

**BRITISH STANDARDS INSTITUTION**

2 PARK STREET, LONDON. W1A 2BS

BS CECC 90103 - 074

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Page 1 of 20 pages

**ELECTRONIC COMPONENTS OF ASSESSED QUALITY****DETAIL SPECIFICATION IN ACCORDANCE WITH:**

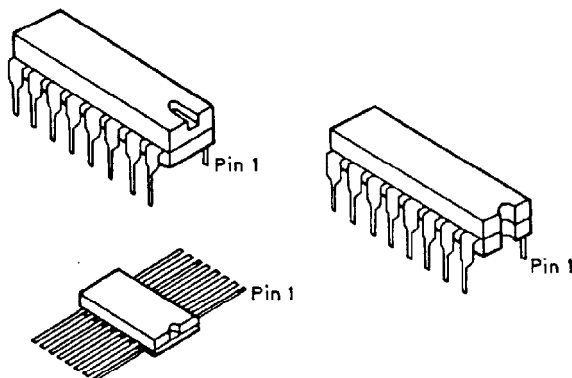
BS CECC 90 000 : 1976  
BS CECC 90 100 : 1977

**MANUFACTURERS TYPE NUMBER**

54LS169A  
64LS169A  
74LS169A  
84LS169A

Outline not to scale: Isometric projection  
Marking information see clause 1

SEE PD 9002 AND CECC 00 200  
For ordering information see  
clause 1

**SYNCHRONOUS 4-BIT UP/DOWN  
BINARY COUNTER**

TYPICAL CONSTRUCTION  
SILICON MONOLITHIC  
BIPOLAR TTL-LOW-POWER  
SCHOTTKY

Refer to IEC 191-1-50a (type A50C)  
Dual-in-Line (plastic or ceramic)  
refer to Appendix A1.3  
Flatpack (metal or ceramic)

ASSESSMENT LEVELS  
R, S, T AND V

1. Type description

## 1.1 Truth table (see page 2)

Refer to Qualified Products List PD 9002 and/or CECC 00 200  
for details of manufacturers approved to this specification

## 1.1 Truth table (contd)

| Operating Mode | INPUTS |              |                  |                  |      |                  | OUTPUTS          |              |
|----------------|--------|--------------|------------------|------------------|------|------------------|------------------|--------------|
|                | Clock  | U/ $\bar{D}$ | Enable $\bar{P}$ | Enable $\bar{T}$ | Load | D <sub>(n)</sub> | Q <sub>(n)</sub> | Ripple Carry |
| Parallel load  | ↑      | X            | X                | X                | L    | L                | L                | (a)          |
|                | ↑      | X            | X                | X                | L    | H                | H                | (a)          |
| Count up       | ↑      | H            | L                | L                | H    | X                | Count up         | (a)          |
| Count down     | ↑      | L            | L                | L                | H    | X                | Count down       | (a)          |
| Hold           | ↑      | X            | H                | X                | H    | X                | Q <sub>n</sub>   | (a)          |
|                | ↑      | X            | X                | H                | H    | X                | Q <sub>n</sub>   | H            |

H = High level

L = Low level

X = Logic level irrelevant

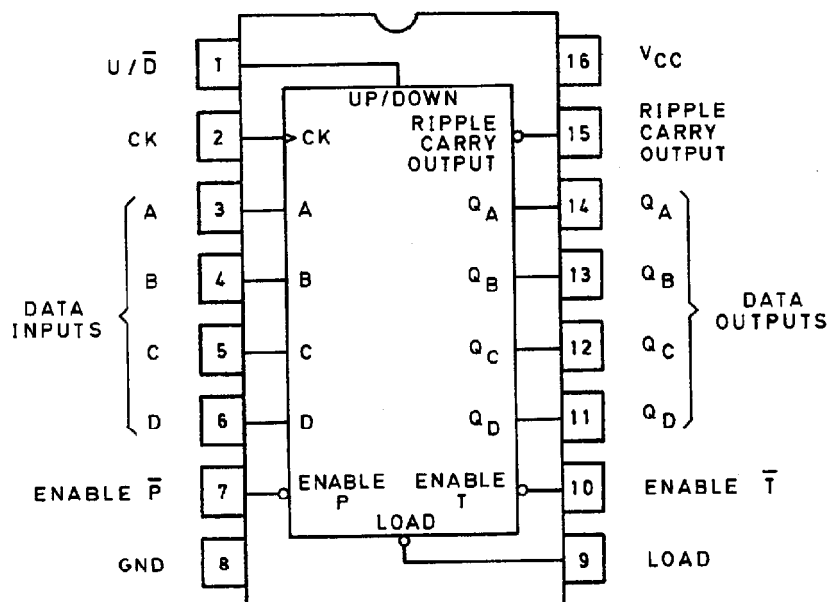
↑ = Low to High level clock transition

Q<sub>n</sub> = Level of Q before the most recent active transition indicated by ↑

NOTE (a) The ripple carry output is Low when enable T is Low and the counter is at terminal count. Terminal count up is (H H H H) and terminal count down is (L L L L).

## 1.2 Terminal identification, type designation and marking

## 1.2.1 Terminal identification



Synchronous 4-bit up/down binary counter

## 1.2.2 Type designation

| TEMPERATURE<br>RANGE | PACKAGE                 |                         |                     |
|----------------------|-------------------------|-------------------------|---------------------|
|                      | Ceramic<br>Dual-in-Line | Plastic<br>Dual-in-Line | Ceramic<br>Flatpack |
| 0 + 70               | 74LS169AJ               | N                       | W                   |
| -25 + 85             | 84LS169AJ               |                         |                     |
| -40 + 85             | 64LS169AJ               |                         |                     |
| -55 +125             | 54LS169AJ               |                         |                     |

## 1.2.3 Marking

Each integrated circuit shall bear the following marking:

- (1) Terminal identification
- (2) Type designation
- (3) Date code
- (4) Factory identification code (unless derived from trademark)
- (5) Manufacturers trade name or mark
- (6) Mark of conformity (unless a certificate of conformity is used)

## 1.3 Ordering information

Orders for these integrated circuits shall contain the following minimum information.

Manufacturers integrated circuit type designation, screening procedures and assessment levels as detailed to this CECC specification number.

(For details of screening procedures see Appendix A1.1).

2. Limiting conditions of use (not for inspection purposes)

|       |                                                                  |                      |                       |                      |               |                 |  |
|-------|------------------------------------------------------------------|----------------------|-----------------------|----------------------|---------------|-----------------|--|
| 2.1   | Maximum continuous supply voltage                                | $V_{CC}$             | -0,5V<br>+7,0V        |                      |               |                 |  |
| 2.2   | Maximum input voltages                                           |                      |                       |                      |               |                 |  |
| 2.2.1 | Maximum input voltage                                            | $V_I$                | -0,5V<br>+7,0V        |                      |               |                 |  |
| 2.2.2 | Maximum input voltage between multiple emitter transistor inputs | $V_{II}$             | +5,5V                 |                      |               |                 |  |
| 2.3   | Minimum and maximum operating ambient temperatures               | $T_{amb}(^{\circ}C)$ | min. -55<br>max. +125 | 64LS -40<br>84LS +85 | 74LS 0<br>+70 | 84LS -25<br>+85 |  |
| 2.4   | Minimum and maximum storage temperatures                         | $T_{stg}(^{\circ}C)$ | min. -65<br>max. +150 | (All types)          |               |                 |  |

3. Recommended operating conditions and associated characteristics (not for inspection purposes)

3.1 Recommended operating conditions.

These apply over the operating ambient temperature range unless otherwise stated.

| Description                                                                                      | Symbol               | Type                            | Value                    | Unit        |
|--------------------------------------------------------------------------------------------------|----------------------|---------------------------------|--------------------------|-------------|
| Positive supply voltage range                                                                    | $V_{CC}$             | 54LS<br>64/74/84LS              | 4,5 - 5,5<br>4,75 - 5,25 | V<br>V      |
| Minimum value of High level input voltage                                                        | $V_{IHB}$            | All types                       | 2,0                      | V           |
| Maximum value of High level input voltage                                                        | $V_{IHA}$            | All types                       | 5,5                      | V           |
| Minimum value of Low level input voltage                                                         | $V_{ILB}$            | All types                       | -0,3                     | V           |
| Maximum value of Low level input voltage                                                         | $V_{ILA}$            | 54LS<br>64/74/84LS              | 0,7<br>0,8               | V<br>V      |
| Maximum value of Low level output current for each output                                        | $I_{OLA}$            | 54LS<br>64/74/84LS              | 4,0<br>8,0               | mA<br>mA    |
| Maximum value of output current for each output at $V_{OH}$                                      | $I_{OHA}$            | All types                       | -400,0                   | $\mu A$     |
| DC noise margin<br>at Low level ( $V_{ILA} - V_{OLA}$ )<br>at High level ( $V_{OHB} - V_{IHB}$ ) | $V_{NL}$<br>$V_{NH}$ | All types<br>54LS<br>64/74/84LS | 0,3<br>0,5<br>0,7        | V<br>V<br>V |

## 3.2 Associated characteristics

3.2.1 Minimum and maximum values are given for the worst case operation over the ambient temperature range, except for those conditions marked with an asterisk (\*)

|                       | 54LS | 64LS | 74LS | 84LS |    |
|-----------------------|------|------|------|------|----|
| T <sub>amb</sub> min. | -55  | -40  | 0    | -25  | °C |
| T <sub>amb</sub> max. | +125 | +85  | +70  | +85  |    |
| V <sub>CC</sub> min.  | 4,5  | 4,75 |      |      | V  |
| V <sub>CC</sub> max.  | 5,5  | 5,25 |      |      |    |

3.2

| Characteristics                                                                                  | Conditions                                                       | $V_{CC}(V)$           | Symbol      | Min. | Max. | Unit          |
|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-----------------------|-------------|------|------|---------------|
| Total supply current per package                                                                 | Clock input at 4,5V then grounded.<br>All other inputs grounded. | $V_{CC} \text{ max.}$ | $I_{CC}$    | -    | 34,0 | mA            |
| High level input current<br>A, B, C, D, $\bar{P}$ and $U/\bar{D}$<br>Clock and $\bar{T}$<br>Load | $V_{IH(1)} = 7,0V$                                               | $V_{CC} \text{ max.}$ | $I_{IH(1)}$ | -    | 0,1  | mA            |
|                                                                                                  |                                                                  |                       | $I_{IH(1)}$ | -    | 0,2  | mA            |
|                                                                                                  |                                                                  |                       | $I_{IH(1)}$ | -    | 0,3  | mA            |
|                                                                                                  | $V_{IH(2)} = 2,7V$                                               | $V_{CC} \text{ max.}$ | $I_{IH(2)}$ | -    | 20,0 | $\mu\text{A}$ |
|                                                                                                  |                                                                  |                       | $I_{IH(2)}$ | -    | 40,0 | $\mu\text{A}$ |
|                                                                                                  |                                                                  |                       | $I_{IH(2)}$ | -    | 60,0 | $\mu\text{A}$ |
| Low level input current<br>A, B, C, D, $\bar{P}$ and $U/\bar{D}$<br>$\bar{T}$<br>Clock and Load  | $V_{IN} = 0,4V$                                                  | $V_{CC} \text{ max.}$ | $-I_{IL}$   | -    | 0,4  | mA            |
|                                                                                                  |                                                                  |                       | $-I_{IL}$   | -    | 0,8  | mA            |
|                                                                                                  |                                                                  |                       | $-I_{IL}$   | -    | 1,2  | mA            |

## 3.2.2 (contd)

| Characteristics              | Conditions                             | $V_{CC}(V)$           | Symbol      | Min. | Max.  | Unit |
|------------------------------|----------------------------------------|-----------------------|-------------|------|-------|------|
| Input clamping voltage       | $-I_{IC} = 18,0V$                      | $V_{CC} \text{ min.}$ | $-V_{ICA}$  | -    | 1,5   | V    |
| Output voltage               |                                        | $V_{CC} \text{ min.}$ |             |      |       |      |
| 54LS                         | $I_{OH} = -400,0\mu A$                 |                       | $V_{OH}$    | 2,5  | -     | V    |
| 64/74/84LS                   | $I_{OH} = -400,0\mu A$                 |                       | $V_{OH}$    | 2,7  | -     | V    |
| All types                    | $I_{OL(1)} = 4,0mA^{(1)}$              |                       | $V_{OL(1)}$ | -    | 0,4   | V    |
| 64/74/84LS                   | $I_{OL(2)} = 8,0mA^{(2)}$              |                       | $V_{OL(2)}$ | -    | 0,5   | V    |
| Output short circuit current | $V_O = 0V^{(3)}$                       | $V_{CC} \text{ max.}$ | $-I_{OS}$   | 15,0 | 130,0 | mA   |
| Propagation times            | $T_{amb} = 25^\circ C^*$               | 5,0V                  |             |      |       |      |
| All types                    | test conditions as in Sub-group A5     |                       |             |      |       |      |
| Low to High                  |                                        |                       | $t_{PLH}$   |      |       |      |
|                              | From Clock To Ripple Carry             |                       |             | -    | 35,0  | ns   |
|                              | Enable $\bar{T}$ To Ripple Carry       |                       |             | -    | 15,0  | ns   |
|                              | Clock To Any Q                         |                       |             | -    | 20,0  | ns   |
|                              | Up/Down To Ripple Carry <sup>(4)</sup> |                       |             | -    | 25,0  | ns   |
| High to Low                  |                                        |                       | $t_{PHL}$   |      |       |      |
|                              | From Clock To Ripple Carry             |                       |             | -    | 35,0  | ns   |
|                              | Enable $\bar{T}$ To Ripple Carry       |                       |             | -    | 23,0  | ns   |
|                              | Clock To Any Q                         |                       |             | -    | 23,0  | ns   |
|                              | Up/Down To Ripple Carry <sup>(4)</sup> |                       |             | -    | 29,0  | ns   |

(1) Fan out = 10, (2) Fan out = 20, (3) Only one output at a time, duration  $t \leq 1 \text{ sec}$

(4) The propagation delay time must be measured with the counter at either a maximum or minimum count.

As the logic level of the Up/Down input is changes, the Ripple Carry output will follow.

If the count is minimum (0) the Ripple Carry output transition will be in phase.

If the count is maximum (15) the Ripple Carry output transition will be out of phase.

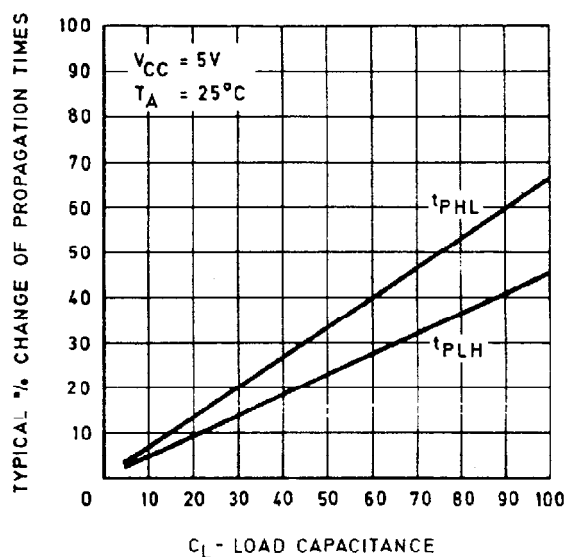
\* See 3.2.1 of this specification

## 3.2.2 (contd)

| Characteristics               | Conditions | $V_{CC}(V)$ | Symbol                | Min. | Max. | Unit |
|-------------------------------|------------|-------------|-----------------------|------|------|------|
| Maximum clock frequency       |            |             | $f_{\text{clock}}$    | 25,0 | —    | MHz  |
| Duration of clock pulse       |            |             | $t_{p(\text{clock})}$ | 25,0 | —    | ns   |
| Set-up time                   |            |             | $t_{\text{set-up}}$   |      |      |      |
| Data inputs A,B,C,D           |            |             |                       | 20,0 | —    | ns   |
| Enable $\bar{P}$ or $\bar{T}$ |            |             |                       | 20,0 | —    | ns   |
| Load                          |            |             |                       | 25,0 | —    | ns   |
| Up/Down                       |            |             |                       | 30,0 | —    | ns   |
| Hold time                     |            |             | $t_{\text{hold}}$     | 0    | —    | ns   |

## 3.3 Supplementary information

## 3.3.1 Change of typical propagation time with output loading



Propagation time vs. load capacitance

## 3.3.2 Variation of propagation time with temperature

