

## 具有三态输出的 SNx4BCT374 八路边沿触发式 D 类锁存器

### 1 特性

- 4.5V 至 5.5V 的工作电压范围
- 与 TTL 设计相比，BiCMOS 设计显著降低了  $I_{CCZ}$
- 针对负载的完全并行访问
- 经缓冲的控制输入
- 三态输出驱动总线或缓冲存储器地址寄存器

### 2 应用

- 缓冲寄存器
- I/O 端口
- 总线驱动器
- 工作寄存器

### 3 说明

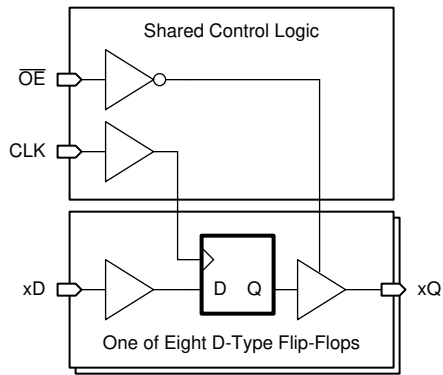
SNx4BCT374 器件包含八通道 D 型触发器，带有一个共享时钟 (CLK) 和输出使能 ( $\overline{OE}$ ) 引脚。

#### 器件信息<sup>(1)</sup>

| 器件型号         | 封装        | 封装尺寸 (标称值)       |
|--------------|-----------|------------------|
| SN74BCT374N  | PDIP (20) | 25.40mm × 6.35mm |
| SN74BCT374DW | SOIC (20) | 12.80mm × 7.50mm |
| SN74BCT374NS | SOP (20)  | 12.60mm × 5.30mm |
| SN74BCT374DB | SSOP (20) | 7.20mm × 5.30mm  |
| SN54BCT374J  | CDIP (20) | 26.92mm × 6.92mm |
| SN54BCT374W  | CFP (20)  | 13.72mm × 6.92mm |
| SN54BCT374FK | LCCC (20) | 8.89mm × 8.89mm  |

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。





功能模块图

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## 4 Revision History

注：以前版本的页码可能与当前版本的页码不同

| Changes from Revision C (March 2003) to Revision D (February 2021)   | Page |
|--|------|
| • 更新了整个文档的表、图和交叉参考的编号格式.....   | 1    |
| • 向 <i>应用</i> 部分添加了新的应用.....   | 1    |
| • 删除了 <i>说明</i> 部分中的 <i>订购信息</i> 和 <i>功能表</i> .....  | 1    |
| • 向 <i>说明</i> 部分添加了 <i>器件信息表</i> .....   | 1    |
| • Moved package thermal impedance, $\Theta_{JA}$ for the DW, N, and NS packages to <a href="#">节 6.4</a> .....           | 5    |
| • Added <i>ESD Ratings</i> section.....  | 5    |
| • Added <i>Thermal Information</i> section.....  | 6    |
| • Changed $I_{OS}(\text{min})$ value From: $-100\text{ mA}$ To: $-50\text{ mA}$ .....                                    | 6    |
| • Added <i>Timing Requirements</i> , <i>Switching Characteristics</i> , and <i>Typical Characteristics</i> sections..... | 7    |
| • Added <i>Detailed Description</i> section.....   | 10   |
| • Added <i>Application and Implementation</i> section.....   | 12   |
| • Added <i>Power Supply Recommendations</i> and <i>Layout</i> sections.....  | 14   |

| Changes from Revision B (April 1994) to Revision C (March 2003)                      | Page |
|--|------|
| • 向 <i>说明</i> 部分添加了 <i>订购信息表</i> .....   | 1    |
| • Added package thermal impedance, $\Theta_{JA}$ for the DW, N, and NS packages..... | 5    |

| Changes from Revision A (November 1993) to Revision B (April 1994) | Page |
|--|------|
| • 首次公开发布量产数据表。.....  | 1    |

## 5 Pin Configuration and Functions

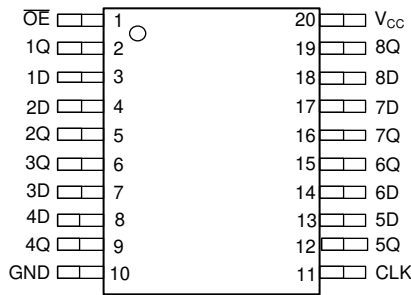


图 5-1. DB, DW, N, NS, J, or W Package  
20-Pin SSOP, SOIC, PDIP, SO, CDIP, or CFP  
Top View

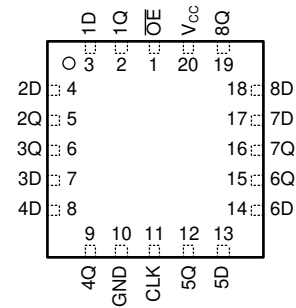


图 5-2. FK Package  
20-Pin LCCC  
Transparent Top View

表 5-1. Pin Functions

| PIN             |     | I/O <sup>(1)</sup> | DESCRIPTION                  |
|-----------------|-----|--------------------|------------------------------|
| NAME            | NO. |                    |                              |
| OE              | 1   | I                  | Output enable, active low    |
| 1Q              | 2   | O                  | Channel 1 output             |
| 1D              | 3   | I                  | Channel 1 input              |
| 2D              | 4   | I                  | Channel 2 input              |
| 2Q              | 5   | O                  | Channel 2 output             |
| 3Q              | 6   | O                  | Channel 3 output             |
| 3D              | 7   | I                  | Channel 3 input              |
| 4D              | 8   | I                  | Channel 4 input              |
| 4Q              | 9   | O                  | Channel 4 output             |
| GND             | 10  | G                  | Ground                       |
| CLK             | 11  | I                  | Clock, rising edge triggered |
| 5Q              | 12  | O                  | Channel 5 output             |
| 5D              | 13  | I                  | Channel 5 input              |
| 6D              | 14  | I                  | Channel 6 input              |
| 6Q              | 15  | O                  | Channel 6 output             |
| 7Q              | 16  | O                  | Channel 7 output             |
| 7D              | 17  | I                  | Channel 7 input              |
| 8D              | 18  | I                  | Channel 8 input              |
| 8Q              | 19  | O                  | Channel 8 output             |
| V <sub>CC</sub> | 20  | P                  | Positive supply              |

(1) I = Input, O = Output, I/O = Input or Output, G = Ground, P = Power.

## 6 Specifications

### 6.1 Absolute Maximum Ratings<sup>(1)</sup>

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

|                  |  | MIN        | MAX             | UNIT |
|------------------|--|------------|-----------------|------|
| V <sub>CC</sub>  | Supply voltage range   | - 0.5      | 7               | V    |
| V <sub>I</sub>   | Input voltage range <sup>(2)</sup>                                     | - 0.5      | 7               | V    |
| V <sub>O</sub>   | Voltage range applied to any output in the disabled or power-off state | - 0.5      | 5.5             | V    |
| V <sub>O</sub>   | Voltage range applied to any output in the high state                  | - 0.5      | V <sub>CC</sub> | V    |
| I <sub>IK</sub>  | Input clamp current  |            | - 30            | mA   |
| I <sub>OL</sub>  | Current into any output in the low state                               | SN54BCT374 | 96              | mA   |
|                  |  | SN74BCT374 | 128             |      |
| T <sub>stg</sub> | Storage temperature range <sup>(3)</sup>                               | - 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.
- (2) The negative input voltage rating may be exceeded if the input clamp current rating is observed.
- (3) Long-term high-temperature storage and extended use at maximum recommended operating conditions or both may result in a reduction of overall device life. See [http://www.ti.com/ep\\_quality](http://www.ti.com/ep_quality) for additional information on enhanced plastic packaging.

### 6.2 ESD Ratings

|                    |                         | VALUE  | UNIT |
|--------------------|-------------------------|--|------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>1</sup>              | V    |
|                    |                         | Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>2</sup> |      |

### 6.3 Recommended Operating Conditions<sup>(1)</sup>

|                 | Operating free-air temperature (T <sub>A</sub> ) |      |     |                            |     |      | UNIT |   |
|-----------------|--|------|-----|----------------------------|-----|------|------|---|
|                 | - 55°C to 125°C <sup>(2)</sup>                   |      |     | 0°C to 70°C <sup>(3)</sup> |     |      |      |   |
|                 | 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> |  |      |     | - 2                        |     | - 15 | mA   |   |
| I <sub>OL</sub> | Low-level output current                         |      |     | 48                         |     | 64   | mA   |   |
| T <sub>A</sub>  | Operating free-air temperature                   | - 55 | 125 |                            | 0   | 70   | °C   |   |

- (1) 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](#).
- (2) Applies to SN54BCT374 devices only
- (3) Applies to SN74BCT374 devices only

## 6.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |  | SN74BCT374   |              |          |         | UNIT |
|-------------------------------|--|--------------|--------------|----------|---------|------|
|                               |  | DB<br>(SSOP) | DW<br>(SOIC) | N (PDIP) | NS (SO) |      |
|                               |  | 20 PINS      | 20 PINS      | 20 PINS  | 20 PINS |      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 84.4         | 73.4         | 59.7     | 71.2    | °C/W |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 40.1         | 41.9         | 40.6     | 36.2    | °C/W |
| $\psi_{JT}$                   | Junction-to-top characterization parameter   | 6.2          | 14.6         | 24.9     | 7.6     | °C/W |
| $\psi_{JB}$                   | Junction-to-board characterization parameter | 39.5         | 41.4         | 40.3     | 35.9    | °C/W |
| $R_{\theta JC(top)}$          | Junction-to-case (top) thermal resistance    | 36.8         | 38.8         | 50.0     | 34.3    | °C/W |

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC package thermal metrics](#) application report.

## 6.5 Electrical Characteristics

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

| PARAMETER               | TEST CONDITIONS  | Operating free-air temperature ( $T_A$ ) |                    |       |                            |                    |       | UNIT          |
|-------------------------|--|--|--------------------|-------|----------------------------|--------------------|-------|---------------|
|                         |  | - 55°C to 125°C <sup>(3)</sup>           |                    |       | 0°C to 70°C <sup>(4)</sup> |                    |       |               |
|                         |  | MIN                                      | TYP <sup>(1)</sup> | MAX   | MIN                        | TYP <sup>(1)</sup> | MAX   |               |
| $V_{IK}$                | $V_{CC} = 4.5\text{ V}$ , $I_I = -18\text{ mA}$                | - 1.2                                    |                    |       | - 1.2                      |                    |       | V             |
| $V_{OH}$                | $V_{CC} = 4.5\text{ V}$  | $I_{OH} = -3\text{ mA}$                  | 2.4                | 3.3   | 2.4                        | 3.3                | V     |               |
|                         |  | $I_{OH} = -12\text{ mA}$                 | 2                  | 3.2   |                            |                    |       |               |
|                         |  | $I_{OH} = -15\text{ mA}$                 |                    |       | 2                          | 3.1                |       |               |
| $V_{OL}$                | $V_{CC} = 4.5\text{ V}$  | $I_{OL} = 48\text{ mA}$                  | 0.38               | 0.55  |                            |                    | V     |               |
|                         |  | $I_{OL} = 64\text{ mA}$                  |                    |       | 0.42                       | 0.55               |       |               |
| $I_I$                   | $V_{CC} = 5.5\text{ V}$ , $V_I = 5.5\text{ V}$                 | 0.4                                      |                    |       | 0.4                        |                    |       | mA            |
| $I_{IH}$                | $V_{CC} = 5.5\text{ V}$ , $V_I = 2.7\text{ V}$                 | 20                                       |                    |       | 20                         |                    |       | $\mu\text{A}$ |
| $I_{IL}$                | $V_{CC} = 5.5\text{ V}$ , $V_I = 0.5\text{ V}$                 | - 0.6                                    |                    |       | - 0.6                      |                    |       | mA            |
| $I_{OS}$ <sup>(2)</sup> | $V_{CC} = 5.5\text{ V}$ , $V_O = 0\text{ V}$                   | - 50                                     |                    | - 225 | - 50                       |                    | - 225 | mA            |
| $I_{OZH}$               | $V_{CC} = 5.5\text{ V}$ , $V_O = 2.7\text{ V}$                 | 50                                       |                    |       | 50                         |                    |       | $\mu\text{A}$ |
| $I_{OZL}$               | $V_{CC} = 5.5\text{ V}$ , $V_O = 0.5\text{ V}$                 | - 50                                     |                    |       | - 50                       |                    |       | $\mu\text{A}$ |
| $I_{CCL}$               | $V_{CC} = 5.5\text{ V}$  | 37                                       | 60                 |       | 37                         | 60                 | mA    |               |
| $I_{CCH}$               | $V_{CC} = 5.5\text{ V}$  | 2  | 5                  |       | 2                          | 5                  | mA    |               |
| $I_{CCZ}$               | $V_{CC} = 5.5\text{ V}$  | 5  | 8                  |       | 5                          | 8                  | mA    |               |
| $C_i$                   | $V_{CC} = 5\text{ V}$ , $V_I = 2.5\text{ V}$ or $0.5\text{ V}$ | 6  |                    |       | 6                          |                    |       | pF            |
| $C_o$                   | $V_{CC} = 5\text{ V}$ , $V_O = 2.5\text{ V}$ or $0.5\text{ V}$ | 10                                       |                    |       | 10                         |                    |       | pF            |

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

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

(3) Applies to SN54BCT374 devices only

(4) Applies to SN74BCT374 devices only

## 6.6 Timing Requirements

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

| PARAMETER          |                         |                  | Operating free-air temperature (T <sub>A</sub> ) |     |                               |     |                            |     | UNIT |
|--------------------|-------------------------|------------------|--|-----|-------------------------------|-----|----------------------------|-----|------|
|                    |                         |                  | 25°C <sup>(1)</sup>                              |     | -55°C to 125°C <sup>(2)</sup> |     | 0°C to 70°C <sup>(3)</sup> |     |      |
|                    |                         |                  | MIN  | MAX | MIN                           | MAX | MIN                        | MAX |      |
| f <sub>clock</sub> | Clock frequency         |                  | 70   |     | 70                            |     | 70                         |     | MHz  |
| t <sub>w</sub>     | Pulse duration          | CLK high         | 7  |     | 8                             |     | 7                          |     | ns   |
| t <sub>su</sub>    | Setup time before CLK ↑ | Data high or low | 6.5  |     | 6.5                           |     | 6.5                        |     | ns   |
| t <sub>h</sub>     | Hold time after CLK ↑   | Data high or low | 0  |     | 0                             |     | 0                          |     | ns   |

- (1) V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C, applies to all SN54BCT374 and SN74BCT374 devices
- (2) Applies to SN54BCT374 devices only
- (3) Applies to SN74BCT374 devices only

## 6.7 Switching Characteristics

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

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | Operating free-air temperature (T <sub>A</sub> ) |     |      |                                   |      |                                | UNIT |     |
|------------------|--------------|-------------|--|-----|------|-----------------------------------|------|--------------------------------|------|-----|
|                  |              |             | 25°C <sup>(1)</sup>                              |     |      | -55°C to 125°C <sup>(2) (3)</sup> |      | 0°C to 70°C <sup>(2) (4)</sup> |      |     |
|                  |              |             | MIN  | TYP | MAX  | MIN                               | MAX  | MIN                            |      | MAX |
| f <sub>max</sub> |              |             | 70   |     |      | 70                                |      | 70                             |      | MHz |
| t <sub>PLH</sub> | CLK          | Q           | 2  | 7.2 | 9.1  | 2                                 | 11.6 | 2                              | 10.6 | ns  |
| t <sub>PHL</sub> |              |             | 2  | 7.1 | 8.8  | 2                                 | 10.6 | 2                              | 10   |     |
| t <sub>PZH</sub> | OE           | Q           | 1  | 8.3 | 10.1 | 1                                 | 12.7 | 1                              | 12.3 | ns  |
| t <sub>PZL</sub> |              |             | 1  | 8.6 | 10.6 | 1                                 | 13   | 1                              | 12.7 |     |
| t <sub>PHZ</sub> | OE           | Q           | 1  | 4.7 | 6.3  | 1                                 | 7.1  | 1                              | 6.8  | ns  |
| t <sub>PLZ</sub> |              |             | 1  | 4.8 | 6.3  | 1                                 | 7.5  | 1                              | 6.8  |     |

- (1) V<sub>CC</sub> = 5 V, C<sub>L</sub> = 50 pF, R<sub>1</sub> = 500 Ω, R<sub>2</sub> = 500 Ω, T<sub>A</sub> = 25°C, applies to all SN54BCT374 and SN74BCT374 devices
- (2) V<sub>CC</sub> = 4.5 V to 5.5 V, C<sub>L</sub> = 50 pF, R<sub>1</sub> = 500 Ω, R<sub>2</sub> = 500 Ω
- (3) Applies to SN54BCT374 devices only
- (4) Applies to SN74BCT374 devices only

## 6.8 Typical Characteristics

T<sub>A</sub> = 25°C

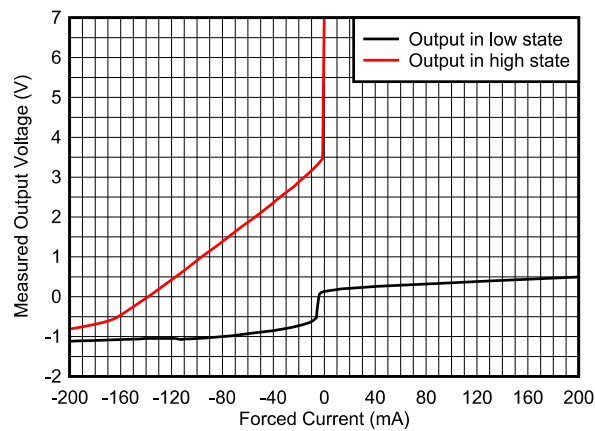
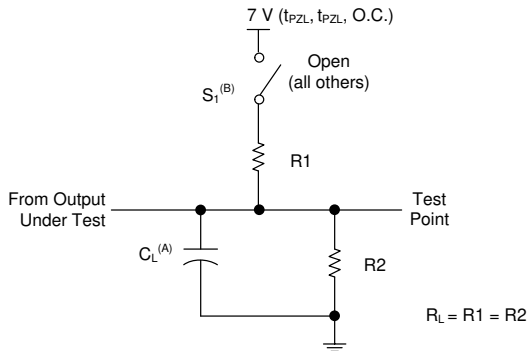


图 6-1. Typical output voltage versus output current for BCT family drivers

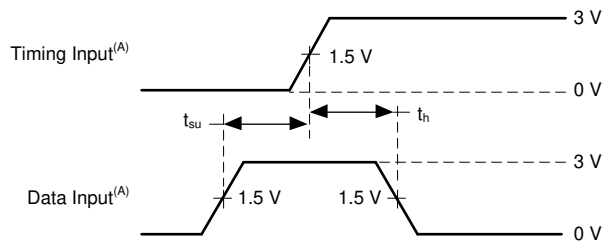
## 7 Parameter Measurement Information

All parameters and waveforms are not applicable to all devices.



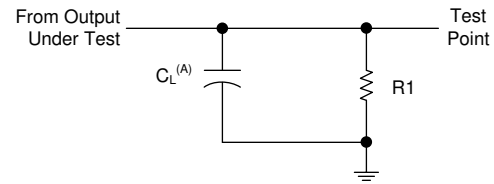
- A.  $C_L$  includes probe and jig capacitance.
- B. When measuring propagation delay times of 3-state outputs, switch  $S_1$  is open.

**图 7-1. Load circuit for 3-state and open-collector outputs**



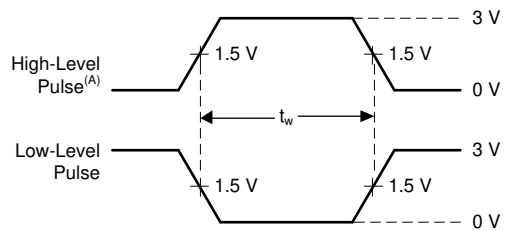
- A. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10$  MHz,  $t_r = t_f \leq 2.5$  ns, duty cycle = 50%.

**图 7-3. Voltage waveforms Setup and hold times**



- A.  $C_L$  includes probe and jig capacitance.

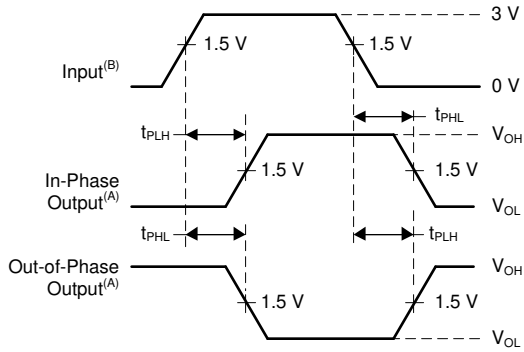
**图 7-2. Load circuit for push-pull outputs**



- A. 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%.

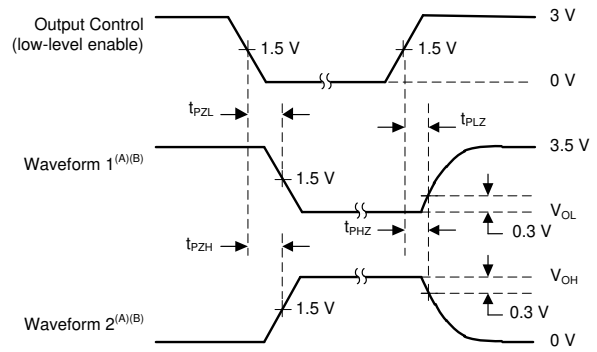
**图 7-4. Voltage waveforms Pulse duration**





- A. The outputs are measured one at a time with one transition per measurement.
- B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $t_r = t_f \leq 2.5 \text{ ns}$ , duty cycle = 50%.

**图 7-5. Voltage waveforms  
Propagation delay times**



- A. The outputs are measured one at a time with one transition per measurement.
- 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.

**图 7-6. Voltage waveforms  
Enable and disable times, 3-state outputs**

## 8 Detailed Description

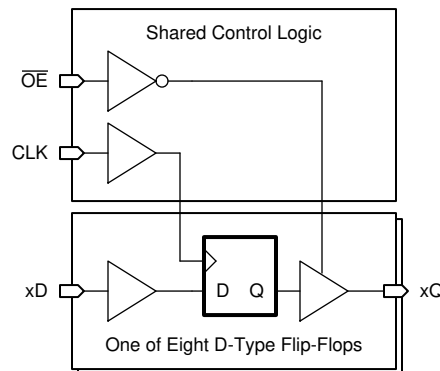
### 8.1 Overview

These 8-bit flip-flops feature 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. They are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

The eight flip-flops of the SNx4BCT374 devices are edge-triggered D-type flip-flops. On the positive transition of the clock (CLK) input, the Q outputs are set to the logic levels that were set up at the data (D) inputs.

A buffered output-enable ( $\overline{OE}$ ) input can be used to place the eight outputs in either a normal logic state (high or low) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and the increased drive provide the capability to drive bus lines without need for interface or pullup components. The output-enable ( $\overline{OE}$ ) input does not affect internal operations of the flip-flop. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

### 8.2 Functional Block Diagram



### 8.3 Feature Description

#### 8.3.1 Bipolar Push-Pull Outputs

This device includes bipolar push-pull outputs. The drive capability of this device may create fast edges into light loads, so routing and load conditions should be considered to prevent ringing. Additionally, the outputs of this device are capable of driving larger currents than the device can sustain without being damaged. It is important for the output power of the device to be limited to avoid damage due to overcurrent. The electrical and thermal limits defined in the *Absolute Maximum Ratings* must be followed at all times.

Unused bipolar push-pull outputs should be left disconnected.

#### 8.3.2 Standard CMOS Inputs

This device includes standard CMOS inputs. Standard CMOS inputs are high impedance and are typically modeled as a resistor in parallel with the input capacitance given in the *Electrical Characteristics*. The worst case resistance is calculated with the maximum input voltage, given in the *Absolute Maximum Ratings*, and the maximum input leakage current, given in the *Electrical Characteristics*, using Ohm's law ( $R = V \div I$ ).

Standard CMOS inputs require that input signals transition between valid logic states quickly, as defined by the input transition time or rate in the *Recommended Operating Conditions* table. Failing to meet this specification will result in excessive power consumption and could cause oscillations. More details can be found in [Implications of Slow or Floating CMOS Inputs](#).

Do not leave standard CMOS inputs floating at any time during operation. Unused inputs must be terminated at  $V_{CC}$  or GND. If a system will not be actively driving an input at all times, a pull-up or pull-down resistor can be added to provide a valid input voltage during these times. The resistor value will depend on multiple factors, however a 10-k $\Omega$  resistor is recommended and will typically meet all requirements.

### 8.3.3 Clamp Diode Structure

The inputs and outputs to this device have negative clamping diodes only as depicted in 图 8-1.

**CAUTION**

Voltages beyond the values specified in the *Absolute Maximum Ratings* table can cause damage to the device. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

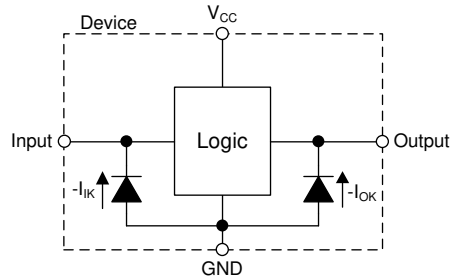


图 8-1. Electrical Placement of Clamping Diodes for Each Input and Output

### 8.4 Device Functional Modes

The *Function Table* below lists the functional modes of the SNx4BCT374.

表 8-1. Function Table

| INPUTS <sup>(1)</sup> |        |   | OUTPUT <sup>(2)</sup> |
|-----------------------|--------|---|-----------------------|
| OE                    | CLK    | D | Q                     |
| L                     | ↑      | H | H                     |
| L                     | ↑      | L | L                     |
| L                     | H or L | X | Q <sub>0</sub>        |
| H                     | X      | X | Z                     |

- (1) L = Low input, H = High input, ↑ = Low to high transition, X = Do not care.  
 (2) L = Low output, H = High output, Q<sub>0</sub> = Previous state, Z = High impedance.

## 9 Application and Implementation

### Note

以下应用部分中的信息不属于 TI 器件规格的范围，TI 不担保其准确性和完整性。TI 的客户应负责确定器件是否适用于其应用。客户应验证并测试其设计，以确保系统功能。

### 9.1 Application Information

The SNx4BCT374 contains multiple D-type flip-flops that are operated by the same clock. By connecting multiple channels together in series, a shift register can be formed. This produces a delay of a specific number of clock cycles for incoming data. The application schematic shown below gives an example of using three channels of the SNx4BCT374 to produce a delay of three clock cycles.

### 9.2 Typical Application

#### 9.2.1 Application

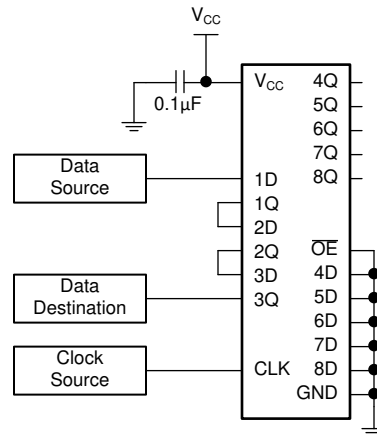


图 9-1. Typical application block diagram

#### 9.2.2 Design Requirements

##### 9.2.2.1 Power Considerations

Ensure the desired supply voltage is within the range specified in the *Recommended Operating Conditions*. The supply voltage sets the device's electrical characteristics as described in the *Electrical Characteristics*.

The positive voltage supply must be capable of sourcing current equal to the total current to be sourced by all outputs of the SNx4BCT374 plus the maximum static supply current,  $I_{CC}$ , listed in *Electrical Characteristics* and any transient current required for switching. The logic device can only source as much current as is provided by the positive supply source.

The ground must be capable of sinking current equal to the total current to be sunk by all outputs of the SNx4BCT374 plus the maximum supply current,  $I_{CC}$ , listed in *Electrical Characteristics*, and any transient current required for switching. The logic device can only sink as much current as can be sunk into its ground connection.

The SNx4BCT374 can drive a load with a total capacitance less than or equal to 50 pF while still meeting all of the datasheet specifications. Larger capacitive loads can be applied, however it is not recommended to exceed 50 pF.

The SNx4BCT374 can drive a load with total resistance described by  $R_L \geq V_O / I_O$ , with the output voltage and current defined in the *Electrical Characteristics* table with  $V_{OH}$  and  $V_{OL}$ . When outputting in the high state, the output voltage in the equation is defined as the difference between the measured output voltage and the supply voltage at the  $V_{CC}$  pin.

Thermal increase can be calculated using the information provided in [Thermal Characteristics of Standard Linear and Logic \(SLL\) Packages and Devices](#).

### 9.2.2.2 Output Considerations

The positive supply voltage is used to produce the output high voltage. Drawing current from the output will decrease the output voltage as specified by the  $V_{OH}$  specification in the *Electrical Characteristics*. The ground voltage is used to produce the output low voltage. Sinking current into the output will increase the output voltage as specified by the  $V_{OL}$  specification in the *Electrical Characteristics*.

Push-pull bipolar outputs should never be connected directly together. This can cause excessive current and damage to the device.

Unused outputs can be left floating. Do not connect outputs directly to  $V_{CC}$  or ground.

Refer to *Feature Description* section for additional information regarding the outputs for this device.

### 9.2.2.3 Input Considerations

Input signals must cross  $V_{IL(max)}$  to be considered a logic low, and  $V_{IH(min)}$  to be considered a logic high. Do not exceed the maximum input voltage range found in the *Absolute Maximum Ratings*.

Unused inputs must be terminated to either  $V_{CC}$  or ground. These can be directly connected if the input is completely unused, or they can be connected with a pull-up or pull-down resistor if the input is to be used sometimes, but not always. A pull-up resistor is used for a default state of high, and a pull-down resistor is used for a default state of low. The resistor size is limited by drive current of the controller, leakage current into the SNx4BCT374, as specified in the *Electrical Characteristics*, and the desired input transition rate. A 10-k $\Omega$  resistor value is often used due to these factors.

The SNx4BCT374 has CMOS inputs and thus requires fast input transitions to operate correctly. Slow input transitions can cause oscillations, additional power consumption, and reduction in device reliability.

Refer to the *Feature Description* section for additional information regarding the inputs for this device.

### 9.2.3 Detailed Design Procedure

1. Add a decoupling capacitor from  $V_{CC}$  to GND. The capacitor needs to be placed physically close to the SNx4BCT374 and electrically close to both the  $V_{CC}$  and GND pins. An example layout is shown in the *Layout* section.
2. Ensure the capacitive load at the output is  $\leq 50$  pF. This is not a hard limit, however it will ensure optimal performance. This can be accomplished by providing short, appropriately sized traces from the SNx4BCT374 to the receiving device(s).
3. Ensure the resistive load at the output is larger than  $(V_{CC} / I_{O(max)}) \Omega$ . This will ensure that the maximum output current from the *Absolute Maximum Ratings* is not violated. Most CMOS inputs have a resistive load measured in megaohms; much larger than the minimum calculated above.
4. Thermal issues are rarely a concern for logic gates, however the power consumption and thermal increase can be calculated using the steps provided in the application report, [CMOS Power Consumption and Cpd Calculation](#).
5. This device includes D-type flip-flop circuits. The output of these circuits is unknown at system startup. Data must be clocked into each D-type flip-flop to initialize it into a known state.

### 9.2.4 Application Curves

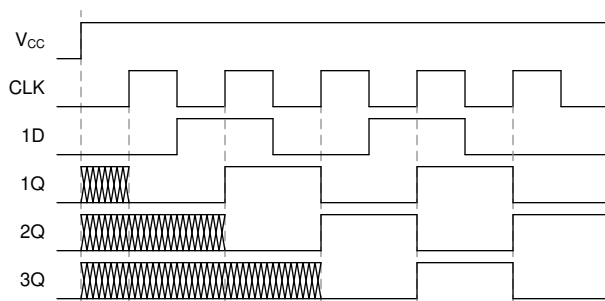


图 9-2. Application timing diagram

## 10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the *Recommended Operating Conditions*. Each  $V_{CC}$  terminal should have a good bypass capacitor to prevent power disturbance. A 0.1- $\mu$ F capacitor is recommended for this device. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. The 0.1- $\mu$ F and 1- $\mu$ F capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results, as shown in given example layout image.

## 11 Layout

### 11.1 Layout Guidelines

When using multiple-input and multiple-channel logic devices inputs must not ever be left floating. In many cases, functions or parts of functions of digital logic devices are unused; for example, when only two inputs of a triple-input AND gate are used or only 3 of the 4 buffer gates are used. Such unused input pins must not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. All unused inputs of digital logic devices must be connected to a logic high or logic low voltage, as defined by the input voltage specifications, to prevent them from floating. The logic level that must be applied to any particular unused input depends on the function of the device. Generally, the inputs are tied to GND or  $V_{CC}$ , whichever makes more sense for the logic function or is more convenient.

### 11.2 Layout Example

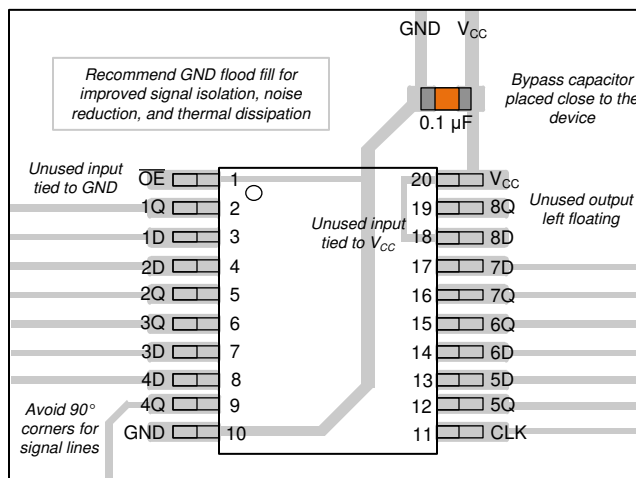


图 11-1. Example layout for the SN74BCT374.

## 12 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

### 12.1 Documentation Support

#### 12.1.1 Related Documentation

For related documentation see the following:

- Texas Instruments, [Designing With Logic application report](#)
- Texas Instruments, [Input and Output Characteristics of Digital Integrated Circuits application report](#)
- Texas Instruments, [Implications of Slow or Floating CMOS Inputs application report](#)
- Texas Instruments, [Understanding and Interpreting Standard-Logic Data Sheets application report](#)

### 12.2 接收文档更新通知

要接收文档更新通知，请导航至 [ti.com](http://ti.com) 上的器件产品文件夹。点击 [订阅更新](#) 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

### 12.3 支持资源

[TI E2E™ 支持论坛](#) 是工程师的重要参考资料，可直接从专家获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题可获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的 [《使用条款》](#)。

### 12.4 Trademarks

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### 12.5 静电放电警告



静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

### 12.6 术语表

[TI 术语表](#) 本术语表列出并解释了术语、首字母缩略词和定义。

## 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**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                 |
|------------------|---------------|--------------|-----------------|------|-------------|------------------|--------------------------------------|----------------------|--------------|-------------------------------------|-------------------------|
| 5962-9051601M2A  | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-9051601M2A<br>SNJ54BCT374FK    | <a href="#">Samples</a> |
| 5962-9051601MRA  | ACTIVE        | CDIP         | J               | 20   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-9051601MR<br>A<br>SNJ54BCT374J | <a href="#">Samples</a> |
| 5962-9051601MSA  | ACTIVE        | CFP          | W               | 20   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-9051601MS<br>A<br>SNJ54BCT374W | <a href="#">Samples</a> |
| SN74BCT374DW     | ACTIVE        | SOIC         | DW              | 20   | 25          | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | BCT374                              | <a href="#">Samples</a> |
| SN74BCT374N      | ACTIVE        | PDIP         | N               | 20   | 20          | RoHS & Non-Green | NIPDAU                               | N / A for Pkg Type   | 0 to 70      | SN74BCT374N                         | <a href="#">Samples</a> |
| SN74BCT374NSR    | ACTIVE        | SO           | NS              | 20   | 2000        | RoHS & Green     | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | BCT374                              | <a href="#">Samples</a> |
| SNJ54BCT374FK    | ACTIVE        | LCCC         | FK              | 20   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-9051601M2A<br>SNJ54BCT374FK    | <a href="#">Samples</a> |
| SNJ54BCT374J     | ACTIVE        | CDIP         | J               | 20   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-9051601MR<br>A<br>SNJ54BCT374J | <a href="#">Samples</a> |
| SNJ54BCT374W     | ACTIVE        | CFP          | W               | 20   | 1           | Non-RoHS & Green | SNPB                                 | N / A for Pkg Type   | -55 to 125   | 5962-9051601MS<br>A<br>SNJ54BCT374W | <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.

**OBSELETE:** 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  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm 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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**OTHER QUALIFIED VERSIONS OF SN54BCT374, SN74BCT374 :**

● Catalog : [SN74BCT374](#)

● Military : [SN54BCT374](#)

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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74BCT374NSR | SO           | NS              | 20   | 2000 | 330.0              | 24.4               | 8.4     | 13.0    | 2.5     | 12.0    | 24.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74BCT374NSR | SO           | NS              | 20   | 2000 | 367.0       | 367.0      | 45.0        |

**TUBE**


\*All dimensions are nominal

| Device          | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 5962-9051601M2A | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |
| 5962-9051601MSA | W            | CFP          | 20   | 1   | 506.98 | 26.16  | 6220   | NA     |
| SN74BCT374DW    | DW           | SOIC         | 20   | 25  | 507    | 12.83  | 5080   | 6.6    |
| SN74BCT374N     | N            | PDIP         | 20   | 20  | 506    | 13.97  | 11230  | 4.32   |
| SNJ54BCT374FK   | FK           | LCCC         | 20   | 1   | 506.98 | 12.06  | 2030   | NA     |
| SNJ54BCT374W    | W            | CFP          | 20   | 1   | 506.98 | 26.16  | 6220   | NA     |

W (R-GDFP-F20)

CERAMIC DUAL FLATPACK



4040180-4/F 04/14

- 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-F20

# 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.

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.



# DW0020A



# PACKAGE OUTLINE

## SOIC - 2.65 mm max height

SOIC



4220724/A 05/2016

**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 0.43 mm per side.
5. Reference JEDEC registration MS-013.

# EXAMPLE BOARD LAYOUT

DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

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

# EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:6X

4220724/A 05/2016

NOTES: (continued)

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

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