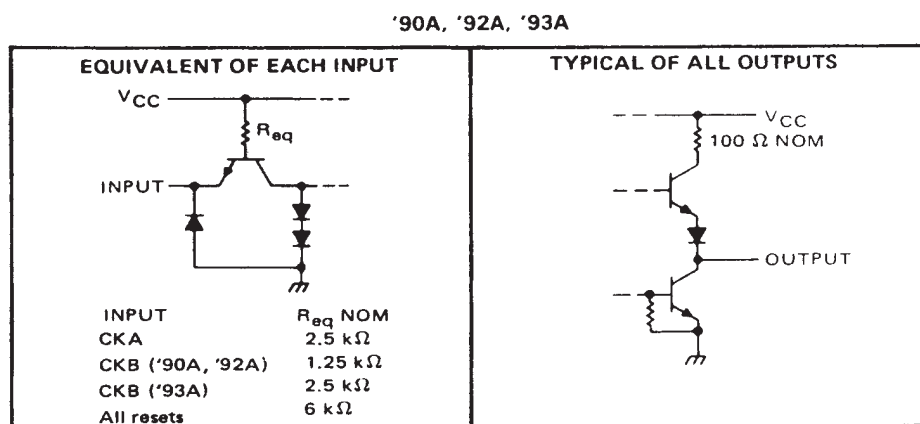
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## logic diagrams (positive logic)



The J and K inputs shown without connection are for reference only and are functionally at a high level.  
Pin numbers shown in ( ) are for the 'LS93 and '93A and pin numbers shown in [ ] are for the '54LS93.

## schematics of inputs and outputs

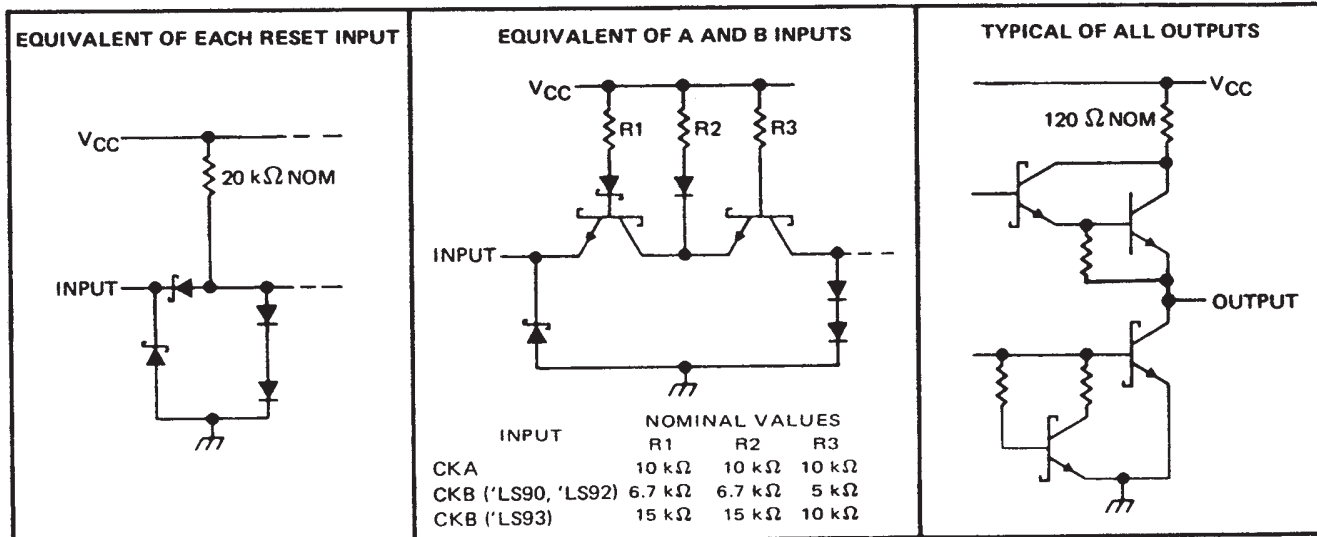


SN5490A, SN5492A, SN5493A, SN54LS90, SN54LS92, SN54LS93  
 SN7490A, SN7492A, SN7493A, SN74LS90, SN74LS92, SN74LS93  
 DECADE, DIVIDE-BY-TWELVE AND BINARY COUNTERS

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schematics of inputs and outputs (continued)

'LS90, 'LS92, 'LS93



# SN5490A, SN5492A, SN5493A, SN54LS90, SN54LS92, SN54LS93 SN7490A, SN7492A, SN7493A, SN74LS90, SN74LS92, SN74LS93 DECADE, DIVIDE-BY-TWELVE AND BINARY COUNTERS

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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          |
| Interemitter voltage (see Note 2)                               | 5.5 V          |
| Operating free-air temperature range: SN5490A, SN5492A, SN5493A | –55°C to 125°C |
| SN7490A, SN7492A, SN7493A                                       | 0°C to 70°C    |
| Storage temperature range                                       | –65°C to 150°C |

NOTES: 1. Voltage values, except interemitter voltage, are with respect to network ground terminal.

2. This is the voltage between two emitters of a multiple-emitter transistor. For these circuits, this rating applies between the two  $R_0$  inputs, and for the '90A circuit, it also applies between the two  $R_0$  inputs.

recommended operating conditions

|                                             |              | SN5490A, SN5492A<br>SN5493A |     |      | SN7490A, SN7492A<br>SN7493A |     |      | 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, $I_{OH}$         |              |                             |     | –800 |                             |     | –800 | $\mu$ A |
| Low-level output current, $I_{OL}$          |              |                             |     | 16   |                             |     | 16   | mA      |
| Count frequency, $f_{count}$ (see Figure 1) | A input      | 0                           |     | 32   | 0                           |     | 32   | MHz     |
|                                             | B input      | 0                           |     | 16   | 0                           |     | 16   |         |
| Pulse width, $t_w$                          | A input      | 15                          |     |      | 15                          |     |      | ns      |
|                                             | B input      | 30                          |     |      | 30                          |     |      |         |
|                                             | Reset inputs | 15                          |     |      | 15                          |     |      |         |
| Reset inactive-state setup time, $t_{SU}$   |              | 25                          |     |      | 25                          |     |      | ns      |
| Operating free-air temperature, $T_A$       |              | –55                         |     | 125  | 0                           |     | 70   | °C      |

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

| PARAMETER ¶     |                                        | TEST CONDITIONS†                                                                                    |                                               | '90A |      |     | '92A |      |     | '93A |      |     | UNIT |
|-----------------|----------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------|------|------|-----|------|------|-----|------|------|-----|------|
|                 |                                        |                                                                                                     |                                               | MIN  | TYP‡ | MAX | MIN  | TYP‡ | MAX | MIN  | TYP‡ | MAX |      |
| V <sub>IH</sub> | High-level input voltage               |                                                                                                     |                                               | 2    |      |     | 2    |      |     | 2    |      |     | V    |
| V <sub>IL</sub> | Low-level input voltage                |                                                                                                     |                                               | 0.8  |      |     | 0.8  |      |     | 0.8  |      |     | V    |
| V <sub>IK</sub> | Input clamp voltage                    | V <sub>CC</sub> = MIN, I <sub>I</sub> = –12 mA                                                      |                                               | –1.5 |      |     | –1.5 |      |     | –1.5 |      |     | V    |
| V <sub>OH</sub> | High-level output voltage              | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V,<br>V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = –800 µA |                                               | 2.4  | 3.4  |     | 2.4  | 3.4  |     | 2.4  | 3.4  |     | V    |
| V <sub>OL</sub> | Low-level output voltage               | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V,<br>V <sub>IL</sub> = 0.8 V, I <sub>OL</sub> = 16 mA¶  |                                               |      | 0.2  | 0.4 |      | 0.2  | 0.4 |      | 0.2  | 0.4 | V    |
| I <sub>I</sub>  | Input current at maximum input voltage | V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V                                                       |                                               | 1    |      |     | 1    |      |     | 1    |      |     | mA   |
| I <sub>IH</sub> | High-level input current               | Any reset                                                                                           | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.4 V | 40   |      |     | 40   |      |     | 40   |      |     | µA   |
|                 |                                        | CKA                                                                                                 |                                               | 80   |      |     | 80   |      |     | 80   |      |     |      |
|                 |                                        | CKB                                                                                                 |                                               | 120  |      |     | 120  |      |     | 80   |      |     |      |
| I <sub>IL</sub> | Low-level input current                | Any reset                                                                                           | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V | –1.6 |      |     | –1.6 |      |     | –1.6 |      |     | mA   |
|                 |                                        | CKA                                                                                                 |                                               | –3.2 |      |     | –3.2 |      |     | –3.2 |      |     |      |
|                 |                                        | CKB                                                                                                 |                                               | –4.8 |      |     | –4.8 |      |     | –3.2 |      |     |      |
| I <sub>OS</sub> | Short-circuit output current §         | V <sub>CC</sub> = MAX                                                                               | SN54'                                         | –20  | –57  | –20 | –57  | –20  | –57 |      |      |     | mA   |
|                 |                                        |                                                                                                     | SN74'                                         | –18  | –57  | –18 | –57  | –18  | –57 |      |      |     |      |
| I <sub>CC</sub> | Supply current                         | V <sub>CC</sub> = MAX, See Note 3                                                                   |                                               |      | 29   | 42  |      | 26   | 39  |      | 26   | 39  | mA   |

<sup>†</sup> For 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.

<sup>¶</sup>  $I_{OL}$  outputs are tested at  $I_{OL} = 16 \text{ mA}$  plus the limit value for  $I_{IL}$  for the CKB input. This permits driving the CKB input while maintaining full fan-out capability.

NOTE 3:  $I_{CC}$  is measured with all outputs open, both  $R_0$  inputs grounded following momentary connection to 4.5 V, and all other inputs grounded.



SN5490A, SN5492A, SN5493A, SN54LS90, SN54LS92, SN54LS93  
 SN7490A, SN7492A, SN7493A, SN74LS90, SN74LS92, SN74LS93  
 DECADE, DIVIDE-BY-TWELVE AND BINARY COUNTERS

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

| PARAMETER†       | FROM<br>(INPUT) | TO<br>(OUTPUT)                  | TEST CONDITIONS                                                    | '90A |     |     | '92A |     |     | '93A |     |     | UNIT |
|------------------|-----------------|---------------------------------|--------------------------------------------------------------------|------|-----|-----|------|-----|-----|------|-----|-----|------|
|                  |                 |                                 |                                                                    | MIN  | TYP | MAX | MIN  | TYP | MAX | MIN  | TYP | MAX |      |
| f <sub>max</sub> | CKA             | Q <sub>A</sub>                  | C <sub>L</sub> = 15 pF,<br>R <sub>L</sub> = 400 Ω,<br>See Figure 1 | 32   | 42  |     | 32   | 42  |     | 32   | 42  |     | MHz  |
|                  | CKB             | Q <sub>B</sub>                  |                                                                    | 16   |     |     | 16   |     |     | 16   |     |     |      |
| t <sub>PLH</sub> | CKA             | Q <sub>A</sub>                  |                                                                    | 10   | 16  |     | 10   | 16  |     | 10   | 16  |     | ns   |
| t <sub>PHL</sub> |                 |                                 |                                                                    | 12   | 18  |     | 12   | 18  |     | 12   | 18  |     |      |
| t <sub>PLH</sub> | CKA             | Q <sub>D</sub>                  |                                                                    | 32   | 48  |     | 32   | 48  |     | 46   | 70  |     | ns   |
| t <sub>PHL</sub> |                 |                                 |                                                                    | 34   | 50  |     | 34   | 50  |     | 46   | 70  |     |      |
| t <sub>PLH</sub> | CKB             | Q <sub>B</sub>                  |                                                                    | 10   | 16  |     | 10   | 16  |     | 10   | 16  |     | ns   |
| t <sub>PHL</sub> |                 |                                 |                                                                    | 14   | 21  |     | 14   | 21  |     | 14   | 21  |     |      |
| t <sub>PLH</sub> | CKB             | Q <sub>C</sub>                  |                                                                    | 21   | 32  |     | 10   | 16  |     | 21   | 32  |     | ns   |
| t <sub>PHL</sub> |                 |                                 |                                                                    | 23   | 35  |     | 14   | 21  |     | 23   | 35  |     |      |
| t <sub>PLH</sub> | CKB             | Q <sub>D</sub>                  |                                                                    | 21   | 32  |     | 21   | 32  |     | 34   | 51  |     | ns   |
| t <sub>PHL</sub> |                 |                                 |                                                                    | 23   | 35  |     | 23   | 35  |     | 34   | 51  |     |      |
| t <sub>PHL</sub> | Set-to-0        | Any                             |                                                                    | 26   | 40  |     | 26   | 40  |     | 26   | 40  |     | ns   |
| t <sub>PLH</sub> | Set-to-9        | Q <sub>A</sub> , Q <sub>D</sub> |                                                                    | 20   | 30  |     |      |     |     |      |     |     | ns   |
| t <sub>PHL</sub> |                 | Q <sub>B</sub> , Q <sub>C</sub> |                                                                    | 26   | 40  |     |      |     |     |      |     |     |      |

†  $f_{\max}$  = maximum count frequency

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

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

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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: R inputs                                | 7 V            |
| A and B inputs                                         | 5.5 V          |
| Operating free-air temperature range: SN54LS* Circuits | –55°C to 125°C |
| SN74LS* Circuits                                       | 0°C to 70°C    |
| Storage temperature range                              | –65°C to 150°C |

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

recommended operating conditions

|                                             |              | SN54LS90<br>SN54LS92<br>SN54LS93 |     |     | SN74LS90<br>SN74LS92<br>SN74LS93 |     |      | 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                             |     |      | $\mu$ A |
| Low-level output current, $I_{OL}$          |              | 4                                |     |     | 8                                |     |      | mA      |
| Count frequency, $f_{count}$ (see Figure 1) | A input      | 0                                |     | 32  | 0                                |     | 32   | MHz     |
|                                             | B input      | 0                                |     | 16  | 0                                |     | 16   |         |
| Pulse width, $t_w$                          | A input      | 15                               |     |     | 15                               |     |      | ns      |
|                                             | B input      | 30                               |     |     | 30                               |     |      |         |
|                                             | Reset inputs | 30                               |     |     | 30                               |     |      |         |
| Reset inactive-state setup time, $t_{su}$   |              | 25                               |     |     | 25                               |     |      | ns      |
| Operating free-air temperature, $T_A$       |              | –55                              |     | 125 | 0                                |     | 70   | °C      |

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

| PARAMETER |                                        | TEST CONDITIONS†                                                                                                                 |                                            | SN54LS90<br>SN54LS92 |      |      | SN74LS90<br>SN74LS92 |      |      | UNIT    |
|-----------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------|------|------|----------------------|------|------|---------|
|           |                                        |                                                                                                                                  |                                            | MIN                  | TYP‡ | MAX  | MIN                  | TYP‡ | MAX  |         |
| $V_{IH}$  | High-level input voltage               |                                                                                                                                  |                                            | 2                    |      |      | 2                    |      |      | V       |
| $V_{IL}$  | Low-level input voltage                |                                                                                                                                  |                                            |                      |      | 0.7  |                      |      | 0.8  | V       |
| $V_{IK}$  | Input clamp voltage                    | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$                                                                                      |                                            |                      |      | –1.5 |                      |      | –1.5 | V       |
| $V_{OH}$  | High-level output voltage              | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OH} = -400 \mu\text{A}$                              |                                            | 2.5                  | 3.4  |      | 2.7                  | 3.4  |      | V       |
| $V_{OL}$  | Low-level output voltage               | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OL} = 4 \text{ mA}^{\S}, I_{OL} = 8 \text{ mA}^{\P}$ |                                            | 0.25                 | 0.4  |      | 0.25                 | 0.4  | 0.5  | V       |
| $I_I$     | Input current at maximum input voltage | Any reset                                                                                                                        | $V_{CC} = \text{MAX}, V_I = 7 \text{ V}$   |                      |      | 0.1  |                      |      | 0.1  | mA      |
|           |                                        | CKA                                                                                                                              | $V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$ |                      |      | 0.2  |                      |      | 0.2  |         |
|           |                                        | CKB                                                                                                                              | $V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$ |                      |      | 0.4  |                      |      | 0.4  |         |
| $I_{IH}$  | High-level input current               | Any reset                                                                                                                        | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$ |                      |      | 20   |                      |      | 20   | $\mu$ A |
|           |                                        | CKA                                                                                                                              | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$ |                      |      | 40   |                      |      | 40   |         |
|           |                                        | CKB                                                                                                                              | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$ |                      |      | 80   |                      |      | 80   |         |
| $I_{IL}$  | Low-level input current                | Any reset                                                                                                                        | $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$ |                      |      | –0.4 |                      |      | –0.4 | mA      |
|           |                                        | CKA                                                                                                                              | $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$ |                      |      | –2.4 |                      |      | –2.4 |         |
|           |                                        | CKB                                                                                                                              | $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$ |                      |      | –3.2 |                      |      | –3.2 |         |
| $I_{OS}$  | Short-circuit output current $^{\S}$   | $V_{CC} = \text{MAX}$                                                                                                            |                                            | –20                  |      | –100 | –20                  |      | –100 | mA      |
| $I_{CC}$  | Supply current                         | $V_{CC} = \text{MAX},$ See Note 3                                                                                                | 'LS90                                      |                      |      | 9    |                      |      | 15   | mA      |
|           |                                        |                                                                                                                                  | 'LS92                                      |                      |      | 9    |                      |      | 15   |         |

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

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

$^{\S}$  Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

$^{\P}$   $I_{QA}$  outputs are tested at specified  $I_{OL}$  plus the limit value of  $I_{IL}$  for the CKB input. This permits driving the CKB input while maintaining full fan-out capability.

NOTE 3:  $I_{CC}$  is measured with all outputs open, both  $R_O$  inputs grounded following momentary connection to 4.5 V, and all other inputs grounded.





SN5490A, SN5492A, SN5493A, SN54LS90, SN54LS92, SN54LS93  
 SN7490A, SN7492A, SN7493A, SN74LS90, SN74LS92, SN74LS93  
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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER       |                                        |            | TEST CONDITIONS†                                                                                               | SN54LS93 |      |      | SN74LS93 |      |     | UNIT |
|-----------------|----------------------------------------|------------|----------------------------------------------------------------------------------------------------------------|----------|------|------|----------|------|-----|------|
|                 |                                        |            |                                                                                                                | MIN      | TYP‡ | MAX  | MIN      | TYP‡ | MAX |      |
| V <sub>IH</sub> | High-level input voltage               |            |                                                                                                                | 2        |      |      | 2        |      |     | V    |
| V <sub>IL</sub> | Low-level input voltage                |            |                                                                                                                | 0.7      |      |      | 0.8      |      |     | V    |
| V <sub>IK</sub> | Input clamp voltage                    |            | V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA                                                                 | -1.5     |      |      | -1.5     |      |     | V    |
| V <sub>OH</sub> | High-level output voltage              |            | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = V <sub>IL</sub> max, I <sub>OH</sub> = -400 µA | 2.5      | 3.4  |      | 2.7      | 3.4  |     | V    |
| V <sub>OL</sub> | Low-level output voltage               |            | V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, I <sub>OL</sub> = 4 mA¶                                          | 0.25     |      | 0.4  | 0.25     |      | 0.4 | V    |
|                 |                                        |            | V <sub>IL</sub> = V <sub>IL</sub> max, I <sub>OL</sub> = 8 mA¶                                                 |          |      | 0.35 |          | 0.5  |     |      |
| I <sub>I</sub>  | Input current at maximum input voltage | Any reset  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V                                                                    | 0.1      |      |      | 0.1      |      |     | mA   |
|                 |                                        | CKA or CKB | V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V                                                                  | 0.2      |      |      | 0.2      |      |     |      |
| I <sub>IH</sub> | High-level input current               | Any reset  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V                                                                  | 20       |      |      | 20       |      |     | µA   |
|                 |                                        | CKA or CKB |                                                                                                                | 40       |      |      | 80       |      |     |      |
| I <sub>IL</sub> | Low-level input current                | Any reset  | V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V                                                                  | -0.4     |      |      | -0.4     |      |     | mA   |
|                 |                                        | CKA        |                                                                                                                | -2.4     |      |      | -2.4     |      |     |      |
|                 |                                        | CKB        |                                                                                                                | -1.6     |      |      | -1.6     |      |     |      |
| I <sub>OS</sub> | Short-circuit output current§          |            | V <sub>CC</sub> = MAX                                                                                          | -20      | -100 |      | -20      | -100 |     | mA   |
| I <sub>CC</sub> | Supply current                         |            | V <sub>CC</sub> = MAX, See Note 3                                                                              | 9        |      | 15   | 9        |      | 15  | mA   |

†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.

§Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

¶Q<sub>A</sub> outputs are tested at specified I<sub>OL</sub> plus the limit value for I<sub>IL</sub> for the CKB input. This permits driving the CKB input while maintaining full fan-out capability.

NOTE 3: I<sub>CC</sub> is measured with all outputs open, both R<sub>Q</sub> inputs grounded following momentary connection to 4.5 V, and all other inputs grounded.

switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

| PARAMETER#       | FROM<br>(INPUT) | TO<br>(OUTPUT)                  | TEST CONDITIONS                                                  | 'LS90 |     |     | 'LS92 |     |     | 'LS93 |     |     | UNIT |
|------------------|-----------------|---------------------------------|------------------------------------------------------------------|-------|-----|-----|-------|-----|-----|-------|-----|-----|------|
|                  |                 |                                 |                                                                  | MIN   | TYP | MAX | MIN   | TYP | MAX | MIN   | TYP | MAX |      |
| f <sub>max</sub> | CKA             | Q <sub>A</sub>                  | C <sub>L</sub> = 15 pF,<br>R <sub>L</sub> = 2 kΩ<br>See Figure 1 | 32    | 42  |     | 32    | 42  |     | 32    | 42  |     | MHz  |
|                  | CKB             | Q <sub>B</sub>                  |                                                                  | 16    |     |     | 16    |     |     | 16    |     |     |      |
| t <sub>PLH</sub> | CKA             | Q <sub>A</sub>                  |                                                                  | 10    | 16  |     | 10    | 16  |     | 10    | 16  |     | ns   |
| t <sub>PHL</sub> |                 |                                 |                                                                  | 12    | 18  |     | 12    | 18  |     | 12    | 18  |     |      |
| t <sub>PLH</sub> | CKA             | Q <sub>D</sub>                  |                                                                  | 32    | 48  |     | 32    | 48  |     | 46    | 70  |     | ns   |
| t <sub>PHL</sub> |                 |                                 |                                                                  | 34    | 50  |     | 34    | 50  |     | 46    | 70  |     |      |
| t <sub>PLH</sub> | CKB             | Q <sub>B</sub>                  |                                                                  | 10    | 16  |     | 10    | 16  |     | 10    | 16  |     | ns   |
| t <sub>PHL</sub> |                 |                                 |                                                                  | 14    | 21  |     | 14    | 21  |     | 14    | 21  |     |      |
| t <sub>PLH</sub> | CKB             | Q <sub>C</sub>                  |                                                                  | 21    | 32  |     | 10    | 16  |     | 21    | 32  |     | ns   |
| t <sub>PHL</sub> |                 |                                 |                                                                  | 23    | 35  |     | 14    | 21  |     | 23    | 35  |     |      |
| t <sub>PLH</sub> | CKB             | Q <sub>D</sub>                  |                                                                  | 21    | 32  |     | 21    | 32  |     | 34    | 51  |     | ns   |
| t <sub>PHL</sub> |                 |                                 |                                                                  | 23    | 35  |     | 23    | 35  |     | 34    | 51  |     |      |
| t <sub>PHL</sub> | Set-to-0        | Any                             |                                                                  | 26    | 40  |     | 26    | 40  |     | 26    | 40  |     | ns   |
| t <sub>PLH</sub> | Set-to-9        | Q <sub>A</sub> , Q <sub>D</sub> |                                                                  | 20    | 30  |     |       |     |     |       |     |     | ns   |
| t <sub>PHI</sub> |                 | Q <sub>B</sub> , Q <sub>C</sub> |                                                                  | 26    | 40  |     |       |     |     |       |     |     |      |

#f<sub>max</sub> = maximum count frequency

t<sub>PLH</sub> = propagation delay time, low-to-high-level output

t<sub>PHL</sub> = propagation delay time, high-to-low-level output



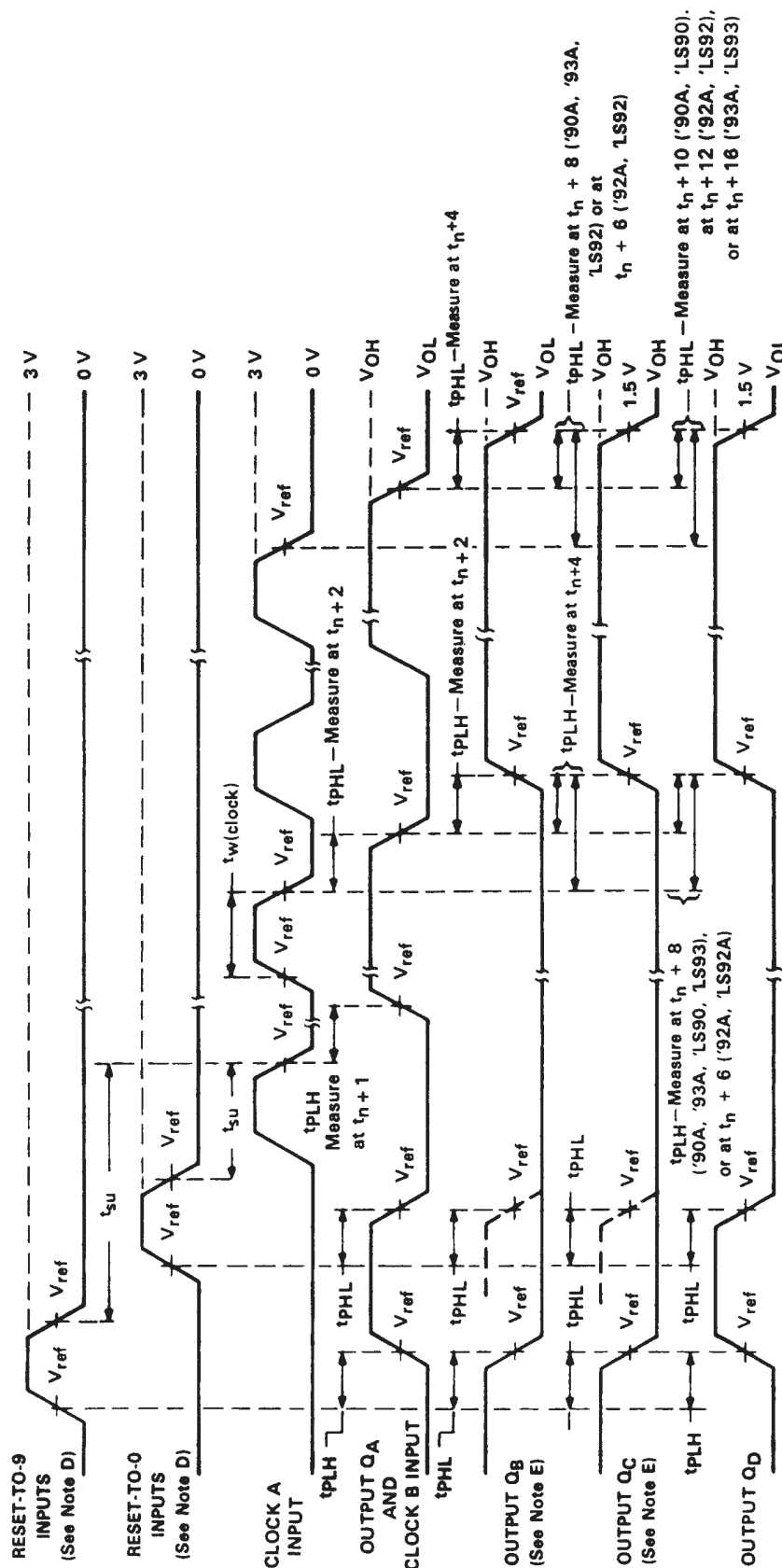
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## PARAMETER MEASUREMENT INFORMATION



NOTES: A. Input pulses are supplied by a generator having the following characteristics:

for '90A, '92A, '93A,  $t_r \leq 5$  ns,  $t_f \leq 5$  ns, PRR = 1 MHz, duty cycle = 50%,  $Z_{out} \approx 50$  ohms;  
for 'LS90, 'LS92, 'LS93,  $t_r \leq 15$  ns,  $t_f \leq 5$  ns, PRR = 1 MHz, duty cycle = 50%,  $Z_{out} \approx 50$  ohms.

B.  $C_L$  includes probe and jig capacitance.

C. All diodes are 1N3064 or equivalent.

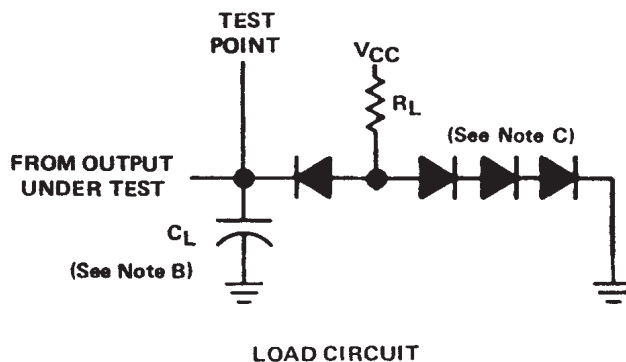
D. Each reset input is tested separately with the other reset at 4.5 V.

E. Reference waveforms are shown with dashed lines.

F. For '90A, '92A, and '93A;  $V_{ref} = 1.5$  V. For 'LS90, 'LS92, and 'LS93;  $V_{ref} = 1.3$  V.

FIGURE 1A

## PARAMETER MEASUREMENT INFORMATION



- NOTES: A. Input pulses are supplied by a generator having the following characteristics:  
 for '90A, '92A, '93A,  $t_r \leq 5$  ns,  $t_f \leq 5$  ns, PRR = 1 MHz, duty cycle = 50%,  $Z_{out} \approx 50$  ohms;  
 for 'LS90, 'LS92, 'LS93,  $t_r \leq 15$  ns,  $t_f \leq 5$  ns, PRR = 1 MHz, duty cycle = 50%,  $Z_{out} \approx 50$  ohms.
- B.  $C_L$  includes probe and jig capacitance.
- C. All diodes are 1N3064 or equivalent.
- D. Each reset input is tested separately with the other reset at 4.5 V.
- E. Reference waveforms are shown with dashed lines.
- F. For '90A, '92A, and '93A;  $V_{ref} = 1.5$  V. For 'LS90, 'LS92, and 'LS93;  $V_{ref} = 1.3$  V.

FIGURE 1B

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