



# SN74LS05

## Hex Inverter with Open-drain outputs

### Product Specification

#### Specification Revision History:

| Version    | Date    | Description         |
|------------|---------|---------------------|
| 2012-06-A1 | 2012-06 | New                 |
| 2023-04-B1 | 2023-04 | Update the template |
|            |         |                     |
|            |         |                     |



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## 1、General Description

The SN74LS05 contains six inverters. The outputs of the SN74LS05 are open-drain and can be connected to other open-drain outputs to implement active-LOW wired-OR or active-HIGH wired-AND functions. The open-drain outputs require pull-up resistors to perform correctly.

### Features:

- Latch-up performance exceeds 100 mA per JESD 78 Class II level A
- Specified from -40°C to +125°C
- Packaging information: DIP14/SOP14/TSSOP14

### Ordering Information:

#### Tube packing specifications:

| Part number | Packaging form | Marking code | Tube quantity  | Boxed tube quantity | Boxed quantity   | Notes  |
|-------------|----------------|--------------|----------------|---------------------|------------------|--|
| SN74LS05N   | DIP14          | SN74LS05N    | 25<br>PCS/tube | 40<br>tube/box      | 1000<br>PCS/box  | Dimensions of plastic enclosure:<br>19.0mm×6.4mm<br>Pin spacing:<br>2.54mm |
| SN74LS05DR  | SOP14          | LS05         | 50<br>PCS/tube | 200<br>tube/box     | 10000<br>PCS/box | Dimensions of plastic enclosure:<br>8.7mm×3.9mm<br>Pin spacing:<br>1.27mm  |
| SN74LS05PW  | TSSOP14        | LS05         | 96<br>PCS/tube | 200<br>tube/box     | 19200<br>PCS/box | Dimensions of plastic enclosure:<br>5.0mm×4.4mm<br>Pin spacing:<br>0.65mm  |



**Reel packing specifications:**

| Part number | Packaging form | Marking code | Reel quantity    | Boxed reel quantity | Notes   |
|-------------|----------------|--------------|------------------|---------------------|---|
| SN74LS05DR  | SOP14          | LS05         | 2500<br>PCS/reel | 5000<br>PCS/box     | Dimensions of plastic enclosure:<br>8.7mm×3.9mm<br>Pin spacing:           |
| SN74LS05PW  | TSSOP14        | LS05         | 5000<br>PCS/reel | 10000<br>PCS/box    | Dimensions of plastic enclosure:<br>5.0mm×4.4mm<br>Pin spacing:<br>0.65mm |

Note: If the physical information is inconsistent with the ordering information, please refer to the actual product.



## 2、Block Diagram And Pin Description

### 2.1、Block Diagram

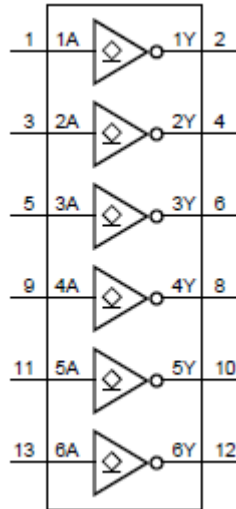


Figure 1. Logic symbol

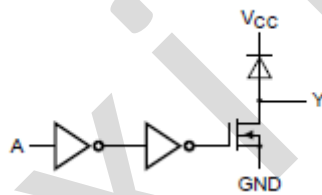
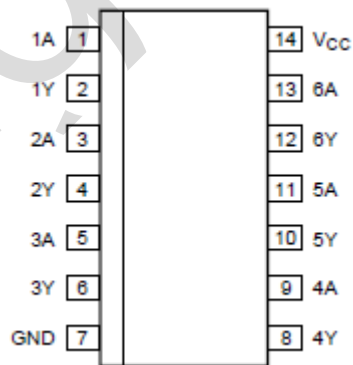


Figure 2. Logic diagram (one gate)

### 2.2、Pin Configurations





### 2.3、Pin Description

| Pin No. | Pin Name        | Description    |
|---------|-----------------|----------------|
| 1       | 1A              | data input     |
| 2       | 1Y              | data output    |
| 3       | 2A              | data input     |
| 4       | 2Y              | data output    |
| 5       | 3A              | data input     |
| 6       | 3Y              | data output    |
| 7       | GND             | ground (0V)    |
| 8       | 4Y              | data output    |
| 9       | 4A              | data input     |
| 10      | 5Y              | data output    |
| 11      | 5A              | data input     |
| 12      | 6Y              | data output    |
| 13      | 6A              | data input     |
| 14      | V <sub>CC</sub> | supply voltage |

### 2.4、Function Table

| Input | Output |
|-------|--------|
| nA    | nY     |
| L     | Z      |
| H     | L      |

Note: H=HIGH voltage level; L=LOW voltage level; Z=high-impedance OFF-state.

## 3、Electrical Parameter

### 3.1、Absolute Maximum Ratings

(Voltages are referenced to GND (ground=0V), unless otherwise specified.)

| Parameter               | Symbol           | Conditions   | Min.      | Max. | Unit |
|-------------------------|------------------|--|-----------|------|------|
| supply voltage          | V <sub>CC</sub>  | -  | -0.5      | +7.0 | V    |
| output voltage          | V <sub>O</sub>   | -  | -0.5      | +7.0 | V    |
| input clamping current  | I <sub>IK</sub>  | V <sub>I</sub> <-0.5V or V <sub>I</sub> >V <sub>CC</sub> +0.5V | -         | ±20  | mA   |
| output clamping current | I <sub>OK</sub>  | V <sub>O</sub> <-0.5V  | -         | -20  | mA   |
| output current          | I <sub>O</sub>   | -0.5V<V <sub>O</sub>   | -         | -25  | mA   |
| supply current          | I <sub>CC</sub>  | -  | -         | +50  | mA   |
| ground current          | I <sub>GND</sub> | -  | -50       | -    | mA   |
| storage temperature     | T <sub>stg</sub> | -  | -65       | +150 | °C   |
| total power dissipation | P <sub>tot</sub> | -  | -         | 500  | mW   |
| soldering temperature   | T <sub>L</sub>   | 10s  | DIP       | 245  | °C   |
|                         |                  |  | SOP/TSSOP | 260  |      |



### 3.2、Recommended Operating Conditions

| Parameter                           | Symbol              | Conditions    | Min. | Typ. | Max.     | Unit |
|-------------------------------------|---------------------|---------------|------|------|----------|------|
| supply voltage                      | $V_{CC}$            | -             | 2.0  | 5.0  | 6.0      | V    |
| input voltage                       | $V_I$               | -             | 0    | -    | $V_{CC}$ | V    |
| output voltage                      | $V_O$               | -             | 0    | -    | $V_{CC}$ | V    |
| input transition rise and fall rate | $\Delta t/\Delta V$ | $V_{CC}=2.0V$ | -    | -    | 625      | ns/V |
|                                     |                     | $V_{CC}=4.5V$ | -    | 1.67 | 139      | ns/V |
|                                     |                     | $V_{CC}=6.0V$ | -    | -    | 83       | ns/V |
| ambient temperature                 | $T_{amb}$           | -             | -40  | -    | +125     | °C   |

### 3.3、Electrical Characteristics

#### 3.3.1、DC Characteristics 1

( $T_{amb}=25^{\circ}C$ , voltages are referenced to GND (ground=0V), unless otherwise specified.)

| Parameter                | Symbol   | Conditions   | Min                        | Typ | Max       | Unit    |   |
|--------------------------|----------|--|----------------------------|-----|-----------|---------|---|
| HIGH-level input voltage | $V_{IH}$ | $V_{CC}=2.0V$  | 1.5                        | 1.2 | -         | V       |   |
|                          |          | $V_{CC}=4.5V$  | 3.15                       | 2.4 | -         | V       |   |
|                          |          | $V_{CC}=6.0V$  | 4.2                        | 3.2 | -         | V       |   |
| LOW-level input voltage  | $V_{IL}$ | $V_{CC}=2.0V$  | -                          | 0.8 | 0.5       | V       |   |
|                          |          | $V_{CC}=4.5V$  | -                          | 2.1 | 1.35      | V       |   |
|                          |          | $V_{CC}=6.0V$  | -                          | 2.8 | 1.8       | V       |   |
| LOW-level output voltage | $V_{OL}$ | $V_I=V_{IH}$ or $V_{IL}$   | $I_O=20\mu A; V_{CC}=2.0V$ | -   | 0         | 0.1     | V |
|                          |          |  | $I_O=20\mu A; V_{CC}=4.5V$ | -   | 0         | 0.1     | V |
|                          |          |  | $I_O=20\mu A; V_{CC}=6.0V$ | -   | 0         | 0.1     | V |
|                          |          |  | $I_O=4.0mA; V_{CC}=4.5V$   | -   | 0.15      | 0.26    | V |
|                          |          |  | $I_O=5.2mA; V_{CC}=6.0V$   | -   | 0.16      | 0.26    | V |
| input leakage current    | $I_I$    | $V_I=V_{CC}$ or GND; $V_{CC}=6.0V$   | -                          | -   | $\pm 1.0$ | $\mu A$ |   |
| OFF-state output current | $I_{OZ}$ | per input pin; $V_I=V_{IL}; V_O=V_{CC}$ or GND; other inputs at $V_{CC}$ or GND; $V_{CC}=6.0V; I_O=0A$ | -                          | -   | $\pm 1.0$ | $\mu A$ |   |
| supply current           | $I_{CC}$ | $V_I=V_{CC}$ or GND; $I_O=0A; V_{CC}=6.0V$   | -                          | -   | 2         | $\mu A$ |   |
| input capacitance        | $C_I$    | -  | -                          | 3.5 | -         | pF      |   |



### 3.3.2、DC Characteristics 2

( $T_{amb} = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , voltages are referenced to GND (ground=0V), unless otherwise specified.)

| Parameter                | Symbol   | Conditions   | Min.                                    | Typ. | Max.      | Unit          |   |
|--------------------------|----------|--|---|------|-----------|---------------|---|
| HIGH-level input voltage | $V_{IH}$ | $V_{CC}=2.0\text{V}$   | 1.5                                     | -    | -         | V             |   |
|                          |          | $V_{CC}=4.5\text{V}$   | 3.15                                    | -    | -         | V             |   |
|                          |          | $V_{CC}=6.0\text{V}$   | 4.2                                     | -    | -         | V             |   |
| LOW-level input voltage  | $V_{IL}$ | $V_{CC}=2.0\text{V}$   | -                                       | -    | 0.5       | V             |   |
|                          |          | $V_{CC}=4.5\text{V}$   | -                                       | -    | 1.35      | V             |   |
|                          |          | $V_{CC}=6.0\text{V}$   | -                                       | -    | 1.8       | V             |   |
| LOW-level output voltage | $V_{OL}$ | $V_I = V_{IH}$ or $V_{IL}$   | $I_O=20\mu\text{A}; V_{CC}=2.0\text{V}$ | -    | -         | 0.1           | V |
|                          |          |  | $I_O=20\mu\text{A}; V_{CC}=4.5\text{V}$ | -    | -         | 0.1           | V |
|                          |          |  | $I_O=20\mu\text{A}; V_{CC}=6.0\text{V}$ | -    | -         | 0.1           | V |
|                          |          |  | $I_O=4.0\text{mA}; V_{CC}=4.5\text{V}$  | -    | -         | 0.33          | V |
|                          |          |  | $I_O=5.2\text{mA}; V_{CC}=6.0\text{V}$  | -    | -         | 0.33          | V |
| input leakage current    | $I_I$    | $V_I = V_{CC}$ or GND; $V_{CC}=6.0\text{V}$  | -                                       | -    | $\pm 1.0$ | $\mu\text{A}$ |   |
| OFF-state output current | $I_{OZ}$ | per input pin; $V_I = V_{IL}$ ; $V_O = V_{CC}$ or GND; other inputs at $V_{CC}$ or GND; $V_{CC}=6.0\text{V}$ ; $I_O=0\text{A}$ | -                                       | -    | $\pm 5.0$ | $\mu\text{A}$ |   |
| supply current           | $I_{CC}$ | $V_I = V_{CC}$ or GND; $I_O=0\text{A}$ ; $V_{CC}=6.0\text{V}$  | -                                       | -    | 20        | $\mu\text{A}$ |   |





### 3.3.3、DC Characteristics 3

( $T_{amb} = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ , voltages are referenced to GND (ground=0V), unless otherwise specified.)

| Parameter                | Symbol   | Conditions   | Min.                                    | Typ. | Max.      | Unit          |   |
|--------------------------|----------|--|---|------|-----------|---------------|---|
| HIGH-level input voltage | $V_{IH}$ | $V_{CC}=2.0\text{V}$   | 1.5                                     | -    | -         | V             |   |
|                          |          | $V_{CC}=4.5\text{V}$   | 3.15                                    | -    | -         | V             |   |
|                          |          | $V_{CC}=6.0\text{V}$   | 4.2                                     | -    | -         | V             |   |
| LOW-level input voltage  | $V_{IL}$ | $V_{CC}=2.0\text{V}$   | -                                       | -    | 0.5       | V             |   |
|                          |          | $V_{CC}=4.5\text{V}$   | -                                       | -    | 1.35      | V             |   |
|                          |          | $V_{CC}=6.0\text{V}$   | -                                       | -    | 1.8       | V             |   |
| LOW-level output voltage | $V_{OL}$ | $V_I = V_{IH}$ or $V_{IL}$   | $I_O=20\mu\text{A}; V_{CC}=2.0\text{V}$ | -    | -         | 0.1           | V |
|                          |          |  | $I_O=20\mu\text{A}; V_{CC}=4.5\text{V}$ | -    | -         | 0.1           | V |
|                          |          |  | $I_O=20\mu\text{A}; V_{CC}=6.0\text{V}$ | -    | -         | 0.1           | V |
|                          |          |  | $I_O=4.0\text{mA}; V_{CC}=4.5\text{V}$  | -    | -         | 0.4           | V |
|                          |          |  | $I_O=5.2\text{mA}; V_{CC}=6.0\text{V}$  | -    | -         | 0.4           | V |
| input leakage current    | $I_I$    | $V_I = V_{CC}$ or GND; $V_{CC}=6.0\text{V}$  | -                                       | -    | $\pm 1.0$ | $\mu\text{A}$ |   |
| OFF-state output current | $I_{OZ}$ | per input pin; $V_I = V_{IL}$ ; $V_O = V_{CC}$ or GND; other inputs at $V_{CC}$ or GND; $V_{CC}=6.0\text{V}$ ; $I_O=0\text{A}$ | -                                       | -    | $\pm 10$  | $\mu\text{A}$ |   |
| supply current           | $I_{CC}$ | $V_I = V_{CC}$ or GND; $I_O=0\text{A}$ ; $V_{CC}=6.0\text{V}$  | -                                       | -    | 40        | $\mu\text{A}$ |   |



### 3.3.4、AC Characteristics 1

( $T_{amb}=25^{\circ}\text{C}$ ,  $\text{GND}=0\text{V}$ ,  $C_L=50\text{pF}$ , unless otherwise specified.)

| Parameter                     | Symbol   | Conditions   | Min.                                  | Typ. | Max. | Unit |    |
|-------------------------------|----------|--|---------------------------------------|------|------|------|----|
| nA to nY propagation delay    | $t_{pd}$ | see Figure 4 <sup>[1]</sup>                                | $V_{CC}=2.0\text{V}$                  | -    | 28   | 95   | ns |
|                               |          |  | $V_{CC}=4.5\text{V}$                  | -    | 10   | 19   | ns |
|                               |          |  | $V_{CC}=5.0\text{V}; C_L=15\text{pF}$ | -    | 8    | -    | ns |
|                               |          |  | $V_{CC}=6.0\text{V}$                  | -    | 8    | 16   | ns |
| transition time               | $t_t$    | see Figure 4 <sup>[2]</sup>                                | $V_{CC}=2.0\text{V}$                  | -    | 19   | 75   | ns |
|                               |          |  | $V_{CC}=4.5\text{V}$                  | -    | 7    | 15   | ns |
|                               |          |  | $V_{CC}=6.0\text{V}$                  | -    | 6    | 13   | ns |
| power dissipation capacitance | $C_{PD}$ | per package;<br>$V_I=\text{GND to } V_{CC}$ <sup>[3]</sup> | -                                     | 4    | -    | pF   |    |

Note:

[1]  $t_{pd}$  is the same as  $t_{PLZ}$  and  $t_{PZL}$ .

[2]  $t_t$  is the same as  $t_{THL}$ .

[3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in uW).

$P_D=C_{PD}\times V_{CC}^2\times f_i\times N+\sum(C_L\times V_{CC}^2\times f_o)$  where:

$f_i$ =input frequency in MHz;  $f_o$ =output frequency in MHz;

$C_L$ =output load capacitance in pF;

$V_{CC}$ =supply voltage in V;

$N$ =number of inputs switching;

$\sum(C_L\times V_{CC}^2\times f_o)$ =sum of outputs.



### 3.3.5、AC Characteristics 2

( $T_{amb} = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $GND = 0\text{V}$ ,  $C_L = 50\text{pF}$ , unless otherwise specified.)

| Parameter                  | Symbol   | Conditions                  | Min.                   | Typ. | Max. | Unit |    |
|----------------------------|----------|-----------------------------|------------------------|------|------|------|----|
| nA to nY propagation delay | $t_{pd}$ | see Figure 4 <sup>[1]</sup> | $V_{CC} = 2.0\text{V}$ | -    | -    | 120  | ns |
|                            |          |                             | $V_{CC} = 4.5\text{V}$ | -    | -    | 24   | ns |
|                            |          |                             | $V_{CC} = 6.0\text{V}$ | -    | -    | 20   | ns |
| transition time            | $t_t$    | see Figure 4 <sup>[2]</sup> | $V_{CC} = 2.0\text{V}$ | -    | -    | 95   | ns |
|                            |          |                             | $V_{CC} = 4.5\text{V}$ | -    | -    | 19   | ns |
|                            |          |                             | $V_{CC} = 6.0\text{V}$ | -    | -    | 16   | ns |

Note:

[1]  $t_{pd}$  is the same as  $t_{PLZ}$  and  $t_{PZL}$ .

[2]  $t_t$  is the same as  $t_{THL}$ .

### 3.3.6、AC Characteristics 3

( $T_{amb} = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $GND = 0\text{V}$ ,  $C_L = 50\text{pF}$ , unless otherwise specified.)

| Parameter                  | Symbol   | Conditions                  | Min.                   | Typ. | Max. | Unit |    |
|----------------------------|----------|-----------------------------|------------------------|------|------|------|----|
| nA to nY propagation delay | $t_{pd}$ | see Figure 4 <sup>[1]</sup> | $V_{CC} = 2.0\text{V}$ | -    | -    | 145  | ns |
|                            |          |                             | $V_{CC} = 4.5\text{V}$ | -    | -    | 29   | ns |
|                            |          |                             | $V_{CC} = 6.0\text{V}$ | -    | -    | 25   | ns |
| transition time            | $t_t$    | see Figure 4 <sup>[2]</sup> | $V_{CC} = 2.0\text{V}$ | -    | -    | 110  | ns |
|                            |          |                             | $V_{CC} = 4.5\text{V}$ | -    | -    | 22   | ns |
|                            |          |                             | $V_{CC} = 6.0\text{V}$ | -    | -    | 19   | ns |

Note:

[1]  $t_{pd}$  is the same as  $t_{PLZ}$  and  $t_{PZL}$ .

[2]  $t_t$  is the same as  $t_{THL}$ .



## 4、Testing Circuit

### 4.1、AC Testing Circuit

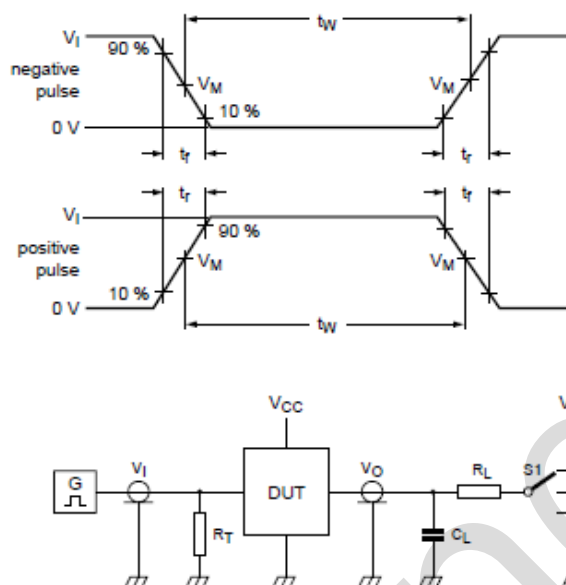


Figure 3. Test circuit for measuring switching times

Definitions for test circuit:

$C_L$ =Load capacitance including jig and probe capacitance.

$R_T$ =Termination resistance should be equal to the output impedance  $Z_o$  of the pulse generator.

$R_L$ =Load resistance.

S1=Test selection switch.

### 4.2、AC Testing Waveforms

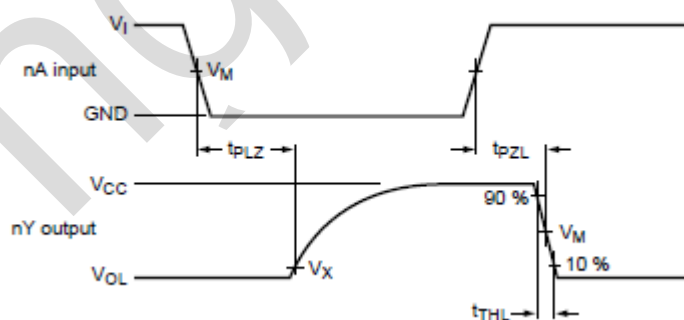


Figure 4. The input nA to output nY propagation delays and output transition times



#### 4.3、Measurement Points

| Input               | Output              |                     |
|---------------------|---------------------|---------------------|
| $V_M$               | $V_M$               | $V_X$               |
| $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ | $0.1 \times V_{CC}$ |

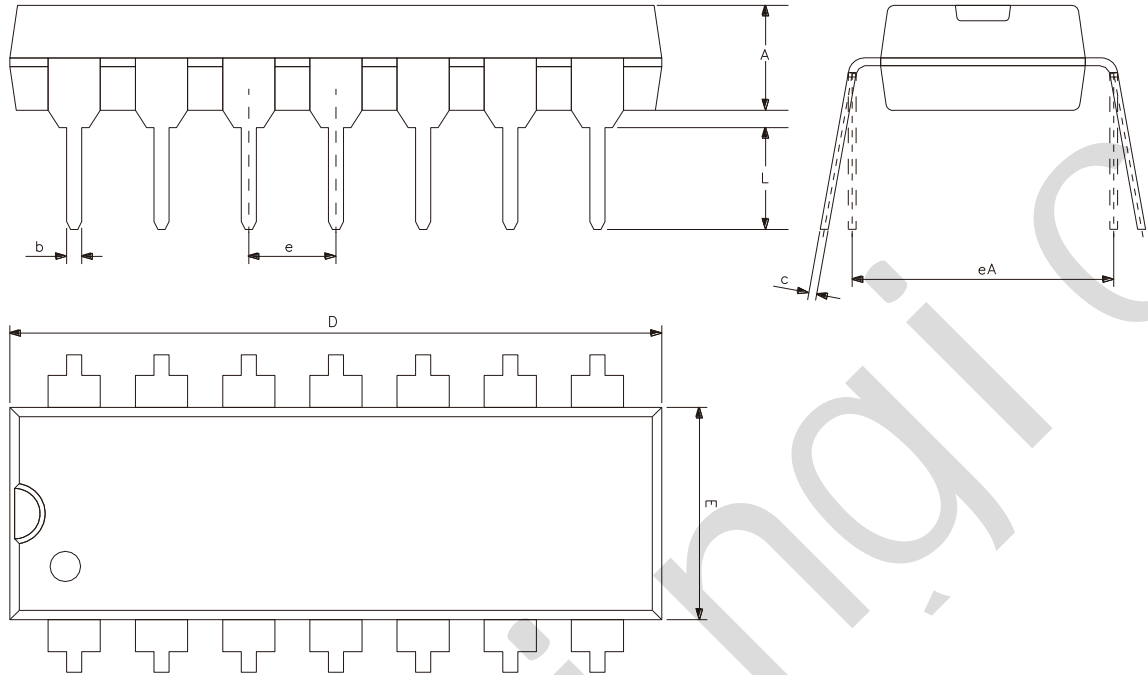
#### 4.4、Test Data

| Input    |            | Load       |             | S1 position        |
|----------|------------|------------|-------------|--------------------|
| $V_I$    | $t_r, t_f$ | $C_L$      | $R_L$       | $t_{PZL}, t_{PLZ}$ |
| $V_{CC}$ | 6ns        | 15pF, 50pF | 1k $\Omega$ | $V_{CC}$           |



## 5、Package Information

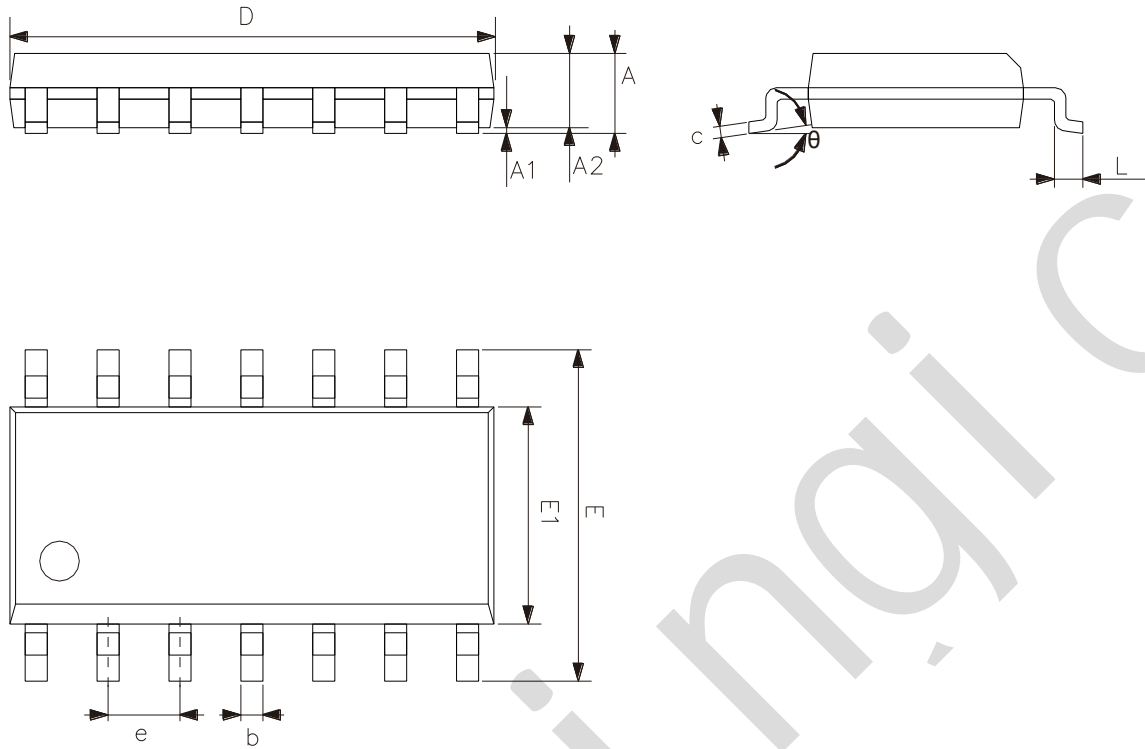
### 5.1、DIP14



| Symbol | Dimensions (mm) |       |
|--------|-----------------|-------|
|        | Min.            | Max.  |
| A      | 3.05            | 3.60  |
| b      | 0.33            | 0.56  |
| c      | 0.20            | 0.36  |
| D      | 18.80           | 19.40 |
| E      | 6.20            | 6.60  |
| e      | 2.54            |       |
| eA     | 7.62            | 10.90 |
| L      | 2.92            | -     |



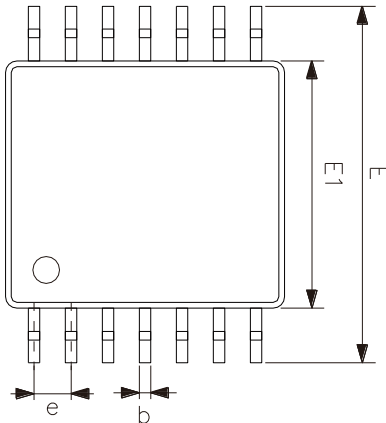
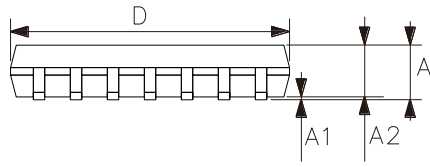
### 5.2、SOP14



| Symbol   | Dimensions (mm) |      |
|----------|-----------------|------|
|          | Min.            | Max. |
| A        | 1.50            | 1.75 |
| A1       | 0.05            | 0.25 |
| A2       | 1.30            | -    |
| b        | 0.33            | 0.50 |
| c        | 0.19            | 0.25 |
| D        | 8.43            | 8.76 |
| E        | 5.80            | 6.25 |
| E1       | 3.75            | 4.00 |
| e        | 1.27            |      |
| L        | 0.40            | 0.89 |
| $\theta$ | 0°              | 8°   |



### 5.3、TSSOP14



| Symbol   | Dimensions (mm) |      |
|----------|-----------------|------|
|          | Min.            | Max. |
| A        | -               | 1.20 |
| A1       | 0.05            | 0.15 |
| A2       | 0.80            | 1.05 |
| b        | 0.19            | 0.30 |
| c        | 0.09            | 0.20 |
| D        | 4.90            | 5.10 |
| E1       | 4.30            | 4.50 |
| E        | 6.20            | 6.60 |
| e        | 0.65            |      |
| L        | 0.45            | 0.75 |
| L1       | 1.00            |      |
| $\theta$ | 0°              | 8°   |





## 6、 Statements And Notes

### 6.1、 The name and content of Hazardous substances or Elements in the product

| Part name               | Hazardous substances or Elements  |                               |                               |                               |                          |                                |                   |                       |                           |                      |
|-------------------------|---|-------------------------------|-------------------------------|-------------------------------|--------------------------|--------------------------------|-------------------|-----------------------|---------------------------|----------------------|
|                         | Lead and lead compounds   | Mercury and mercury compounds | Cadmium and cadmium compounds | Hexavalent chromium compounds | Polybrominated biphenyls | Polybrominated biphenyl ethers | Dibutyl phthalate | Butylbenzyl phthalate | Di-2-ethylhexyl phthalate | Diisobutyl phthalate |
| Lead frame              | ○   | ○                             | ○                             | ○                             | ○                        | ○                              | ○                 | ○                     | ○                         | ○                    |
| Plastic resin           | ○   | ○                             | ○                             | ○                             | ○                        | ○                              | ○                 | ○                     | ○                         | ○                    |
| Chip                    | ○   | ○                             | ○                             | ○                             | ○                        | ○                              | ○                 | ○                     | ○                         | ○                    |
| The lead                | ○   | ○                             | ○                             | ○                             | ○                        | ○                              | ○                 | ○                     | ○                         | ○                    |
| Plastic sheet installed | ○   | ○                             | ○                             | ○                             | ○                        | ○                              | ○                 | ○                     | ○                         | ○                    |
| explanation             | ○: Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard.<br>×: Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements. |                               |                               |                               |                          |                                |                   |                       |                           |                      |

### 6.2、 Notes

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