



# CD4028 (LX) BCD to decimal decoder

## Product Specification

### Specification Revision History:

| Version    | Date    | Description |
|------------|---------|-------------|
| 2023-04-A1 | 2023-04 | New         |
|            |         |             |
|            |         |             |
|            |         |             |



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## 1、General Description

The CD4028 is a 4-bit BCD to decimal decoder, a 4-bit BCD to octal decoder with active LOW enable or an 8-output(Y0 to Y7) inverting demultiplexer.

### Features:

- Supply voltage range:3V to 15V
- Temperature range:-40℃ to +125℃
- Packaging information: DIP16/SOP16/TSSOP16

### Ordering Information:

#### Tube packing specifications:

| Part number   | Packaging form | Marking code | Tube quantity | Boxed tube quantity | Boxed quantity | Notes                                                               |
|---------------|----------------|--------------|---------------|---------------------|----------------|---------------------------------------------------------------------|
| CD4028BE(LX)  | DIP16          | CD4028BE     | 25 PCS/tube   | 40 tube/box         | 1000 PCS/box   | Dimensions of plastic enclosure: 19.0mm×6.4mm<br>Pin spacing:2.54mm |
| CD4028BM(LX)  | SOP16          | CD4028BM     | 50 PCS/tube   | 200 tube/box        | 10000 PCS/box  | Dimensions of plastic enclosure: 10.0mm×3.9mm<br>Pin spacing:1.27mm |
| CD4028BPW(LX) | TSSOP16        | CD4028       | 96 PCS/tube   | 200 tube/box        | 19200 PCS/box  | Dimensions of plastic enclosure: 5.0mm×4.4mm<br>Pin spacing:0.65mm  |

#### Reel packing specifications:

| Part number   | Packaging form | Marking code | Reel quantity | Boxed reel quantity | Notes                                                               |
|---------------|----------------|--------------|---------------|---------------------|---------------------------------------------------------------------|
| CD4028BM(LX)  | SOP16(1)       | CD4028BM     | 2500PCS/reel  | 5000PCS/box         | Dimensions of plastic enclosure: 10.0mm×3.9mm<br>Pin spacing:1.27mm |
| CD4028BM(LX)  | SOP16(2)       | CD4028BM     | 4000PCS/reel  | 8000PCS/box         | Dimensions of plastic enclosure: 10.0mm×3.9mm<br>Pin spacing:1.27mm |
| CD4028BPW(LX) | TSSOP16        | CD4028       | 5000PCS/reel  | 10000PCS/box        | Dimensions of plastic enclosure: 5.0mm×4.4mm<br>Pin spacing: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

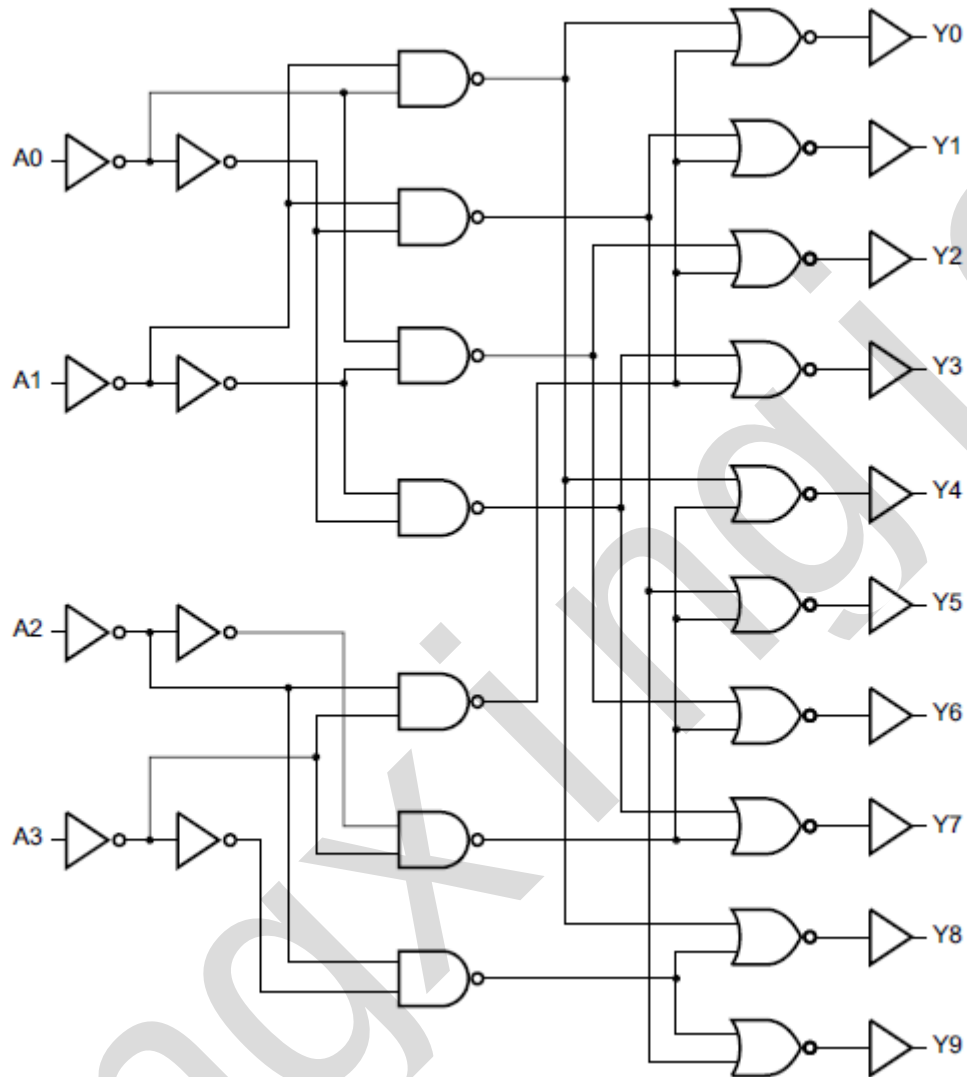
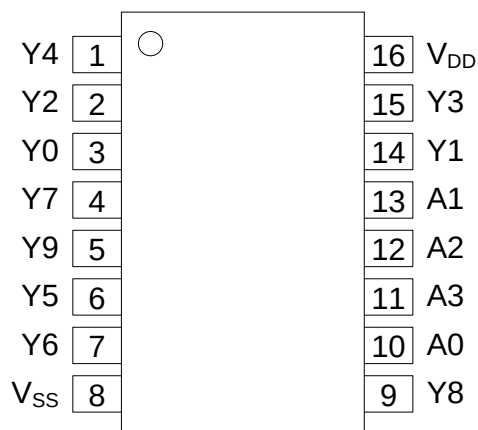


Figure 1. Functional diagram



## 2.2、Pin Configurations



## 2.3、Pin Description

| Pin No. | Pin Name        | Description           |
|---------|-----------------|-----------------------|
| 1       | Y4              | output(active HIGH)   |
| 2       | Y2              | output(active HIGH)   |
| 3       | Y0              | output(active HIGH)   |
| 4       | Y7              | output(active HIGH)   |
| 5       | Y9              | output(active HIGH)   |
| 6       | Y5              | output(active HIGH)   |
| 7       | Y6              | output(active HIGH)   |
| 8       | V <sub>SS</sub> | ground supply voltage |
| 9       | Y8              | output(active HIGH)   |
| 10      | A0              | address input         |
| 11      | A3              | address input         |
| 12      | A2              | address input         |
| 13      | A1              | address input         |
| 14      | Y1              | output(active HIGH)   |
| 15      | Y3              | output(active HIGH)   |
| 16      | V <sub>DD</sub> | supply voltage        |



## 2.4、Function Table

| Input |    |    |    | Output |    |    |    |    |    |    |    |    |    |
|-------|----|----|----|--------|----|----|----|----|----|----|----|----|----|
| A3    | A2 | A1 | A0 | Y0     | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 | Y8 | Y9 |
| L     | L  | L  | L  | H      | L  | L  | L  | L  | L  | L  | L  | L  | L  |
| L     | L  | L  | H  | L      | H  | L  | L  | L  | L  | L  | L  | L  | L  |
| L     | L  | H  | L  | L      | L  | H  | L  | L  | L  | L  | L  | L  | L  |
| L     | L  | H  | H  | L      | L  | L  | H  | L  | L  | L  | L  | L  | L  |
| L     | H  | L  | L  | L      | L  | L  | L  | H  | L  | L  | L  | L  | L  |
| L     | H  | L  | H  | L      | L  | L  | L  | L  | H  | L  | L  | L  | L  |
| L     | H  | H  | L  | L      | L  | L  | L  | L  | L  | H  | L  | L  | L  |
| L     | H  | H  | H  | L      | L  | L  | L  | L  | L  | L  | H  | L  | L  |
| H     | L  | L  | L  | L      | L  | L  | L  | L  | L  | L  | L  | H  | L  |
| H     | L  | L  | H  | L      | L  | L  | L  | L  | L  | L  | L  | L  | H  |
| H     | L  | H  | X  | L      | L  | L  | L  | L  | L  | L  | L  | L  | L  |
| H     | H  | X  | X  | L      | L  | L  | L  | L  | L  | L  | L  | L  | L  |

Note: H=HIGH voltage level; L=LOW voltage level; X=don't care.

## 3、Electrical Parameter

### 3.1、Absolute Maximum Ratings

(Voltages are referenced to  $V_{SS}$  (ground=0V), unless otherwise specified.)

| Parameter             | Symbol    | Conditions    | Min.      | Max.         | Unit |
|-----------------------|-----------|---------------|-----------|--------------|------|
| supply voltage        | $V_{DD}$  | -             | -0.5      | +18          | V    |
| input voltage         | $V_I$     | all inputs    | -0.5      | $V_{DD}+0.5$ | V    |
| DC input current      | $I_{IK}$  | any one input | -         | $\pm 10$     | mA   |
| storage temperature   | $T_{stg}$ | -             | -65       | +150         | °C   |
| soldering temperature | $T_L$     | 10s           | DIP       |              | 245  |
|                       |           |               | SOP/TSSOP |              | 260  |

### 3.2、Recommended Operating Conditions

| Parameter           | Symbol    | Conditions  | Min. | Typ. | Max. | Unit |
|---------------------|-----------|-------------|------|------|------|------|
| supply voltage      | $V_{DD}$  | -           | 3    | -    | 15   | V    |
| ambient temperature | $T_{amb}$ | in free air | -40  | -    | +125 | °C   |



### 3.3、Electrical Characteristics

#### 3.3.1、DC Characteristics 1

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

| Parameter                 | Symbol   | $V_{DD}$ | Conditions                                   | Min.  | Typ. | Max.    | Unit          |
|---------------------------|----------|----------|----------------------------------------------|-------|------|---------|---------------|
| HIGH-level input voltage  | $V_{IH}$ | 5V       | -                                            | 3.5   | -    | -       | V             |
|                           |          | 10V      | -                                            | 7     | -    | -       | V             |
|                           |          | 15V      | -                                            | 11    | -    | -       | V             |
| LOW-level input voltage   | $V_{IL}$ | 5V       | -                                            | -     | -    | 1.5     | V             |
|                           |          | 10V      | -                                            | -     | -    | 3       | V             |
|                           |          | 15V      | -                                            | -     | -    | 4       | V             |
| HIGH-level output voltage | $V_{OH}$ | 5V       | $ I_O  < 1\mu\text{A}$                       | 4.95  | -    | -       | V             |
|                           |          | 10V      | $ I_O  < 1\mu\text{A}$                       | 9.95  | -    | -       | V             |
|                           |          | 15V      | $ I_O  < 1\mu\text{A}$                       | 14.95 | -    | -       | V             |
| LOW-level output voltage  | $V_{OL}$ | 5V       | $ I_O  < 1\mu\text{A}$                       | -     | -    | 0.05    | V             |
|                           |          | 10V      | $ I_O  < 1\mu\text{A}$                       | -     | -    | 0.05    | V             |
|                           |          | 15V      | $ I_O  < 1\mu\text{A}$                       | -     | -    | 0.05    | V             |
| HIGH-level output current | $I_{OH}$ | 5V       | $V_O = 4.6\text{V}$                          | -     | -    | -0.34   | mA            |
|                           |          | 5V       | $V_O = 2.5\text{V}$                          | -     | -    | -1.3    | mA            |
|                           |          | 10V      | $V_O = 9.5\text{V}$                          | -     | -    | -0.55   | mA            |
|                           |          | 15V      | $V_O = 13.5\text{V}$                         | -     | -    | -1.65   | mA            |
| LOW-level output current  | $I_{OL}$ | 5V       | $V_O = 0.4\text{V}$                          | 0.34  | -    | -       | mA            |
|                           |          | 10V      | $V_O = 0.5\text{V}$                          | 0.46  | -    | -       | mA            |
|                           |          | 15V      | $V_O = 1.5\text{V}$                          | 1.4   | -    | -       | mA            |
| input leakage current     | $I_I$    | 15V      | $V_I = 15\text{V}$ or GND                    | -     | -    | $\pm 2$ | $\mu\text{A}$ |
| supply current            | $I_{DD}$ | 5V       | $V_I = 5\text{V}$ or GND; $I_O = 0\text{A}$  | -     | -    | 7.5     | $\mu\text{A}$ |
|                           |          | 10V      | $V_I = 10\text{V}$ or GND; $I_O = 0\text{A}$ | -     | -    | 15      | $\mu\text{A}$ |
|                           |          | 15V      | $V_I = 15\text{V}$ or GND; $I_O = 0\text{A}$ | -     | -    | 30      | $\mu\text{A}$ |



### 3.3.2、DC Characteristics 2

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

| Parameter                 | Symbol   | $V_{DD}$ | Conditions                                   | Min.  | Typ. | Max.    | Unit          |
|---------------------------|----------|----------|----------------------------------------------|-------|------|---------|---------------|
| HIGH-level input voltage  | $V_{IH}$ | 5V       | -                                            | 3.5   | -    | -       | V             |
|                           |          | 10V      | -                                            | 7     | -    | -       | V             |
|                           |          | 15V      | -                                            | 11    | -    | -       | V             |
| LOW-level input voltage   | $V_{IL}$ | 5V       | -                                            | -     | -    | 1.5     | V             |
|                           |          | 10V      | -                                            | -     | -    | 3       | V             |
|                           |          | 15V      | -                                            | -     | -    | 4       | V             |
| HIGH-level output voltage | $V_{OH}$ | 5V       | $ I_O  < 1\mu\text{A}$                       | 4.95  | -    | -       | V             |
|                           |          | 10V      | $ I_O  < 1\mu\text{A}$                       | 9.95  | -    | -       | V             |
|                           |          | 15V      | $ I_O  < 1\mu\text{A}$                       | 14.95 | -    | -       | V             |
| LOW-level output voltage  | $V_{OL}$ | 5V       | $ I_O  < 1\mu\text{A}$                       | -     | -    | 0.05    | V             |
|                           |          | 10V      | $ I_O  < 1\mu\text{A}$                       | -     | -    | 0.05    | V             |
|                           |          | 15V      | $ I_O  < 1\mu\text{A}$                       | -     | -    | 0.05    | V             |
| HIGH-level output current | $I_{OH}$ | 5V       | $V_O = 4.6\text{V}$                          | -     | -    | -0.3    | mA            |
|                           |          | 5V       | $V_O = 2.5\text{V}$                          | -     | -    | -1.15   | mA            |
|                           |          | 10V      | $V_O = 9.5\text{V}$                          | -     | -    | -0.45   | mA            |
|                           |          | 15V      | $V_O = 13.5\text{V}$                         | -     | -    | -1.4    | mA            |
| LOW-level output current  | $I_{OL}$ | 5V       | $V_O = 0.4\text{V}$                          | 0.29  | -    | -       | mA            |
|                           |          | 10V      | $V_O = 0.5\text{V}$                          | 0.38  | -    | -       | mA            |
|                           |          | 15V      | $V_O = 1.5\text{V}$                          | 1.2   | -    | -       | mA            |
| input leakage current     | $I_I$    | 15V      | $V_I = 15\text{V}$ or GND                    | -     | -    | $\pm 4$ | $\mu\text{A}$ |
| supply current            | $I_{DD}$ | 5V       | $V_I = 5\text{V}$ or GND; $I_O = 0\text{A}$  | -     | -    | 7.5     | $\mu\text{A}$ |
|                           |          | 10V      | $V_I = 10\text{V}$ or GND; $I_O = 0\text{A}$ | -     | -    | 15      | $\mu\text{A}$ |
|                           |          | 15V      | $V_I = 15\text{V}$ or GND; $I_O = 0\text{A}$ | -     | -    | 30      | $\mu\text{A}$ |

### 3.3.3、AC Characteristics 1

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

| Parameter                                   | Symbol             | $V_{DD}$ | Conditions                          | Min. | Typ. | Max. | Unit |
|---------------------------------------------|--------------------|----------|-------------------------------------|------|------|------|------|
| An to Yn HIGH to LOW propagation delay time | $t_{PHL}$          | 5V       | $C_L = 50\text{pF}$<br>see Figure 4 | -    | 100  | 200  | ns   |
|                                             |                    | 10V      |                                     | -    | 40   | 80   | ns   |
|                                             |                    | 15V      |                                     | -    | 30   | 60   | ns   |
| An to Yn LOW to HIGH propagation delay time | $t_{PLH}$          | 5V       |                                     | -    | 90   | 180  | ns   |
|                                             |                    | 10V      |                                     | -    | 40   | 80   | ns   |
|                                             |                    | 15V      |                                     | -    | 30   | 60   | ns   |
| transition time                             | $t_{THL}, t_{TLH}$ | 5V       |                                     | -    | 60   | 120  | ns   |
|                                             |                    | 10V      |                                     | -    | 30   | 60   | ns   |
|                                             |                    | 15V      |                                     | -    | 20   | 40   | ns   |





### 3.3.4、AC Characteristics 2

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

| Parameter                                   | Symbol             | $V_{DD}$ | Conditions                          | Min. | Typ. | Max. | Unit |
|---------------------------------------------|--------------------|----------|-------------------------------------|------|------|------|------|
| An to Yn HIGH to LOW propagation delay time | $t_{PHL}$          | 5V       | $C_L = 50\text{pF}$<br>see Figure 4 | -    | -    | 240  | ns   |
|                                             |                    | 10V      |                                     | -    | -    | 96   | ns   |
|                                             |                    | 15V      |                                     | -    | -    | 72   | ns   |
| An to Yn LOW to HIGH propagation delay time | $t_{PLH}$          | 5V       |                                     | -    | -    | 216  | ns   |
|                                             |                    | 10V      |                                     | -    | -    | 96   | ns   |
|                                             |                    | 15V      |                                     | -    | -    | 70   | ns   |
| transition time                             | $t_{THL}, t_{TLH}$ | 5V       |                                     | -    | -    | 144  | ns   |
|                                             |                    | 10V      |                                     | -    | -    | 72   | ns   |
|                                             |                    | 15V      |                                     | -    | -    | 48   | ns   |

## 4、Testing Circuit

### 4.1、AC Testing Circuit

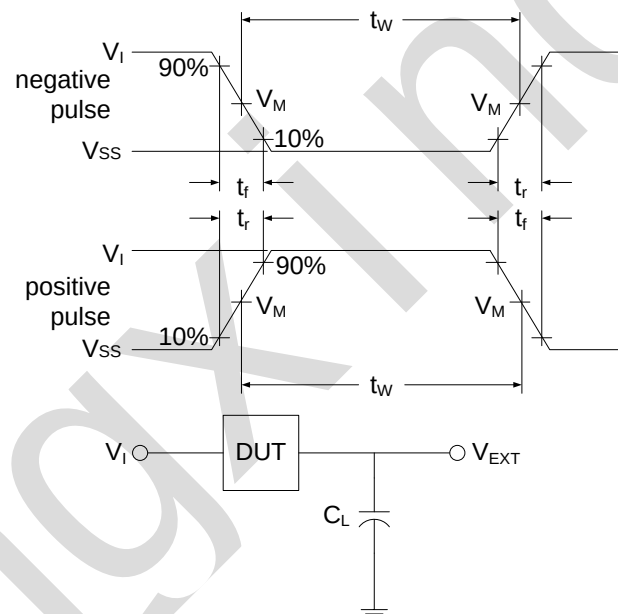


Figure 3. Load circuit

$C_L$  includes probe and jig capacitance.

### 4.2、Test Data

| Supply voltage | Input    |                    | Load  | $V_{EXT}$         |                   |                   |
|----------------|----------|--------------------|-------|-------------------|-------------------|-------------------|
| $V_{DD}$       | $V_I$    | $t_r = t_f$        | $C_L$ | $t_{PLH}/t_{PHL}$ | $t_{PLZ}/t_{PZL}$ | $t_{PHZ}/t_{PZH}$ |
| 5V to 15V      | $V_{DD}$ | $\leq 20\text{ns}$ | 50pF  | Open              | $V_{DD}$          | $V_{SS}$          |



### 4.3、AC Testing Waveforms

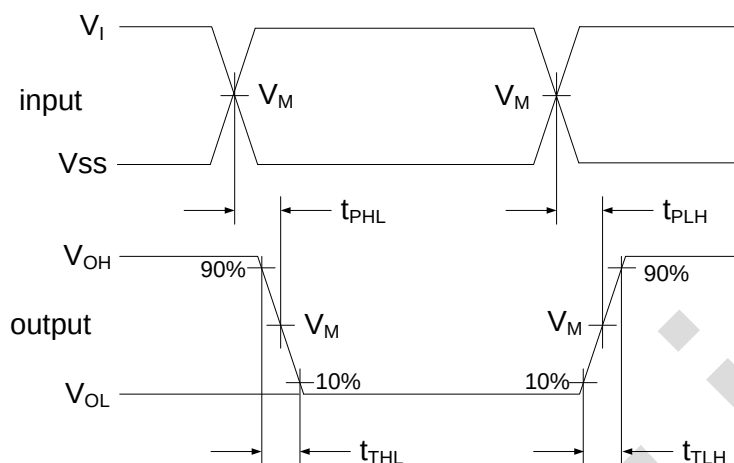


Figure 4. Propagation delay, output transition time

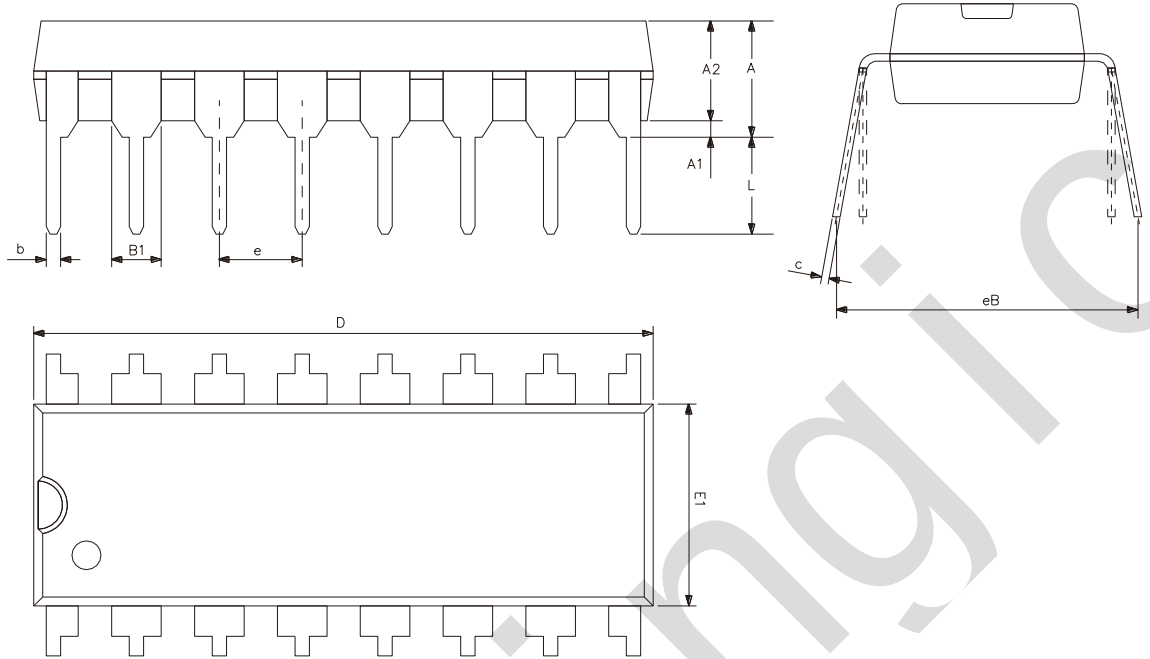
### 4.4、Measurement Points

| Supply voltage | Input               | Output              |                     |                     |
|----------------|---------------------|---------------------|---------------------|---------------------|
| $V_{DD}$       | $V_M$               | $V_M$               | $V_X$               | $V_Y$               |
| 5V to 15V      | $0.5 \times V_{DD}$ | $0.5 \times V_{DD}$ | $0.1 \times V_{DD}$ | $0.9 \times V_{DD}$ |



## 5、Package Information

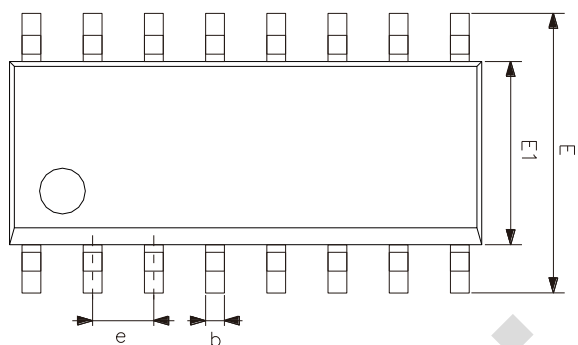
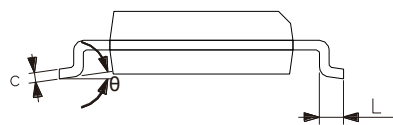
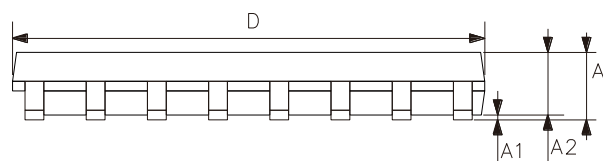
### 5.1、DIP16



| Symbol | Dimensions (mm) |       |
|--------|-----------------|-------|
|        | Min.            | Max.  |
| A2     | 3.20            | 3.60  |
| A1     | 0.51            | -     |
| A      | 3.60            | 5.33  |
| L      | 3.00            | 3.60  |
| b      | 0.36            | 0.56  |
| B1     | 1.52            |       |
| D      | 18.80           | 19.94 |
| E1     | 6.20            | 6.60  |
| e      | 2.54            |       |
| c      | 0.20            | 0.36  |
| eB     | 7.62            | 9.30  |



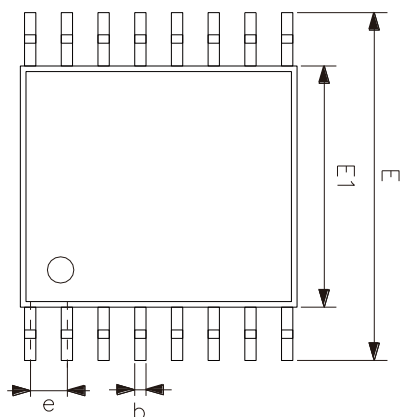
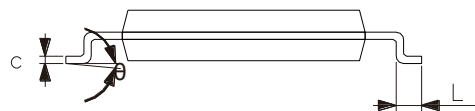
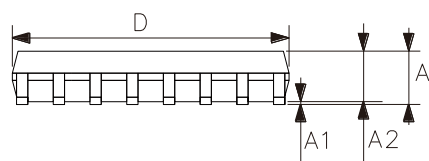
## 5.2、SOP16



| Symbol | Dimensions (mm) |       |
|--------|-----------------|-------|
|        | Min.            | Max.  |
| A      | 1.35            | 1.80  |
| A1     | 0.10            | 0.25  |
| A2     | 1.25            | 1.55  |
| b      | 0.33            | 0.51  |
| c      | 0.19            | 0.25  |
| D      | 9.50            | 10.10 |
| E      | 5.80            | 6.30  |
| E1     | 3.70            | 4.10  |
| e      | 1.27            |       |
| L      | 0.35            | 0.89  |
| θ      | 0°              | 8°    |



### 5.3、TSSOP16



| 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 |
| $\theta$ | 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             | <p>○: Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard.</p> <p>×: Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements.</p> |                               |                               |                               |                          |                                |                   |                       |                           |                      |

### 6.2、Notes

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