

# SN54BCT2240, SN74BCT2240 OCTAL BUFFERS AND LINE/MOS DRIVERS WITH 3-STATE OUTPUTS

SCBS030E – SEPTEMBER 1988 – REVISED MARCH 2003

- Operating Voltage Range of 4.5 V to 5.5 V
- State-of-the-Art BiCMOS Design Significantly Reduces  $I_{CCZ}$
- Output Ports Have Equivalent 33- $\Omega$  Series Resistors, So No External Resistors Are Required
- 3-State Outputs Drive Bus Lines or Buffer Memory Address Registers

## description/ordering information

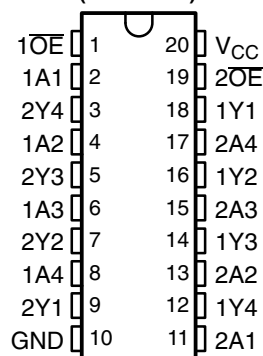
These octal buffers and line drivers are designed specifically to improve both the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters. Together with the SN74BCT2241 and the 'BCT2244 devices, these devices provide the choice of selected combinations of inverting and noninverting outputs, symmetrical active-low output-enable ( $\overline{OE}$ ) inputs, and complementary OE and  $\overline{OE}$  inputs. These devices feature high fan-out and improved fan-in.

The 'BCT2240 devices are organized as two 4-bit line drivers with separate output-enable ( $\overline{OE}$ ) inputs. When  $\overline{OE}$  is low, the device passes data from the A inputs to the Y outputs. When  $\overline{OE}$  is high, the outputs are in the high-impedance state.

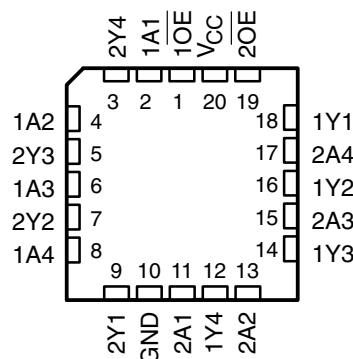
To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The outputs, which are designed to source or sink up to 12 mA, include 33- $\Omega$  series resistors to reduce overshoot and undershoot.

SN54BCT2240 . . . J OR W PACKAGE  
SN74BCT2240 . . . DB, DW, N, OR NS PACKAGE  
(TOP VIEW)



SN54BCT2240 . . . FK PACKAGE  
(TOP VIEW)



## ORDERING INFORMATION

| $T_A$          | PACKAGE†      |                | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|---------------|----------------|-----------------------|------------------|
| 0°C to 70°C    | PDIP – N      | Tube           | SN74BCT2240N          | SN74BCT2240N     |
|                | SOIC – DW     | Tube           | SN74BCT2240DW         | BCT2240          |
|                |               | Tape and reel  | SN74BCT2240DWR        |                  |
|                | SOP – NS      | Tape and reel  | SN74BCT2240NSR        | BCT2240          |
| SSOP – DB      | Tape and reel | SN74BCT2240DBR | BA240                 |                  |
| –55°C to 125°C | CDIP – J      | Tube           | SNJ54BCT2240J         | SNJ54BCT2240J    |
|                | CFP – W       | Tube           | SNJ54BCT2240W         | SNJ54BCT2240W    |
|                | LCCC – FK     | Tube           | SNJ54BCT2240FK        | SNJ54BCT2240FK   |

† 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).



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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**

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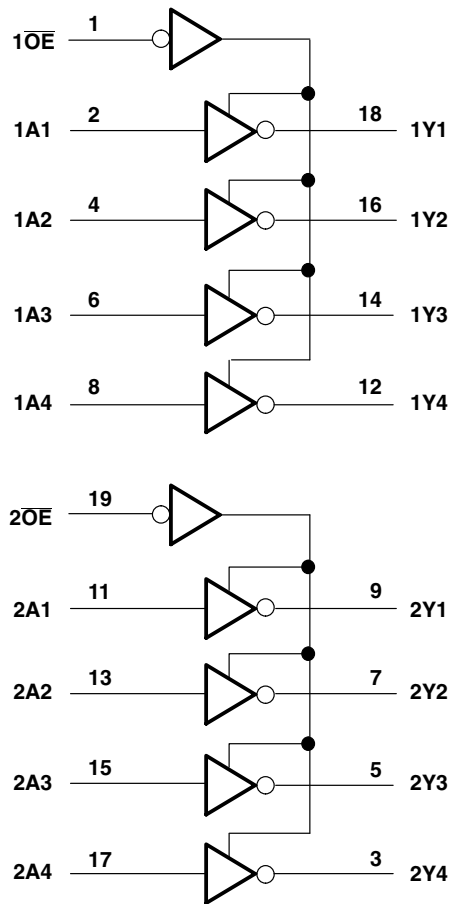
# SN54BCT2240, SN74BCT2240 OCTAL BUFFERS AND LINE/MOS DRIVERS WITH 3-STATE OUTPUTS

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FUNCTION TABLE  
(each buffer)

| INPUTS |   | OUTPUT |
|--------|---|--------|
| OE     | A | Y      |
| L      | H | L      |
| L      | L | H      |
| H      | X | Z      |

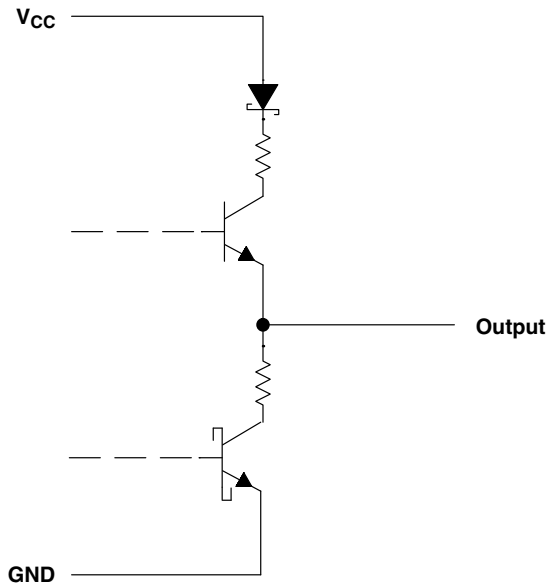
logic diagram (positive logic)



# SN54BCT2240, SN74BCT2240 OCTAL BUFFERS AND LINE/MOS DRIVERS WITH 3-STATE OUTPUTS

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## schematic of Y outputs



## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|   |                    |
|---|--------------------|
| Supply voltage range, $V_{CC}$  | –0.5 V to 7 V      |
| Input voltage range, $V_I$ (see Note 1)                                       | –0.5 V to 7 V      |
| Voltage range applied to any output in the disabled or power-off state, $V_O$ | –0.5 V to 5.5 V    |
| Voltage range applied to any output in the high state, $V_O$                  | –0.5 V to $V_{CC}$ |
| Input clamp current, $I_{IK}$   | –30 mA             |
| Current into any output in the low state                                      | 24 mA              |
| Package thermal impedance, $\theta_{JA}$ (see Note 2):                        |                    |
| DB package  | 70°C/W             |
| DW package  | 58°C/W             |
| N package   | 69°C/W             |
| NS package  | 60°C/W             |
| Storage temperature range, $T_{stg}$  | –65°C to 150°C     |

<sup>†</sup> 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.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
 2. The package thermal impedance is calculated in accordance with JESD 51-7.



# SN54BCT2240, SN74BCT2240 OCTAL BUFFERS AND LINE/MOS DRIVERS WITH 3-STATE OUTPUTS

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## recommended operating conditions (see Note 3)

|                 |                                | SN54BCT2240 |     |     | SN74BCT2240 |     |     | UNIT |
|-----------------|--------------------------------|-------------|-----|-----|-------------|-----|-----|------|
|                 |                                | MIN         | NOM | MAX | MIN         | NOM | MAX |      |
| V <sub>CC</sub> | Supply voltage                 | 4.5         | 5   | 5.5 | 4.5         | 5   | 5.5 | V    |
| V <sub>IH</sub> | High-level input voltage       | 2           |     |     | 2           |     |     | V    |
| V <sub>IL</sub> | Low-level input voltage        |             |     | 0.8 |             |     | 0.8 | V    |
| I <sub>IK</sub> | Input clamp current            |             |     | -18 |             |     | -18 | mA   |
| I <sub>OH</sub> | High-level output current      |             |     | -12 |             |     | -12 | mA   |
| I <sub>OL</sub> | Low-level output current       |             |     | 12  |             |     | 12  | mA   |
| T <sub>A</sub>  | Operating free-air temperature | -55         |     | 125 | 0           |     | 70  | °C   |

NOTE 3: All unused inputs of the device must be held at V<sub>CC</sub> 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          |                          | SN54BCT2240 |      |      | SN74BCT2240 |      |      | UNIT |
|-------------------|--------------------------|--------------------------|-------------|------|------|-------------|------|------|------|
|                   |                          |                          | MIN         | TYP† | MAX  | MIN         | TYP† | MAX  |      |
| V <sub>IK</sub>   | V <sub>CC</sub> = 4.5 V, | I <sub>I</sub> = -18 mA  |             |      | -1.2 |             |      | -1.2 | V    |
| V <sub>OH</sub>   | V <sub>CC</sub> = 4.5 V  | I <sub>OH</sub> = -1 mA  | 2.4         | 3.3  |      | 2.4         | 3.3  |      | V    |
|                   |                          | I <sub>OH</sub> = -12 mA | 2           | 3.2  |      | 2           | 3.2  |      |      |
| V <sub>OL</sub>   | V <sub>CC</sub> = 4.5 V  | I <sub>OL</sub> = 1 mA   |             | 0.15 | 0.5  |             | 0.15 | 0.5  | V    |
|                   |                          | I <sub>OL</sub> = 12 mA  |             | 0.35 | 0.8  |             | 0.35 | 0.8  |      |
| 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> = 0.5 V   |             |      | -1   |             |      | -1   | mA   |
| I <sub>OZH</sub>  | V <sub>CC</sub> = 5.5 V, | V <sub>O</sub> = 2.7 V   |             |      | 50   |             |      | 50   | μA   |
| I <sub>OZL</sub>  | V <sub>CC</sub> = 5.5 V, | V <sub>O</sub> = 0.5 V   |             |      | -50  |             |      | -50  | μA   |
| I <sub>OS</sub> ‡ | V <sub>CC</sub> = 5.5 V, | V <sub>O</sub> = 0       | -100        |      | -225 | -100        |      | -225 | mA   |
| I <sub>CCH</sub>  | V <sub>CC</sub> = 5.5 V, | Outputs open             |             | 19   | 32   |             | 19   | 32   | mA   |
| I <sub>CCL</sub>  | V <sub>CC</sub> = 5.5 V, | Outputs open             |             | 46   | 76   |             | 46   | 76   | mA   |
| I <sub>CCZ</sub>  | V <sub>CC</sub> = 5.5 V, | Outputs open             |             | 6    | 8    |             | 6    | 8    | mA   |

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

‡ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

## switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

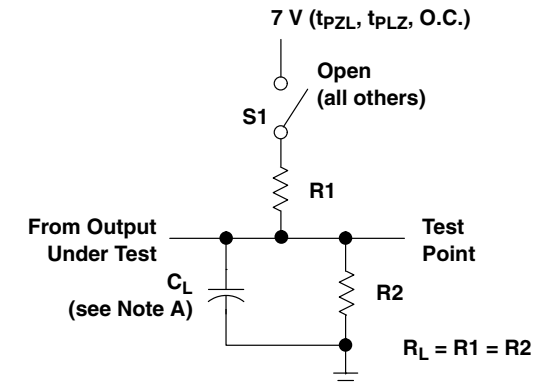
| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | V <sub>CC</sub> = 5 V,<br>T <sub>A</sub> = 25°C |     |      | SN54BCT2240 |      | SN74BCT2240 |      | UNIT |
|------------------|--------------|-------------|---|-----|------|-------------|------|-------------|------|------|
|                  |              |             | MIN   | TYP | MAX  | MIN         | MAX  | MIN         | MAX  |      |
| t <sub>PLH</sub> | A            | Y           | 0.5   | 3.4 | 4.8  | 0.5         | 6.3  | 0.5         | 5.7  | ns   |
| t <sub>PHL</sub> |              |             | 0.5   | 2.8 | 4    | 0.5         | 4.6  | 0.5         | 4.4  |      |
| t <sub>PZH</sub> | OE           | Y           | 2.6   | 6.2 | 8.2  | 2.6         | 10.1 | 2.6         | 9.3  | ns   |
| t <sub>PZL</sub> |              |             | 4.3   | 8.8 | 10.9 | 4.3         | 12.9 | 4.3         | 12.4 |      |
| t <sub>PHZ</sub> | OE           | Y           | 2   | 5.3 | 7.1  | 2           | 9.2  | 2           | 8.7  | ns   |
| t <sub>PLZ</sub> |              |             | 2.2   | 6.7 | 8.5  | 2.2         | 12.2 | 2.2         | 10.6 |      |



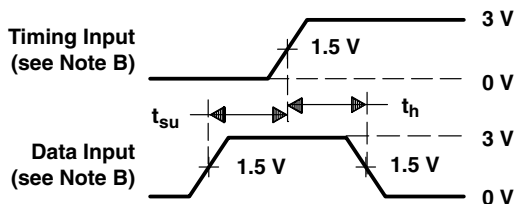
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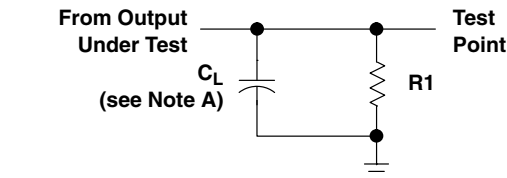
## PARAMETER MEASUREMENT INFORMATION



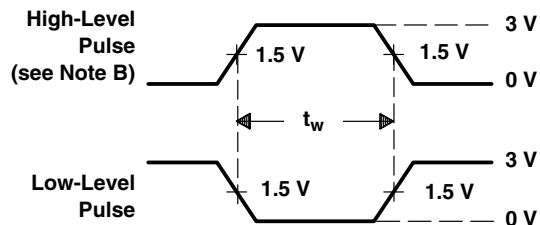
LOAD CIRCUIT FOR  
3-STATE AND OPEN-COLLECTOR OUTPUTS



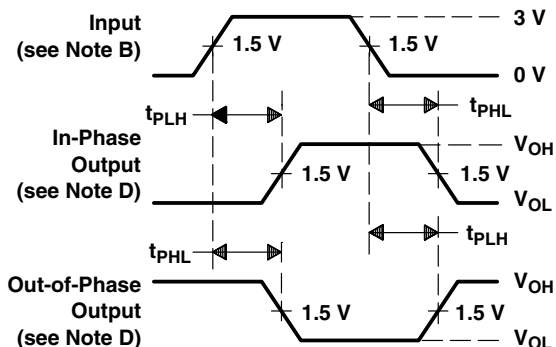
VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



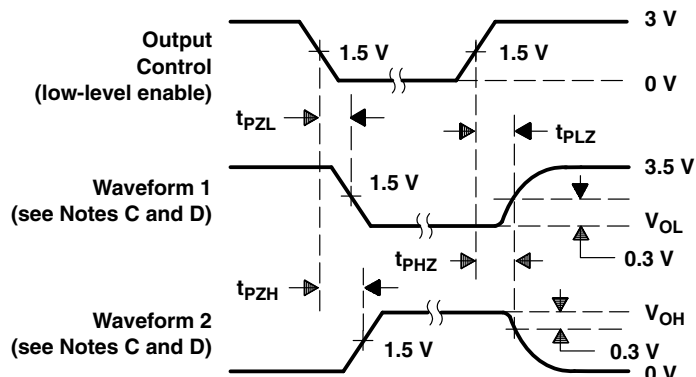
LOAD CIRCUIT FOR  
TOTEM-POLE OUTPUTS



VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES (see Note D)



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

- NOTES:
- $C_L$  includes probe and jig capacitance.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10$  MHz,  $t_r = t_f \leq 2.5$  ns, duty cycle = 50%.
  - 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.
  - The outputs are measured one at a time with one transition per measurement.
  - When measuring propagation delay times of 3-state outputs, switch S1 is open.
  - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit 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                 |
|------------------|---------------|--------------|-----------------|------|-------------|---------------------|--------------------------------------|----------------------|--------------|---|-------------------------|
| 5962-9093901M2A  | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-<br>9093901M2A<br>SNJ54BCT<br>2240FK | <a href="#">Samples</a> |
| 5962-9093901MRA  | ACTIVE        | CDIP         | J               | 20   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-9093901MR<br>A<br>SNJ54BCT2240J      | <a href="#">Samples</a> |
| SNJ54BCT2240FK   | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-<br>9093901M2A<br>SNJ54BCT<br>2240FK | <a href="#">Samples</a> |
| SNJ54BCT2240J    | ACTIVE        | CDIP         | J               | 20   | 1           | Non-RoHS<br>& Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-9093901MR<br>A<br>SNJ54BCT2240J      | <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.

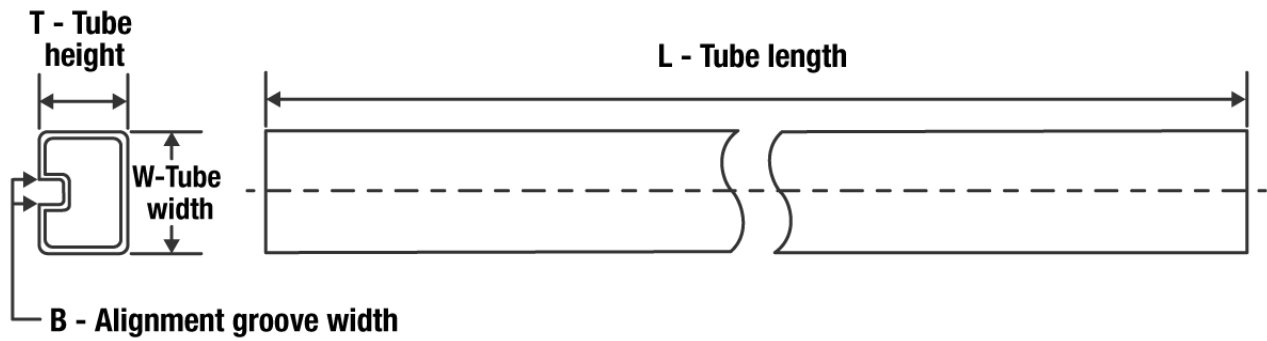
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

<sup>(6)</sup> 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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**TUBE**


\*All dimensions are nominal

| Device          | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 5962-9093901M2A | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |
| SNJ54BCT2240FK  | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |



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.

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

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