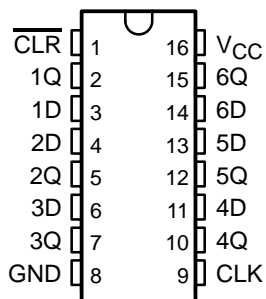


# SN54ALS174, SN54ALS175, SN54AS174, SN54AS175B SN74ALS174, SN74ALS175, SN74AS174, SN74AS175B HEX/QUADRUPLE D-TYPE FLIP-FLOPS WITH CLEAR

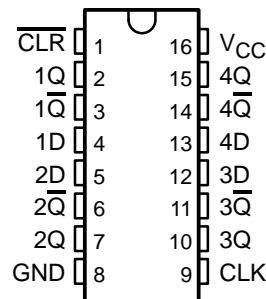
SDAS207E - APRIL 1982 - REVISED MAY 2002

- 'ALS174 and 'AS174 Contain Six Flip-Flops With Single-Rail Outputs
- 'ALS175 and 'AS175B Contain Four Flip-Flops With Double-Rail Outputs
- Buffered Clock and Direct-Clear Inputs
- Applications Include:
  - Buffer/Storage Registers
  - Shift Registers
  - Pattern Generators
- Fully Buffered Outputs for Maximum Isolation From External Disturbances ('AS Only)

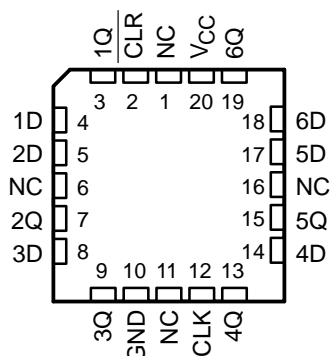
SN54ALS174 . . . J OR W PACKAGE  
SN54AS174 . . . J PACKAGE  
SN74ALS174, SN74AS174 . . . D, N, OR NS PACKAGE  
(TOP VIEW)



SN54ALS175 . . . J OR W PACKAGE  
SN54AS175B . . . J PACKAGE  
SN74ALS175, SN74AS175B . . . D, N, OR NS PACKAGE  
(TOP VIEW)

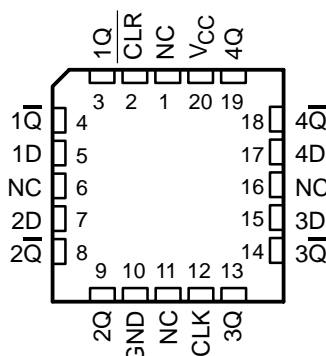


SN54ALS174, SN54AS174 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

SN54ALS175 . . . FK PACKAGE  
(TOP VIEW)



## description

These positive-edge-triggered flip-flops utilize TTL circuitry to implement D-type flip-flop logic. All have a direct-clear ( $\overline{\text{CLR}}$ ) input. The 'ALS175 and 'AS175B feature complementary outputs from each flip-flop.

Information at the data (D) inputs meeting the setup-time requirements is transferred to the outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going pulse. When the clock (CLK) input is at either the high or low level, the D-input signal has no effect at the output.

These circuits are fully compatible for use with most TTL circuits.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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 © 2002, Texas Instruments Incorporated  
On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

**SN54ALS174, SN54ALS175, SN54AS174, SN54AS175B  
 SN74ALS174, SN74ALS175, SN74AS174, SN74AS175B  
 HEX/QUADRUPLE D-TYPE FLIP-FLOPS WITH CLEAR**

SDAS207E - APRIL 1982 - REVISED MAY 2002

**ORDERING INFORMATION**

| T <sub>A</sub> | PACKAGE†  |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|-----------|---------------|-----------------------|------------------|
| 0°C to 70°C    | PDIP – N  | Tube          | SN74ALS174N           | SN74ALS174N      |
|                |           |               | SN74AS174N            | SN74AS174N       |
|                |           |               | SN74ALS175N           | SN74ALS175N      |
|                |           |               | SN74AS175BN           | SN74AS175BN      |
|                | SOIC – D  | Tube          | SN74ALS174D           | ALS174           |
|                |           |               | SN74ALS174DR          |                  |
|                |           | Tape and reel | SN74AS174D            | AS174            |
|                |           |               | SN74AS174DR           |                  |
|                |           | Tube          | SN74ALS175D           | ALS175           |
|                |           |               | SN74ALS175DR          |                  |
|                |           | Tape and reel | SN74AS175BD           | AS175B           |
|                |           |               | SN74AS175BDR          |                  |
|                | SOP – NS  | Tape and reel | SN74ALS174NSR         | ALS174           |
|                |           |               | SN74AS174NSR          | 74AS174          |
| SN74ALS175NSR  |           |               | ALS175                |                  |
| SN74AS175BNSR  |           |               | 74AS175B              |                  |
| –55°C to 125°C | CDIP – J  | Tube          | SNJ54ALS174J          | SNJ54ALS174J     |
|                |           |               | SNJ54AS174J           | SNJ54AS174J      |
|                |           |               | SNJ54ALS175J          | SNJ54ALS175J     |
|                |           |               | SNJ54AS175BJ          | SNJ54AS175BJ     |
|                | CFP – W   | Tube          | SNJ54ALS174W          | SNJ54ALS174W     |
|                |           |               | SNJ54ALS175W          | SNJ54ALS175W     |
|                | LCCC – FK | Tube          | SNJ54ALS174FK         | SNJ54ALS174FK    |
|                |           |               | SNJ54AS174FK‡         | SNJ54AS174FK     |
|                |           |               | SNJ54ALS175FK         | SNJ54ALS175FK    |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

‡ This orderable is not recommended for new designs.

**FUNCTION TABLE  
 (each flip-flop)**

| INPUTS |     |   | OUTPUTS        |                 |
|--------|-----|---|----------------|-----------------|
| CLR    | CLK | D | Q              | Q̄§             |
| L      | X   | X | L              | H               |
| H      | ↑   | H | H              | L               |
| H      | ↑   | L | L              | H               |
| H      | L   | X | Q <sub>0</sub> | Q̄ <sub>0</sub> |

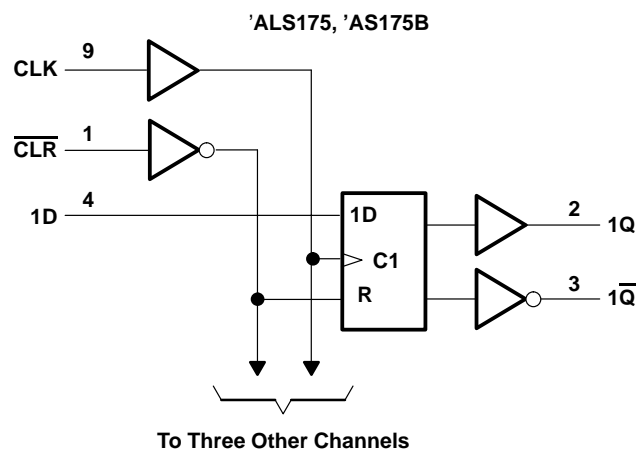
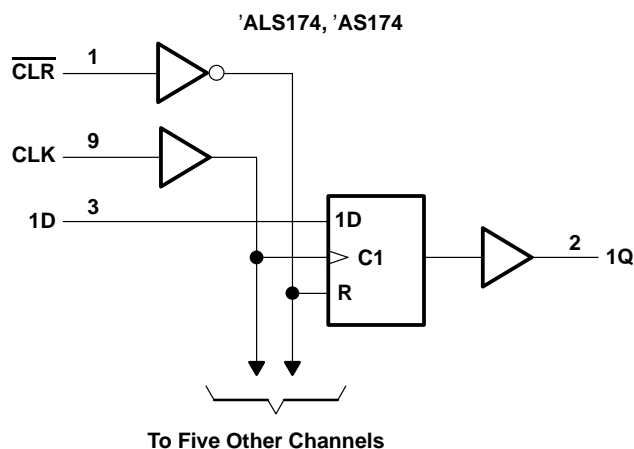
§ 'ALS175 and 'AS175B only



# SN54ALS174, SN54ALS175, SN54AS174, SN54AS175B SN74ALS174, SN74ALS175, SN74AS174, SN74AS175B HEX/QUADRUPLE D-TYPE FLIP-FLOPS WITH CLEAR

SDAS207E - APRIL 1982 - REVISED MAY 2002

## logic diagrams (positive logic)



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

## absolute maximum ratings over operating free-air temperature range, SN54/74ALS174, SN54/74ALS175 (unless otherwise noted)†

|  |                |
|--|----------------|
| Supply voltage, $V_{CC}$   | 7 V            |
| Input voltage, $V_I$   | 7 V            |
| Package thermal impedance, $\theta_{JA}$ (see Note 1): D package | 73°C/W         |
| N package  | 67°C/W         |
| NS package   | 64°C/W         |
| Storage temperature range, $T_{stg}$                             | -65°C to 150°C |

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions (see Note 2)

|                                      | SN54ALS174<br>SN54ALS175 |     |      | SN74ALS174<br>SN74ALS175 |     |      | UNIT |
|--------------------------------------|--------------------------|-----|------|--------------------------|-----|------|------|
|                                      | MIN                      | NOM | MAX  | MIN                      | NOM | MAX  |      |
| $V_{CC}$ Supply voltage              | 4.5                      | 5   | 5.5  | 4.5                      | 5   | 5.5  | V    |
| $V_{IH}$ High-level input voltage    | 2                        |     |      | 2                        |     |      | V    |
| $V_{IL}$ Low-level input voltage     |                          |     | 0.8  |                          |     | 0.8  | V    |
| $I_{OH}$ High-level output current   |                          |     | -0.4 |                          |     | -0.4 | mA   |
| $I_{OL}$ Low-level output current    |                          |     | 4    |                          |     | 8    | mA   |
| $T_A$ Operating free-air temperature | -55                      |     | 125  | 0                        |     | 70   | °C   |

NOTE 2: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

**SN54ALS174, SN54ALS175, SN54AS174, SN54AS175B  
SN74ALS174, SN74ALS175, SN74AS174, SN74AS175B  
HEX/QUADRUPLE D-TYPE FLIP-FLOPS WITH CLEAR**

SDAS207E - APRIL 1982 - REVISED MAY 2002

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

| PARAMETER       | TEST CONDITIONS   |                                     | SN54ALS174<br>SN54ALS175 |      | SN74ALS174<br>SN74ALS175 |      | UNIT |
|-----------------|---|-------------------------------------|--------------------------|------|--------------------------|------|------|
|                 |   |                                     | MIN                      | TYP† | MAX                      | MIN  |      |
| V <sub>IK</sub> | V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA            |                                     | -1.5                     |      | -1.5                     |      | V    |
| V <sub>OH</sub> | V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>OH</sub> = -0.4 mA |                                     | V <sub>CC</sub> -2       |      | V <sub>CC</sub> -2       |      | V    |
| V <sub>OL</sub> | V <sub>CC</sub> = 4.5 V                                     | I <sub>OL</sub> = 4 mA              | 0.25 0.4                 |      | 0.25 0.4                 |      | V    |
|                 |   | I <sub>OL</sub> = 8 mA              |                          |      | 0.35 0.5                 |      |      |
| I <sub>I</sub>  | V <sub>CC</sub> = 5.5 V,                                    | V <sub>I</sub> = 7 V                | 0.1                      |      | 0.1                      |      | mA   |
| I <sub>IH</sub> | V <sub>CC</sub> = 5.5 V,                                    | V <sub>I</sub> = 2.7 V              | 20                       |      | 20                       |      | μA   |
| I <sub>IL</sub> | V <sub>CC</sub> = 5.5 V,                                    | V <sub>I</sub> = 0.4 V              | -0.1                     |      | -0.1                     |      | mA   |
|                 |   |                                     | -0.15                    |      |                          |      |      |
| I <sub>O‡</sub> | V <sub>CC</sub> = 5.5 V,                                    | V <sub>O</sub> = 2.25 V             | -20                      | -112 | -30                      | -112 | mA   |
| I <sub>CC</sub> | 'ALS174   | V <sub>CC</sub> = 5.5 V, See Note 3 | 11                       | 19   | 11                       | 19   | mA   |
|                 | 'ALS175   |                                     | 8                        | 14   | 9                        | 14   |      |

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

‡ The output conditions have been chosen to produce a current that closely approximates one-half of the true short-circuit output current, I<sub>OS</sub>.

NOTE 3: I<sub>CC</sub> is measured with D inputs and CLR grounded, and CLK at 4.5 V.

**timing requirements over recommended operating free-air temperature range (unless otherwise noted)**

|                    |                            |              | SN54ALS174<br>SN54ALS175 |     | SN74ALS174<br>SN74ALS175 |     | UNIT |
|--------------------|----------------------------|--------------|--------------------------|-----|--------------------------|-----|------|
|                    |                            |              | MIN                      | MAX | MIN                      | MAX |      |
| f <sub>clock</sub> | Clock frequency            |              | 40                       |     | 50                       |     | MHz  |
| t <sub>w</sub>     | Pulse duration             | CLR low      | 15                       | 10  |                          |     | ns   |
|                    |                            | CLK high     | 12.5                     | 10  |                          |     |      |
|                    |                            | CLK low      | 12.5                     | 10  |                          |     |      |
| t <sub>su</sub>    | Setup time before CLK↑     | Data         | 15                       | 10  |                          |     | ns   |
|                    |                            | CLR inactive | 8                        | 6   |                          |     |      |
| t <sub>h</sub>     | Hold time, data after CLK↑ |              | 0                        |     | 0                        |     | ns   |

**switching characteristics (see Figure 1)**

| PARAMETER        | FROM<br>(INPUT) | TO<br>(OUTPUT)            | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R <sub>L</sub> = 500 Ω,<br>T <sub>A</sub> = MIN to MAX§ |     |                          |     | UNIT |
|------------------|-----------------|---------------------------|---|-----|--------------------------|-----|------|
|                  |                 |                           | SN54ALS174<br>SN54ALS175  |     | SN74ALS174<br>SN74ALS175 |     |      |
|                  |                 |                           | MIN   | MAX | MIN                      | MAX |      |
| f <sub>max</sub> |                 |                           | 40  |     | 50                       |     | MHz  |
| t <sub>PLH</sub> | CLR             | Any Q<br>(or Q̄, 'ALS175) | 3   | 20  | 5                        | 18  | ns   |
| t <sub>PHL</sub> |                 |                           | 5   | 30  | 8                        | 23  |      |
| t <sub>PLH</sub> | CLK             | Any Q<br>(or Q̄, 'ALS175) | 3   | 20  | 3                        | 15  | ns   |
| t <sub>PHL</sub> |                 |                           | 5   | 24  | 5                        | 17  |      |

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



**SN54ALS174, SN54ALS175, SN54AS174, SN54AS175B  
SN74ALS174, SN74ALS175, SN74AS174, SN74AS175B  
HEX/QUADRUPLE D-TYPE FLIP-FLOPS WITH CLEAR**

SDAS207E - APRIL 1982 - REVISED MAY 2002

**absolute maximum ratings over operating free-air temperature range, SN54/74AS174, SN54/74AS175B (unless otherwise noted)†**

|  |                |
|--|----------------|
| Supply voltage, $V_{CC}$ .....   | 7 V            |
| Input voltage, $V_I$ .....   | 7 V            |
| Package thermal impedance, $\theta_{JA}$ (see Note 1): D package ..... | 73°C/W         |
| N package .....  | 67°C/W         |
| NS package .....   | 64°C/W         |
| Storage temperature range, $T_{stg}$ .....                             | -65°C to 150°C |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51-7.

**recommended operating conditions (see Note 2)**

|                                      | SN54AS174<br>SN54AS175B |     |     | SN74AS174<br>SN74AS175B |     |     | UNIT |
|--------------------------------------|-------------------------|-----|-----|-------------------------|-----|-----|------|
|                                      | MIN                     | NOM | MAX | MIN                     | NOM | MAX |      |
| $V_{CC}$ Supply voltage              | 4.5                     | 5   | 5.5 | 4.5                     | 5   | 5.5 | V    |
| $V_{IH}$ High-level input voltage    | 2                       |     |     | 2                       |     |     | V    |
| $V_{IL}$ Low-level input voltage     |                         |     | 0.8 |                         |     | 0.8 | V    |
| $I_{OH}$ High-level output current   |                         |     | -2  |                         |     | -2  | mA   |
| $I_{OL}$ Low-level output current    |                         |     | 20  |                         |     | 20  | mA   |
| $T_A$ Operating free-air temperature | -55                     |     | 125 | 0                       |     | 70  | °C   |

NOTE 2: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

| PARAMETER    | TEST CONDITIONS  | SN54AS174<br>SN54AS175B                 |      |      | SN74AS174<br>SN74AS175B |      |      | UNIT |    |
|--------------|--|---|------|------|-------------------------|------|------|------|----|
|              |  | MIN                                     | TYP‡ | MAX  | MIN                     | TYP‡ | MAX  |      |    |
| $V_{IK}$     | $V_{CC} = 4.5\text{ V}$ , $I_I = -18\text{ mA}$                    |   |      | -1.2 |                         |      | -1.2 | V    |    |
| $V_{OH}$     | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ , $I_{OH} = -2\text{ mA}$ | $V_{CC}-2$                              |      |      | $V_{CC}-2$              |      |      | V    |    |
| $V_{OL}$     | $V_{CC} = 4.5\text{ V}$ , $I_{OL} = 20\text{ mA}$                  |   | 0.35 | 0.5  |                         | 0.35 | 0.5  | V    |    |
| $I_I$        | $V_{CC} = 5.5\text{ V}$ , $V_I = 7\text{ V}$                       |   |      | 0.1  |                         |      | 0.1  | mA   |    |
| $I_{IH}$     | $V_{CC} = 5.5\text{ V}$ , $V_I = 2.7\text{ V}$                     |   |      | 20   |                         |      | 20   | µA   |    |
| $I_{IL}$     | $V_{CC} = 5.5\text{ V}$ , $V_I = 0.4\text{ V}$                     |   |      | -0.5 |                         |      | -0.5 | mA   |    |
| $I_{O}^{\S}$ | $V_{CC} = 5.5\text{ V}$ , $V_O = 2.25\text{ V}$                    |   | -30  | -112 |                         | -30  | -112 | mA   |    |
| $I_{CC}$     | 'AS174   | $V_{CC} = 5.5\text{ V}$ ,<br>See Note 4 |      | 30   | 45                      |      | 30   | 45   | mA |
|              | 'AS175B  |   |      | 22.5 | 34                      |      | 22.5 | 34   |    |

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

§ The output conditions have been chosen to produce a current that closely approximates one-half of the true short-circuit output current,  $I_{OS}$ .

NOTE 4:  $I_{CC}$  is measured with D inputs, CLR, and CLK grounded.



**SN54ALS174, SN54ALS175, SN54AS174, SN54AS175B  
SN74ALS174, SN74ALS175, SN74AS174, SN74AS175B  
HEX/QUADRUPLE D-TYPE FLIP-FLOPS WITH CLEAR**

SDAS207E - APRIL 1982 - REVISED MAY 2002

timing requirements over recommended operating free-air temperature range (unless otherwise noted)

|               |                            | SN54AS174<br>SN54AS175B |         | SN74AS174<br>SN74AS175B |     | UNIT |
|---------------|----------------------------|-------------------------|---------|-------------------------|-----|------|
|               |                            | MIN                     | MAX     | MIN                     | MAX |      |
| $f_{clock}^*$ | Clock frequency            | 100                     |         | 100                     |     | MHz  |
| $t_w^*$       | Pulse duration             | CLR low                 |         | 5.5                     | 5   | ns   |
|               |                            | CLK high                |         | 4                       | 4   |      |
|               |                            | CLK low                 | 'AS174  | 6                       | 6   |      |
|               |                            | CLK low                 | 'AS175B | 5                       | 5   |      |
| $t_{su}^*$    | Setup time before CLK↑     | Data                    | 'AS174  | 4                       | 4   | ns   |
|               |                            |                         | 'AS175B | 3                       | 3   |      |
|               |                            | CLR inactive            |         | 6                       | 6   |      |
| $t_h^*$       | Hold time, data after CLK↑ | 1                       |         | 1                       |     | ns   |

\* On products compliant to MIL-STD-883, Class B, this parameter is based on characterization data, but is not production tested.

**switching characteristics (see Figure 1)**

| PARAMETER   | FROM<br>(INPUT)         | TO<br>(OUTPUT) | $V_{CC} = 4.5\text{ V to }5.5\text{ V},$<br>$C_L = 50\text{ pF},$<br>$R_L = 500\ \Omega,$<br>$T_A = \text{MIN to MAX}\dagger$ |      |           |     | UNIT |
|-------------|-------------------------|----------------|---|------|-----------|-----|------|
|             |                         |                | SN54AS174   |      | SN74AS174 |     |      |
|             |                         |                | MIN   | MAX  | MIN       | MAX |      |
| $f_{max}^*$ |                         |                | 100   |      | 100       |     | MHz  |
| $t_{PHL}$   | $\overline{\text{CLR}}$ | Any Q          | 5   | 15   | 5         | 14  | ns   |
| $t_{PLH}$   | CLK                     | Any Q          | 3.5   | 9.5  | 3.5       | 8   | ns   |
| $t_{PHL}$   |                         |                | 4.5   | 11.5 | 4.5       | 10  |      |

\* On products compliant to MIL-STD-883, Class B, this parameter is based on characterization data, but is not production tested.

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

**switching characteristics (see Figure 1)**

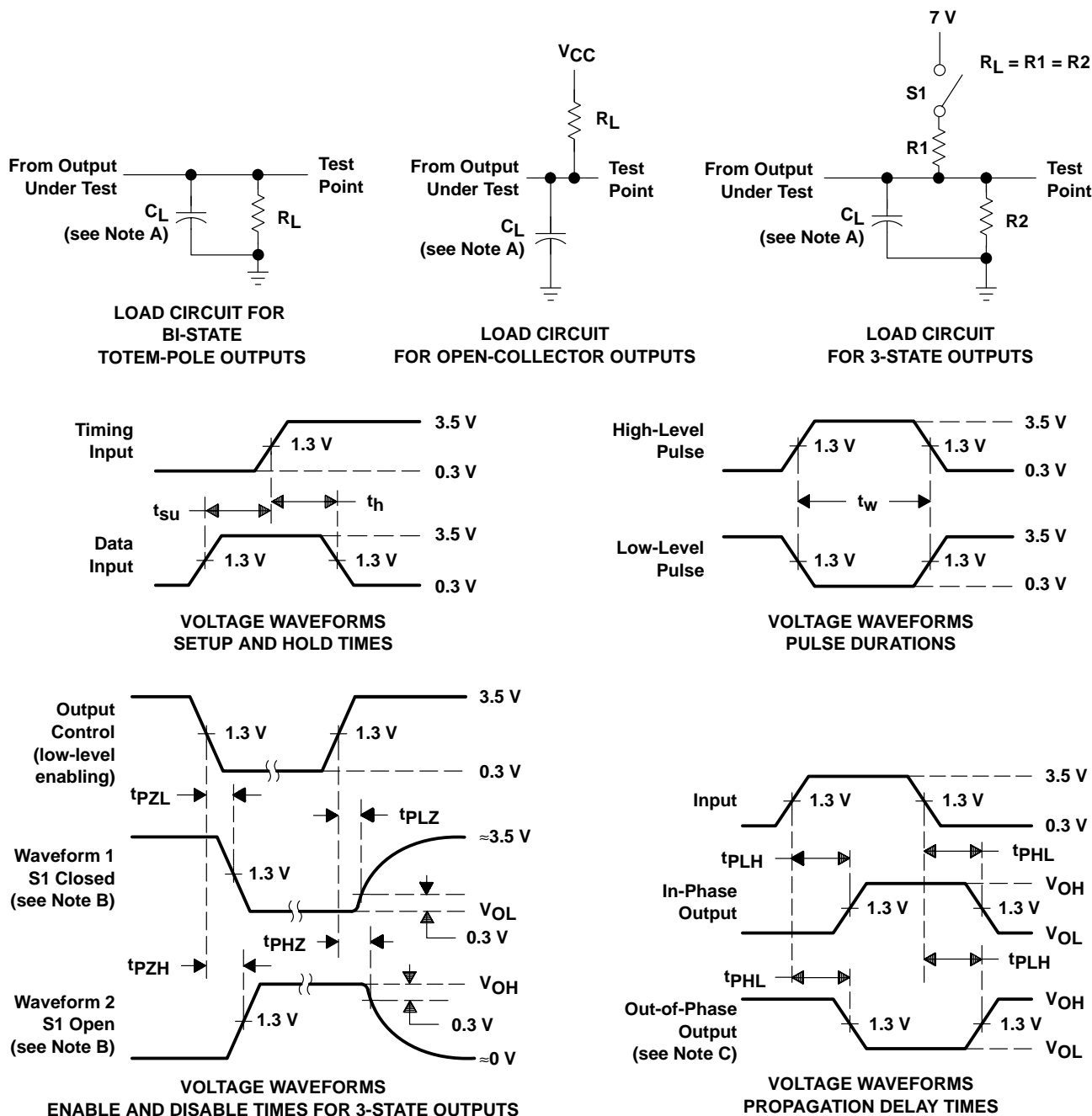
| PARAMETER   | FROM<br>(INPUT)         | TO<br>(OUTPUT)                 | $V_{CC} = 4.5\text{ V to }5.5\text{ V},$<br>$C_L = 50\text{ pF},$<br>$R_L = 500\ \Omega,$<br>$T_A = \text{MIN to MAX}\dagger$ |     |            |     | UNIT |
|-------------|-------------------------|--------------------------------|---|-----|------------|-----|------|
|             |                         |                                | SN54AS175B  |     | SN74AS175B |     |      |
|             |                         |                                | MIN   | MAX | MIN        | MAX |      |
| $f_{max}^*$ |                         |                                | 100   |     | 100        |     | MHz  |
| $t_{PLH}$   | $\overline{\text{CLR}}$ | Any Q or $\overline{\text{Q}}$ | 4   | 10  | 4          | 9   | ns   |
| $t_{PHL}$   |                         |                                | 4.5   | 15  | 4.5        | 13  |      |
| $t_{PLH}$   | CLK                     | Any Q or $\overline{\text{Q}}$ | 3   | 8.5 | 3          | 7.5 | ns   |
| $t_{PHL}$   |                         |                                | 3   | 11  | 3          | 10  |      |

\* On products compliant to MIL-STD-883, Class B, this parameter is based on characterization data, but is not production tested.

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



PARAMETER MEASUREMENT INFORMATION  
 SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.  
 C. When measuring propagation delay items of 3-state outputs, switch S1 is open.  
 D. All input pulses have the following characteristics:  $PRR \leq 1$  MHz,  $t_r = t_f = 2$  ns, duty cycle = 50%.  
 E. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)     | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)             | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|---------------------|--------------------------------------|----------------------|--------------|-------------------------------------|-------------------------|
| 5962-9553701QEA  | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-9553701QE<br>A<br>SNJ54AS175BJ | <a href="#">Samples</a> |
| 83019012A        | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 83019012A<br>SNJ54ALS<br>174FK      | <a href="#">Samples</a> |
| 8301901EA        | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 8301901EA<br>SNJ54ALS174J           | <a href="#">Samples</a> |
| 8301901FA        | ACTIVE        | CFP          | W               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 8301901FA<br>SNJ54ALS174W           | <a href="#">Samples</a> |
| 8301902EA        | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 8301902EA<br>SNJ54ALS175J           | <a href="#">Samples</a> |
| JM38510/37201B2A | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | JM38510/<br>37201B2A                | <a href="#">Samples</a> |
| JM38510/37201BEA | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | JM38510/<br>37201BEA                | <a href="#">Samples</a> |
| JM38510/37202B2A | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | JM38510/<br>37202B2A                | <a href="#">Samples</a> |
| JM38510/37202BEA | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | JM38510/<br>37202BEA                | <a href="#">Samples</a> |
| M38510/37201B2A  | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | JM38510/<br>37201B2A                | <a href="#">Samples</a> |
| M38510/37201BEA  | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | JM38510/<br>37201BEA                | <a href="#">Samples</a> |
| M38510/37202B2A  | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | JM38510/<br>37202B2A                | <a href="#">Samples</a> |
| M38510/37202BEA  | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | JM38510/<br>37202BEA                | <a href="#">Samples</a> |
| SN54ALS174J      | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | SN54ALS174J                         | <a href="#">Samples</a> |
| SN54ALS175J      | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | SN54ALS175J                         | <a href="#">Samples</a> |
| SN74ALS174D      | ACTIVE        | SOIC         | D               | 16   | 40          | RoHS & Green        | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | ALS174                              | <a href="#">Samples</a> |



| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)  | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)        | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|------------------|--------------------------------------|----------------------|--------------|--------------------------------|-------------------------|
| SN74ALS174DG4    | ACTIVE        | SOIC         | D               | 16   | 40          | TBD              | Call TI                              | Call TI              | 0 to 70      |                                | <a href="#">Samples</a> |
| SN74ALS174DR     | ACTIVE        | SOIC         | D               | 16   | 2500        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | ALS174                         | <a href="#">Samples</a> |
| SN74ALS174DRG4   | ACTIVE        | SOIC         | D               | 16   | 2500        | TBD              | Call TI                              | Call TI              | 0 to 70      |                                | <a href="#">Samples</a> |
| SN74ALS174N      | ACTIVE        | PDIP         | N               | 16   | 25          | RoHS & Green     | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | SN74ALS174N                    | <a href="#">Samples</a> |
| SN74ALS174NSR    | ACTIVE        | SO           | NS              | 16   | 2000        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | ALS174                         | <a href="#">Samples</a> |
| SN74ALS175D      | ACTIVE        | SOIC         | D               | 16   | 40          | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | ALS175                         | <a href="#">Samples</a> |
| SN74ALS175DR     | ACTIVE        | SOIC         | D               | 16   | 2500        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | ALS175                         | <a href="#">Samples</a> |
| SN74ALS175N      | ACTIVE        | PDIP         | N               | 16   | 25          | RoHS & Green     | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | SN74ALS175N                    | <a href="#">Samples</a> |
| SN74ALS175NSR    | ACTIVE        | SO           | NS              | 16   | 2000        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | ALS175                         | <a href="#">Samples</a> |
| SN74AS174D       | ACTIVE        | SOIC         | D               | 16   | 40          | RoHS & Green     | NIPDAU                               | Level-2-260C-1 YEAR  | 0 to 70      | AS174                          | <a href="#">Samples</a> |
| SN74AS174N       | ACTIVE        | PDIP         | N               | 16   | 25          | RoHS & Green     | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | SN74AS174N                     | <a href="#">Samples</a> |
| SN74AS174NSR     | ACTIVE        | SO           | NS              | 16   | 2000        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 74AS174                        | <a href="#">Samples</a> |
| SN74AS175BD      | ACTIVE        | SOIC         | D               | 16   | 40          | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | AS175B                         | <a href="#">Samples</a> |
| SN74AS175BN      | ACTIVE        | PDIP         | N               | 16   | 25          | RoHS & Green     | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | SN74AS175BN                    | <a href="#">Samples</a> |
| SN74AS175BNSR    | ACTIVE        | SO           | NS              | 16   | 2000        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | 74AS175B                       | <a href="#">Samples</a> |
| SNJ54ALS174FK    | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 83019012A<br>SNJ54ALS<br>174FK | <a href="#">Samples</a> |
| SNJ54ALS174J     | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 8301901EA<br>SNJ54ALS174J      | <a href="#">Samples</a> |
| SNJ54ALS174W     | ACTIVE        | CFP          | W               | 16   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 8301901FA<br>SNJ54ALS174W      | <a href="#">Samples</a> |
| SNJ54ALS175J     | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 8301902EA<br>SNJ54ALS175J      | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)     | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)             | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|---------------------|--------------------------------------|----------------------|--------------|-------------------------------------|-------------------------|
| SNJ54AS174J      | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | SNJ54AS174J                         | <a href="#">Samples</a> |
| SNJ54AS175BJ     | ACTIVE        | CDIP         | J               | 16   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-9553701QE<br>A<br>SNJ54AS175BJ | <a href="#">Samples</a> |

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

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

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

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

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

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

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

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

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

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

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

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

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

**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.

**OTHER QUALIFIED VERSIONS OF SN54ALS174, SN54ALS175, SN54AS174, SN54AS175B, SN74ALS174, SN74ALS175, SN74AS174, SN74AS175B :**

- Catalog : [SN74ALS174](#), [SN74ALS175](#), [SN74AS174](#), [SN74AS175B](#)
- Military : [SN54ALS174](#), [SN54ALS175](#), [SN54AS174](#), [SN54AS175B](#)

## NOTE: Qualified Version Definitions:

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

**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

| Device        | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74ALS174DR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74ALS174NSR | SO           | NS              | 16   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| SN74ALS175DR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74ALS175NSR | SO           | NS              | 16   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| SN74AS174NSR  | SO           | NS              | 16   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| SN74AS175BNSR | SO           | NS              | 16   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74ALS174DR  | SOIC         | D               | 16   | 2500 | 340.5       | 336.1      | 32.0        |
| SN74ALS174NSR | SO           | NS              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74ALS175DR  | SOIC         | D               | 16   | 2500 | 340.5       | 336.1      | 32.0        |
| SN74ALS175NSR | SO           | NS              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74AS174NSR  | SO           | NS              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74AS175BNSR | SO           | NS              | 16   | 2000 | 356.0       | 356.0      | 35.0        |

**TUBE**


\*All dimensions are nominal

| Device           | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (µm) | B (mm) |
|------------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 83019012A        | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |
| 8301901FA        | W            | CFP          | 16   | 1   | 506.98 | 26.16  | 6220   | NA     |
| JM38510/37201B2A | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |
| JM38510/37202B2A | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |
| M38510/37201B2A  | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |
| M38510/37202B2A  | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |
| SN74ALS174D      | D            | SOIC         | 16   | 40  | 507    | 8      | 3940   | 4.32   |
| SN74ALS174N      | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74ALS174N      | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74ALS175D      | D            | SOIC         | 16   | 40  | 507    | 8      | 3940   | 4.32   |
| SN74ALS175N      | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74ALS175N      | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74AS174D       | D            | SOIC         | 16   | 40  | 507    | 8      | 3940   | 4.32   |
| SN74AS174N       | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74AS174N       | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74AS175BD      | D            | SOIC         | 16   | 40  | 507    | 8      | 3940   | 4.32   |
| SN74AS175BN      | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74AS175BN      | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SNJ54ALS174FK    | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |
| SNJ54ALS174W     | W            | CFP          | 16   | 1   | 506.98 | 26.16  | 6220   | NA     |

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



| NO. OF TERMINALS ** | A                |                  | B                |                  |
|---------------------|------------------|------------------|------------------|------------------|
|                     | MIN              | MAX              | MIN              | MAX              |
| 20                  | 0.342<br>(8,69)  | 0.358<br>(9,09)  | 0.307<br>(7,80)  | 0.358<br>(9,09)  |
| 28                  | 0.442<br>(11,23) | 0.458<br>(11,63) | 0.406<br>(10,31) | 0.458<br>(11,63) |
| 44                  | 0.640<br>(16,26) | 0.660<br>(16,76) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 52                  | 0.740<br>(18,78) | 0.761<br>(19,32) | 0.495<br>(12,58) | 0.560<br>(14,22) |
| 68                  | 0.938<br>(23,83) | 0.962<br>(24,43) | 0.850<br>(21,6)  | 0.858<br>(21,8)  |
| 84                  | 1.141<br>(28,99) | 1.165<br>(29,59) | 1.047<br>(26,6)  | 1.063<br>(27,0)  |

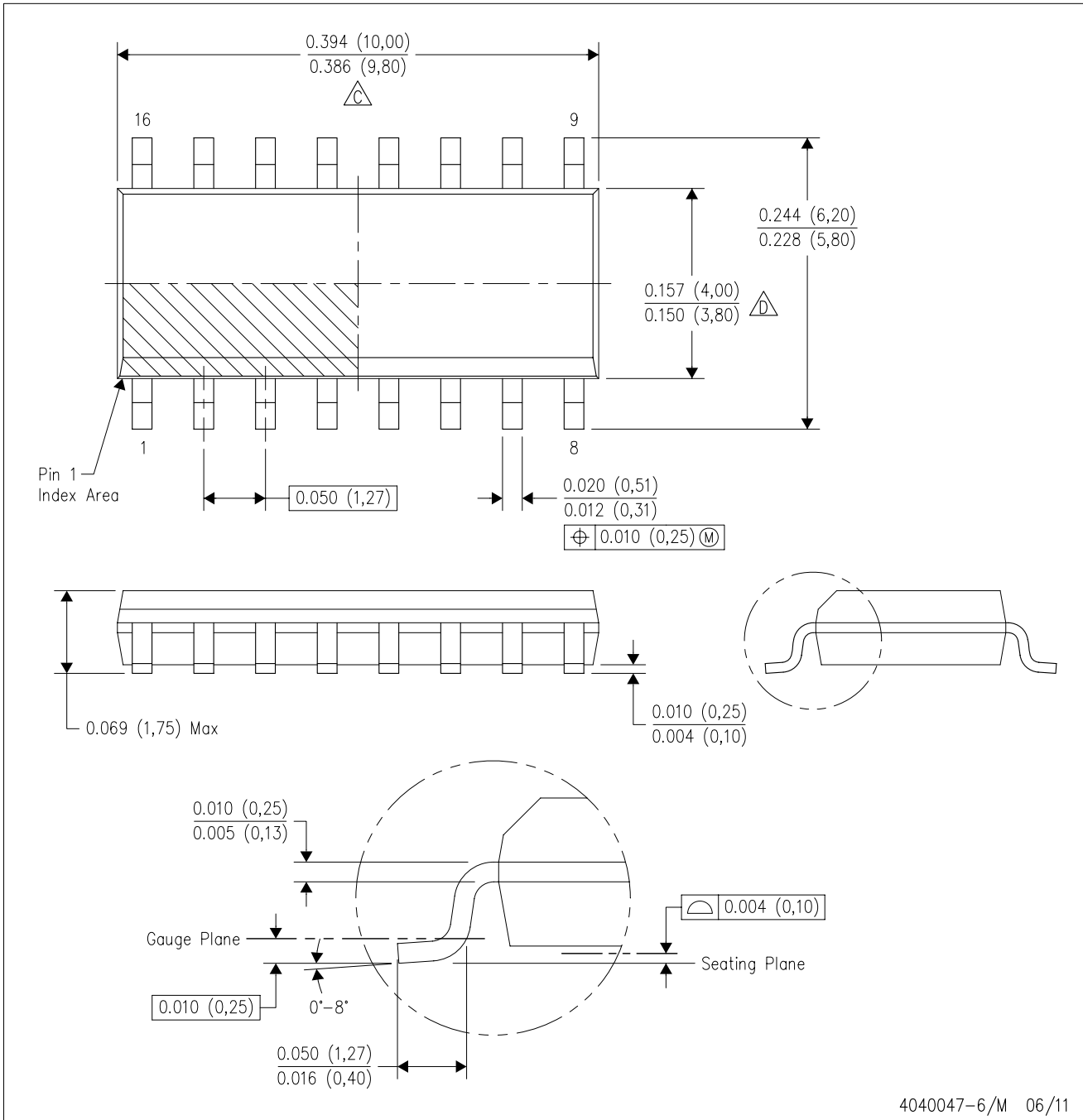


4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - Falls within JEDEC MS-004

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AC.



D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only.
  - E. Falls within MIL STD 1835 GDFP2-F16

J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



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



4040083/F 03/03

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

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

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- 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.



# PACKAGE OUTLINE

## NS0016A

### SOP - 2.00 mm max height

SOP



4220735/A 12/2021

#### NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.

# EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



4220735/A 12/2021

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:7X

4220735/A 12/2021

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.



## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](#) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2022, Texas Instruments Incorporated