

## FEATURES

- Synchronous Parallel Load
- Positive-Edge-Triggered Clocking
- J and  $\bar{K}$  Inputs to First Stage
- Complementary Outputs From Last Stage
- Package Options: Plastic and Ceramic DIPS and Ceramic Chip Carriers
- Dependable Texas Instruments Quality and Reliability

## DESCRIPTION/ORDERING INFORMATION

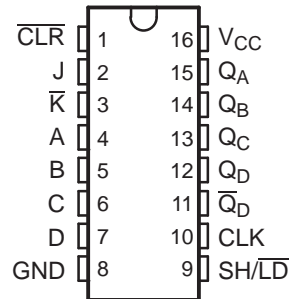
These 4-bit registers feature parallel inputs, parallel outputs, J-K serial inputs, shift/load control input, and a direct overriding clear. The registers have two modes of operation: parallel (broadside) load, and shift (in the direction  $Q_A$  and  $Q_D$ ).

Parallel loading is accomplished by applying the 4-bits of data and taking the shift/load control input low. The data is loaded into the associated flip-flop and appears at the outputs after the positive transition of the clock input. During loading, serial data flow is inhibited.

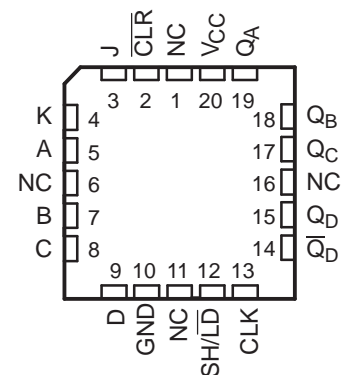
Shifting is accomplished synchronously when the shift/load control input is high. Serial data for this mode is entered at the J- $\bar{K}$  inputs. These inputs permit the first stage to perform as a J- $\bar{K}$ , D, or T type flip-flop as shown in the function table.

The SN54HC195 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ .

SN54HC195 . . . J PACKAGE  
(TOP VIEW)

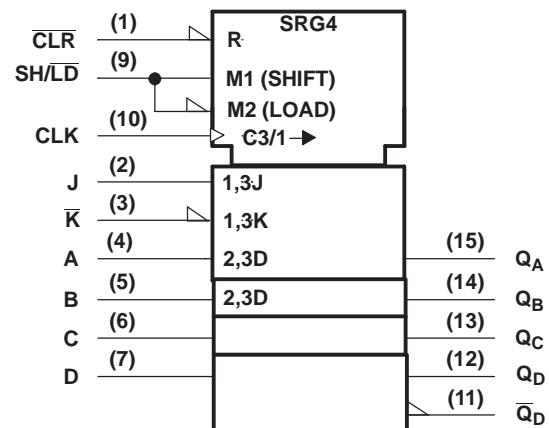


SN54HC195 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## LOGIC SYMBOL†



† This symbol is in accordance with ANSI/IEEE Std 91–1984 and IEC Publication 617–12.

Pin numbers shown are for J package.

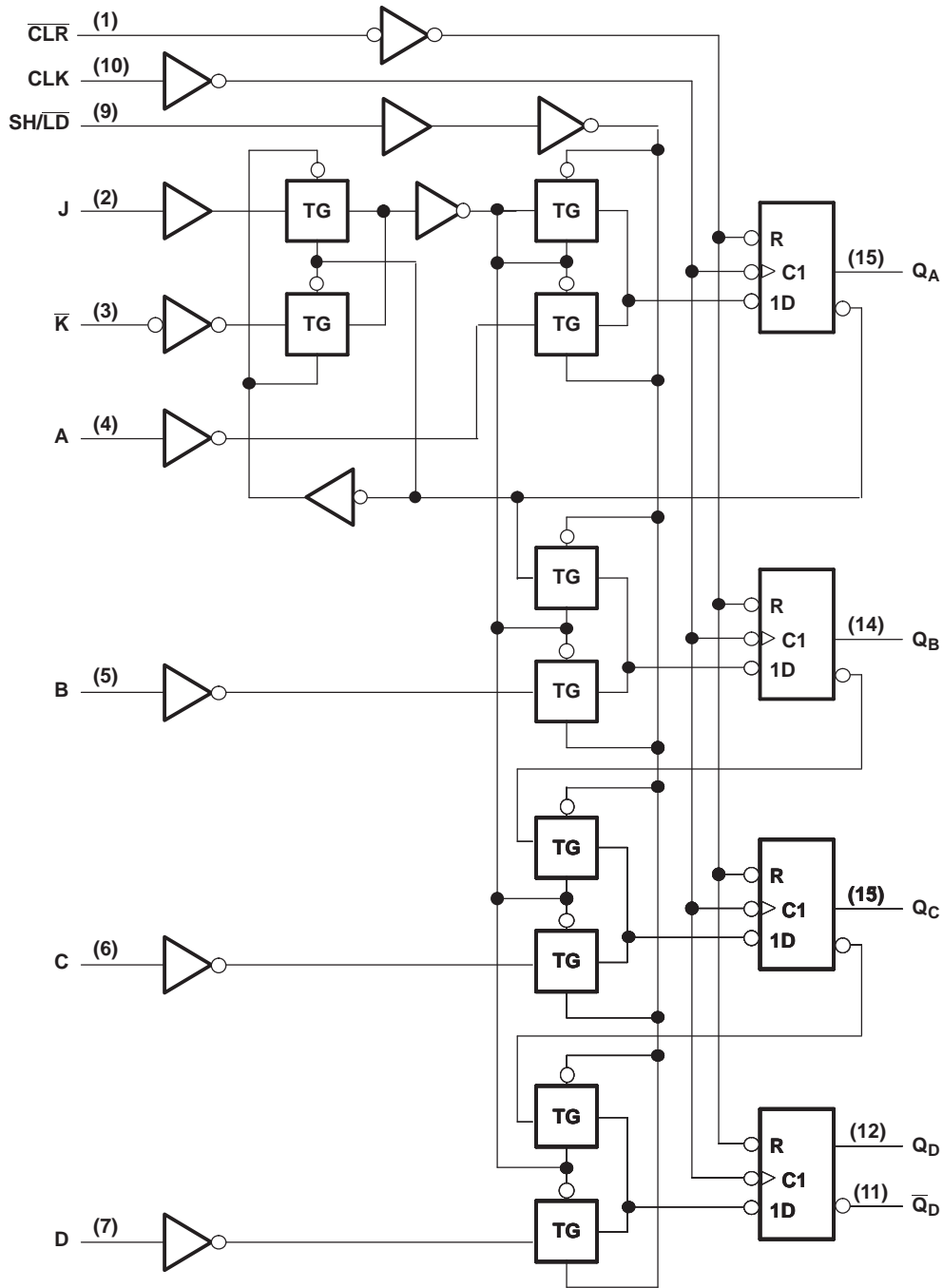


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# SN54HC195 4-BIT PARALLEL-ACCESS SHIFT REGISTERS

SCLS124A—DECEMBER 1992—REVISED NOVEMBER 2007

## LOGIC DIAGRAM (POSITIVE LOGIC)

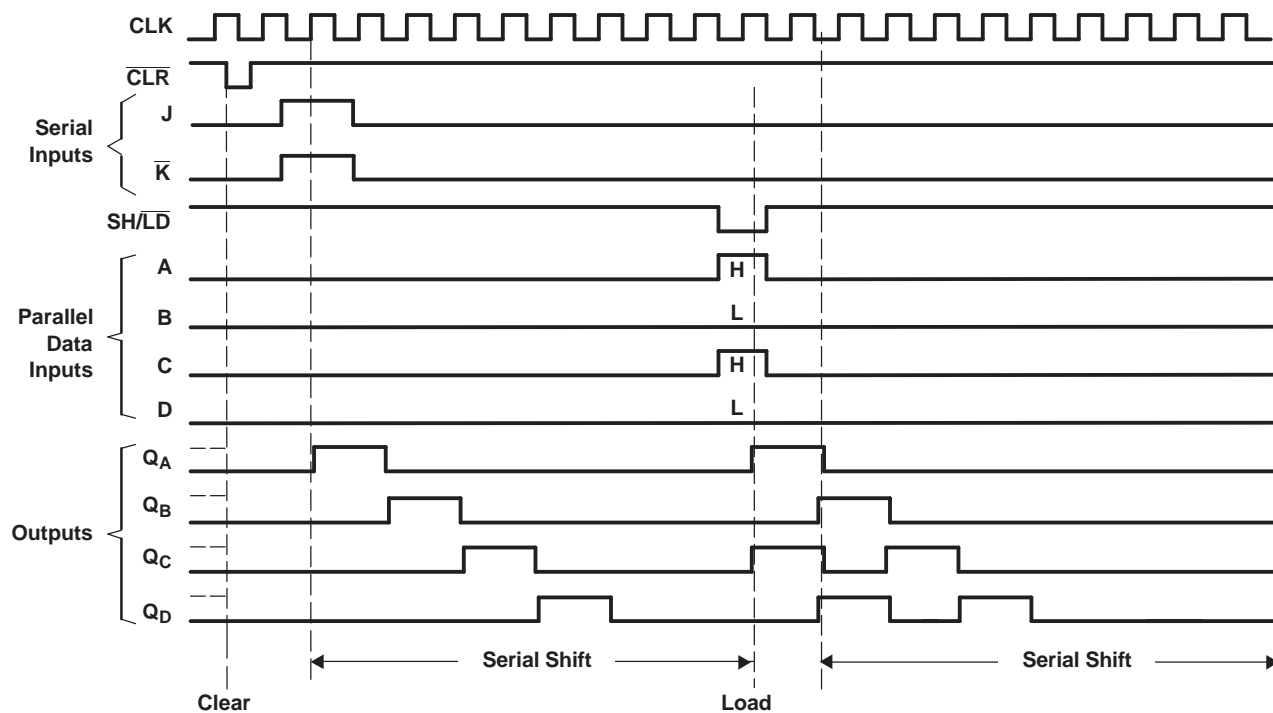


Pin numbers shown are for J package.

**FUNCTION TABLE**

| CLR | SH/LD | CLK | INPUTS |           |          |   |   |   | OUTPUTS         |                 |                 |                 |                |
|-----|-------|-----|--------|-----------|----------|---|---|---|-----------------|-----------------|-----------------|-----------------|----------------|
|     |       |     | SERIAL |           | PARALLEL |   |   |   | Q <sub>A</sub>  | Q <sub>B</sub>  | Q <sub>C</sub>  | Q <sub>D</sub>  | $\bar{Q}_D$    |
|     |       |     | J      | $\bar{K}$ | A        | B | C | D |                 |                 |                 |                 |                |
| L   | X     | X   | X      | X         | X        | X | X | X | L               | L               | L               | L               | H              |
| H   | L     | ↑   | X      | X         | a        | b | c | d | a               | b               | c               | d               | $\bar{d}$      |
| H   | H     | L   | X      | X         | X        | X | X | X | Q <sub>A0</sub> | Q <sub>B0</sub> | Q <sub>C0</sub> | Q <sub>D0</sub> | $\bar{Q}_{D0}$ |
| H   | H     | ↑   | L      | H         | X        | X | X | X | Q <sub>A0</sub> | Q <sub>A0</sub> | Q <sub>Bn</sub> | Q <sub>Cn</sub> | $\bar{Q}_{Cn}$ |
| H   | H     | ↑   | L      | L         | X        | X | X | X | L               | Q <sub>An</sub> | Q <sub>Bn</sub> | Q <sub>Cn</sub> | $\bar{Q}_{Cn}$ |
| H   | H     | ↑   | H      | H         | X        | X | X | X | H               | Q <sub>An</sub> | Q <sub>Bn</sub> | Q <sub>Cn</sub> | $\bar{Q}_{Cn}$ |
| H   | H     | ↑   | H      | L         | X        | X | X | X | $\bar{Q}_{An}$  | Q <sub>An</sub> | Q <sub>Bn</sub> | Q <sub>Cn</sub> | $\bar{Q}_{Cn}$ |

**TYPICAL CLEAR, SHIFT, AND LOAD SEQUENCES**



# SN54HC195 4-BIT PARALLEL-ACCESS SHIFT REGISTERS

SCLS124A–DECEMBER 1992–REVISED NOVEMBER 2007

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

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

|           |   | MIN                         | MAX | UNIT        |
|-----------|---|-----------------------------|-----|-------------|
| $V_{CC}$  | Supply voltage range  | -0.5                        | 7   | V           |
| $I_{IK}$  | Input clamp current   | $V_I < 0$ or $V_I > V_{CC}$ |     | $\pm 20$ mA |
| $I_{OK}$  | Output clamp current  | $V_O < 0$ or $V_O > V_{CC}$ |     | $\pm 20$ mA |
| $I_O$     | Continuous output current   | $V_O = 0$ to $V_{CC}$       |     | 25 mA       |
|           | Continuous current through $V_{CC}$ or GND pins                       |                             |     | 50 mA       |
|           | Lead temperature 1,6 mm (1/16 in) from case for 60 s: FK or J package |                             |     | 300 °C      |
|           | Lead temperature 1,6 mm (1/16 in) from case for 10 s: N package       |                             |     | 260 °C      |
| $T_{stg}$ | Storage temperature range   | -65                         | 150 | °C          |

(1) 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.

## RECOMMENDED OPERATING CONDITIONS

|          |  | MIN              | NOM  | MAX      | UNIT |
|----------|--|------------------|------|----------|------|
| $V_{CC}$ | Supply voltage                         | 2                | 5    | 6        | V    |
| $V_{IH}$ | High-level input voltage               | $V_{CC} = 2$ V   | 1.5  |          | V    |
|          |  | $V_{CC} = 4.5$ V | 3.15 |          |      |
|          |  | $V_{CC} = 6$ V   | 4.2  |          |      |
| $V_{IL}$ | Low-level input voltage                | $V_{CC} = 2$ V   | 0    | 0.3      | V    |
|          |  | $V_{CC} = 4.5$ V | 0    | 0.9      |      |
|          |  | $V_{CC} = 6$ V   | 0    | 1.2      |      |
| $V_I$    | Input voltage                          | 0                |      | $V_{CC}$ | V    |
| $V_O$    | Output voltage                         | 0                |      | $V_{CC}$ | V    |
| $t_t$    | Input transition (rise and fall) times | $V_{CC} = 2$ V   | 0    | 1000     | ns   |
|          |  | $V_{CC} = 4.5$ V | 0    | 500      |      |
|          |  | $V_{CC} = 6$ V   | 0    | 400      |      |
| $T_A$    | Operating free-air temperature         | -55              |      | 125      | °C   |

## ELECTRICAL CHARACTERISTICS

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

| PARAMETER | TEST CONDITIONS  | $V_{CC}$   | $T_A = 25^\circ\text{C}$ |           |           | SN54HC195  |               | UNIT |
|-----------|--|------------|--------------------------|-----------|-----------|------------|---------------|------|
|           |  |            | MIN                      | TYP       | MAX       | MIN        | MAX           |      |
| $V_{OH}$  | $V_I = V_{IH}$ or $V_{IL}$ ,<br>$I_{OH} = -20 \mu\text{A}$ | 2 V        | 1.9                      | 1.998     |           | 1.9        | V             |      |
|           |  | 4.5 V      | 4.4                      | 4.499     |           | 4.4        |               |      |
|           |  | 6 V        | 5.9                      | 5.999     |           | 5.9        |               |      |
|           | $V_I = V_{IH}$ or $V_{IL}$ ,<br>$I_{OH} = -4 \text{ mA}$   | 4.5 V      | 3.98                     | 4.30      |           | 3.7        |               |      |
|           |  | 6 V        | 5.48                     | 5.80      |           | 5.2        |               |      |
| $V_{OL}$  | $V_I = V_{IH}$ or $V_{IL}$ ,<br>$I_{OL} = 20 \mu\text{A}$  | 2 V        |                          | 0.002     | 0.1       | 0.1        | V             |      |
|           |  | 4.5 V      |                          | 0.001     | 0.1       | 0.1        |               |      |
|           |  | 6 V        |                          | 0.001     | 0.1       | 0.1        |               |      |
|           | $V_I = V_{IH}$ or $V_{IL}$ ,<br>$I_{OL} = 4 \text{ mA}$    | 4.5 V      |                          | 0.17      | 0.26      | 0.4        |               |      |
|           |  | 6 V        |                          | 0.15      | 0.26      | 0.4        |               |      |
| $I_I$     | $V_I = V_{CC}$ or 0  | 6 V        |                          | $\pm 0.1$ | $\pm 100$ | $\pm 1000$ | nA            |      |
| $I_{CC}$  | $V_I = V_{CC}$ or 0, $I_O = 0$                             | 6 V        |                          |           | 8         | 160        | $\mu\text{A}$ |      |
| $C_I$     | $V_I = V_{CC}$ or GND                                      | 2 V to 6 V |                          | 3         | 10        | 10         | pF            |      |

## TIMING REQUIREMENTS

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

|                    |                                   | $V_{CC}$  | $T_A = 25^\circ\text{C}$ |       | SN54HC195 |     | UNIT |
|--------------------|-----------------------------------|---|--------------------------|-------|-----------|-----|------|
|                    |                                   |   | MIN                      | MAX   | MIN       | MAX |      |
| $f_{\text{clock}}$ | Clock frequency                   | 2 V   | 0                        | 6     | 0         | 4.2 | MHz  |
|                    |                                   | 4.5 V   | 0                        | 31    | 0         | 21  |      |
|                    |                                   | 6 V   | 0                        | 36    | 0         | 25  |      |
| $t_w$              | Pulse duration                    | CLK high or low   |                          | 2 V   | 80        | 120 | ns   |
|                    |                                   |   |                          | 4.5 V | 16        | 24  |      |
|                    |                                   |   |                          | 6 V   | 14        | 20  |      |
|                    | $\overline{\text{CLR}}$ low       |   | 2 V                      | 80    | 120       |     |      |
|                    |                                   |   | 4.5 V                    | 16    | 24        |     |      |
|                    |                                   |   | 6 V                      | 14    | 20        |     |      |
| $t_{\text{su}}$    | Setup time, before CLK $\uparrow$ | SH/ $\overline{\text{LD}}$ , or serial and parallel data, or CLR inactive |                          | 2 V   | 100       | 150 | ns   |
|                    |                                   |   |                          | 4.5 V | 20        | 30  |      |
|                    |                                   |   |                          | 6 V   | 17        | 26  |      |
| $t_h$              | Hold time, after CLK $\uparrow$   | SH/ $\overline{\text{LD}}$ , or serial and parallel data, or CLR inactive |                          | 2 V   | 0         | 0   | ns   |
|                    |                                   |   |                          | 4.5 V | 0         | 0   |      |
|                    |                                   |   |                          | 6 V   | 0         | 0   |      |

## SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range (unless otherwise noted),  $C_L = 50 \text{ pF}^{(1)}$

| PARAMETER        | FROM (INPUT)                  | TO (OUTPUT)                                | $V_{CC}$ | $T_A = 25^\circ\text{C}$          |     |     | SN54HC195 |           | UNIT |
|------------------|-------------------------------|--|----------|-----------------------------------|-----|-----|-----------|-----------|------|
|                  |                               |  |          | MIN                               | TYP | MAX | MIN       | MAX       |      |
| $f_{\text{max}}$ |                               |  | 2 V      | 6                                 | 12  |     | 4.2       | MHz       |      |
|                  |                               |  | 4.5 V    | 31                                | 50  |     | 21        |           |      |
|                  |                               |  | 6 V      | 36                                | 60  |     | 25        |           |      |
| $t_{\text{pd}}$  | CLK                           | $Q_A$ thru $Q_D$<br>or<br>$\overline{Q_D}$ | 2 V      |                                   | 67  | 145 |           | 220       | ns   |
|                  |                               |  | 4.5 V    |                                   | 17  | 29  |           | 44        |      |
|                  |                               |  | 6 V      |                                   | 14  | 25  |           | 37        |      |
| $t_{\text{pd}}$  | $\overline{\text{CLR}}$       | $Q_A$ thru $Q_D$<br>or<br>$\overline{Q_D}$ | 2 V      |                                   | 67  | 150 |           | 225       | ns   |
|                  |                               |  | 4.5 V    |                                   | 17  | 30  |           | 45        |      |
|                  |                               |  | 6 V      |                                   | 13  | 26  |           | 38        |      |
| $t_t$            |                               | Any  | 2 V      |                                   | 28  | 75  |           | 110       | ns   |
|                  |                               |  | 4.5 V    |                                   | 8   | 15  |           | 22        |      |
|                  |                               |  | 6 V      |                                   | 6   | 13  |           | 19        |      |
| $C_{\text{pd}}$  | Power dissipation capacitance |  |          | No load, $T_A = 25^\circ\text{C}$ |     |     |           | 65 pF typ |      |

(1) Load circuit and voltage waveforms are shown in previous pages.

**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                 |
|------------------|---------------|--------------|-----------------|------|-------------|---------------------|--------------------------------------|----------------------|--------------|-------------------------------|-------------------------|
| 5962-8682701EA   | ACTIVE        | CDIP         | J               | 16   | 25          | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-8682701EA<br>SNJ54HC195J | <a href="#">Samples</a> |
| SN54HC195J       | ACTIVE        | CDIP         | J               | 16   | 25          | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | SN54HC195J                    | <a href="#">Samples</a> |
| SNJ54HC195J      | ACTIVE        | CDIP         | J               | 16   | 25          | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-8682701EA<br>SNJ54HC195J | <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.

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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.



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