

### Features

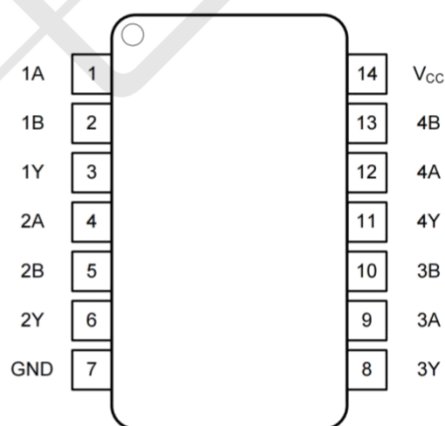
- Wide supply voltage range from 1.2 V to 5.5 V
- CMOS low power dissipation
- Overvoltage tolerant inputs to 5.5 V
- Latch-up performance exceeds 250 mA
- Direct interface with TTL levels
- ESD protection:  
HBM ANSI/ESDA/JEDEC JS-00  
Class 3A exceeds 6000 V  
CDM ANSI/ESDA/JEDEC JS-002  
Class C3 exceeds 2000 V
- I<sub>OFF</sub> circuitry provides partial Power-down mode operation
- Complies with JEDEC standard:  
JESD8-7 (1.65 V to 1.95 V)  
JESD8-5 (2.3 V to 2.7 V)  
JESD8C (2.7 V to 3.6 V)  
JESD36 (4.5 V to 5.5 V)
- Packaging: SOP-14

### General Description

The is a quad 2-input EXCLUSIVE-OR gate. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V applications.

Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times. This device is fully specified for partial power down applications using IOFF. The IOFF circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down.

### PIN CONFIGURATIONS (Top view)



SOP-14

### PIN DESCRIPTION

| PIN NO. | PIN NAME | DESCRIPTION  | PIN NO. | PIN NAME        | DESCRIPTION    |
|---------|----------|--------------|---------|-----------------|----------------|
| 1       | 1A       | Data input   | 8       | 3Y              | Data output    |
| 2       | 1B       | Data input   | 9       | 3A              | Data input     |
| 3       | 1Y       | Data output  | 10      | 3B              | Data input     |
| 4       | 2A       | Data input   | 11      | 4Y              | Data output    |
| 5       | 2B       | Data input   | 12      | 4A              | Data input     |
| 6       | 2Y       | Data output  | 13      | 4B              | Data input     |
| 7       | GND      | ground (0 V) | 14      | V <sub>CC</sub> | supply voltage |

### Functional diagram

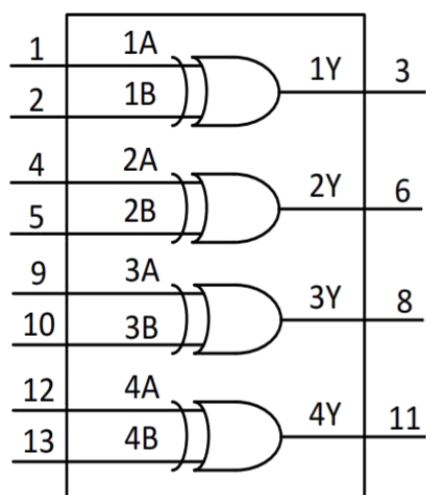


Fig. 1. Logic symbol

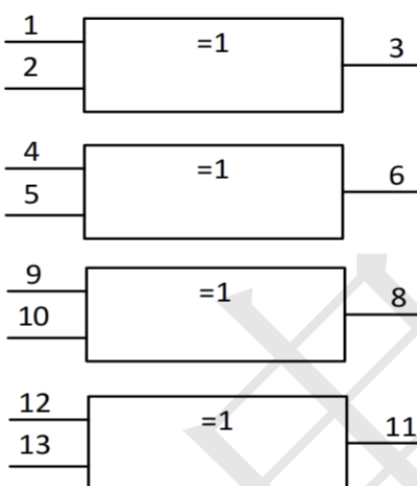


Fig. 2. IEC logic symbol

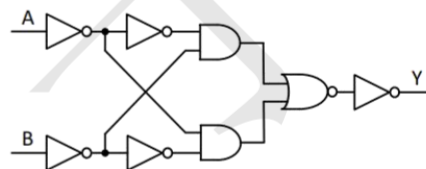


Fig. 3. Logic diagram (one gate)

### Functional Description

#### Function table

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

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

### ABSOLUTE MAXIMUM RATINGS

In accordance with the Absolute Maximum Rating System. Voltages are referenced to GND.

| Symbol    | Parameter               | Conditions                                                            | Min  | Max            | Unit             |
|-----------|-------------------------|-----------------------------------------------------------------------|------|----------------|------------------|
| $V_{CC}$  | supply voltage          |                                                                       | -0.5 | 6.5            | V                |
| $I_{IK}$  | input clamping current  | $V_I < 0\text{ V}$                                                    | -50  | --             | mA               |
| $V_I$     | input voltage           | (1)                                                                   | -0.5 | 6.5            | V                |
| $I_{OK}$  | output clamping current | $V_O > V_{CC}$ or $V_O < 0\text{ V}$                                  | --   | $\pm 50$       | mA               |
| $V_O$     | output voltage          | Active mode (1)                                                       | 0    | $V_{CC} + 0.5$ | V                |
|           |                         | Power-down mode; $V_{CC} = 0\text{ V}$ (1)                            | 0    | 6.5            | V                |
| $I_O$     | output current          | $V_O = 0\text{ V}$ to $V_{CC}$                                        | --   | $\pm 50$       | mA               |
| $I_{CC}$  | supply current          |                                                                       | --   | 100            | mA               |
| $I_{GND}$ | ground current          |                                                                       | -100 | --             | mA               |
| $P_{tot}$ | total power dissipation | $T_{amb} = -40\text{ }^\circ\text{C}$ to $+125\text{ }^\circ\text{C}$ | --   | 500            | mW               |
| $T_{stg}$ | storage temperature     |                                                                       | -65  | 150            | $^\circ\text{C}$ |

**Note:**1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

### Recommended operating conditions

| Symbol              | Parameter                           | Conditions                                 | Min  | Max      | Unit             |
|---------------------|-------------------------------------|--------------------------------------------|------|----------|------------------|
| $V_{CC}$            | supply voltage                      |                                            | 1.65 | 5.5      | V                |
|                     |                                     | functional                                 | 1.2  | --       | V                |
| $V_I$               | input voltage                       |                                            | 0    | 5.5      | V                |
| $V_O$               | output voltage                      | Active mode                                | 0    | $V_{CC}$ | V                |
|                     |                                     | Power-down mode; $V_{CC} = 0\text{ V}$     | 0    | 5.5      | V                |
| $T_{amb}$           | ambient temperature                 |                                            | -40  | 125      | $^\circ\text{C}$ |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 1.65\text{ V}$ to $2.7\text{ V}$ | 0    | 20       | ns/V             |
|                     |                                     | $V_{CC} = 2.7\text{ V}$ to $3.6\text{ V}$  | 0    | 10       | ns/V             |
|                     |                                     | $V_{CC} = 4.5\text{ V}$ to $5.5\text{ V}$  | 0    | 5        | ns/V             |

### Static characteristics

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

| Symbol   | Parameter                 | Conditions                                                           | -40 °C to +85 °C |           |              | -40 °C to +125 °C |              | Unit          |
|----------|---------------------------|----------------------------------------------------------------------|------------------|-----------|--------------|-------------------|--------------|---------------|
|          |                           |                                                                      | Min              | Typ       | Max          | Min               | Max          |               |
| $V_{IH}$ | HIGH-level input voltage  | $V_{CC} = 1.2 \text{ V}$                                             | 1.08             | --        | --           | 1.08              | --           | V             |
|          |                           | $V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$                         | $0.65V_{CC}$     | --        | --           | $0.65V_{CC}$      | --           | V             |
|          |                           | $V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$                           | 1.7              | --        | --           | 1.7               | --           | V             |
|          |                           | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$                           | 2.0              | --        | --           | 2.0               | --           | V             |
|          |                           | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$                           | $0.7V_{CC}$      | --        | --           | $0.7V_{CC}$       | --           | V             |
| $V_{IL}$ | LOW-level input voltage   | $V_{CC} = 1.2 \text{ V}$                                             | --               | --        | 0.12         | --                | 0.12         | V             |
|          |                           | $V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$                         | --               | --        | $0.35V_{CC}$ | --                | $0.35V_{CC}$ | V             |
|          |                           | $V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$                           | --               | --        | 0.7          | --                | 0.7          | V             |
|          |                           | $V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$                           | --               | --        | 0.8          | --                | 0.8          | V             |
|          |                           | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$                           | --               | --        | $0.3V_{CC}$  | --                | $0.3V_{CC}$  | V             |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{IH} \text{ or } V_{IL}$                                    |                  |           |              |                   |              |               |
|          |                           | $I_O = -100 \mu\text{A}; V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$  | $V_{CC} - 0.1$   | --        | --           | $V_{CC} - 0.1$    | --           | V             |
|          |                           | $I_O = -4 \text{ mA}; V_{CC} = 1.65 \text{ V}$                       | 1.2              | --        | --           | 1.05              | --           | V             |
|          |                           | $I_O = -8 \text{ mA}; V_{CC} = 2.3 \text{ V}$                        | 1.9              | --        | --           | 1.7               | --           | V             |
|          |                           | $I_O = -12 \text{ mA}; V_{CC} = 2.7 \text{ V}$                       | 2.2              | --        | --           | 2.05              | --           | V             |
|          |                           | $I_O = -24 \text{ mA}; V_{CC} = 3.0 \text{ V}$                       | 2.4              | --        | --           | 2.25              | --           | V             |
|          |                           | $I_O = -32 \text{ mA}; V_{CC} = 4.5 \text{ V}$                       | 3.8              | --        | --           | 3.5               | --           | V             |
| $V_{OL}$ | LOW-level output voltage  | $V_I = V_{IH} \text{ or } V_{IL}$                                    |                  |           |              |                   |              |               |
|          |                           | $I_O = 100 \mu\text{A}; V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$   | --               | --        | 0.10         | --                | 0.10         | V             |
|          |                           | $I_O = 4 \text{ mA}; V_{CC} = 1.65 \text{ V}$                        | --               | --        | 0.45         | --                | 0.65         | V             |
|          |                           | $I_O = 8 \text{ mA}; V_{CC} = 2.3 \text{ V}$                         | --               | --        | 0.30         | --                | 0.45         | V             |
|          |                           | $I_O = 12 \text{ mA}; V_{CC} = 2.7 \text{ V}$                        | --               | --        | 0.40         | --                | 0.60         | V             |
|          |                           | $I_O = 24 \text{ mA}; V_{CC} = 3.0 \text{ V}$                        | --               | --        | 0.55         | --                | 0.80         | V             |
|          |                           | $I_O = 32 \text{ mA}; V_{CC} = 4.5 \text{ V}$                        | --               | --        | 0.55         | --                | 0.80         | V             |
| $I_I$    | input leakage current     | $V_I = 5.5 \text{ V or GND}; V_{CC} = 0 \text{ V to } 5.5 \text{ V}$ | --               | $\pm 0.1$ | $\pm 5$      | --                | $\pm 20$     | $\mu\text{A}$ |

### Static characteristics

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

| Symbol          | Parameter                 | Conditions                                                                                                              | -40 °C to +85 °C |           |          | -40 °C to +125 °C |          | Unit          |
|-----------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------|-----------|----------|-------------------|----------|---------------|
|                 |                           |                                                                                                                         | Min              | Typ       | Max      | Min               | Max      |               |
| $I_{OFF}$       | power-off leakage current | $V_{CC} = 0 \text{ V}$ ;<br>$V_I$ or $V_O = 5.5 \text{ V}$                                                              | --               | $\pm 0.1$ | $\pm 10$ | --                | $\pm 20$ | $\mu\text{A}$ |
| $I_{CC}$        | supply current            | $V_{CC} = 1.65 \text{ V to } 5.5 \text{ V}$ ;<br>$V_I = V_{CC}$ or GND ; $I_O = 0 \text{ A}$ ;                          | --               | 0.01      | 10       | --                | 40       | $\mu\text{A}$ |
| $\Delta I_{CC}$ | additional supply current | per input pin ;<br>$V_{CC} = 2.3 \text{ V to } 5.5 \text{ V}$ ;<br>$V_I = V_{CC} - 0.6 \text{ V}$ ; $I_O = 0 \text{ A}$ | --               | 0.2       | 500      | --                | 5000     | $\mu\text{A}$ |
| $C_I$           | input capacitance         | $V_{CC} = 3.3 \text{ V}$ ;<br>$V_I = \text{GND to } V_{CC}$                                                             | --               | 4         | --       | --                | --       | pF            |

**Note:** All typical values are measured at  $V_{CC} = 3.3\text{V}$  and  $T_{amb} = 25^\circ\text{C}$ .

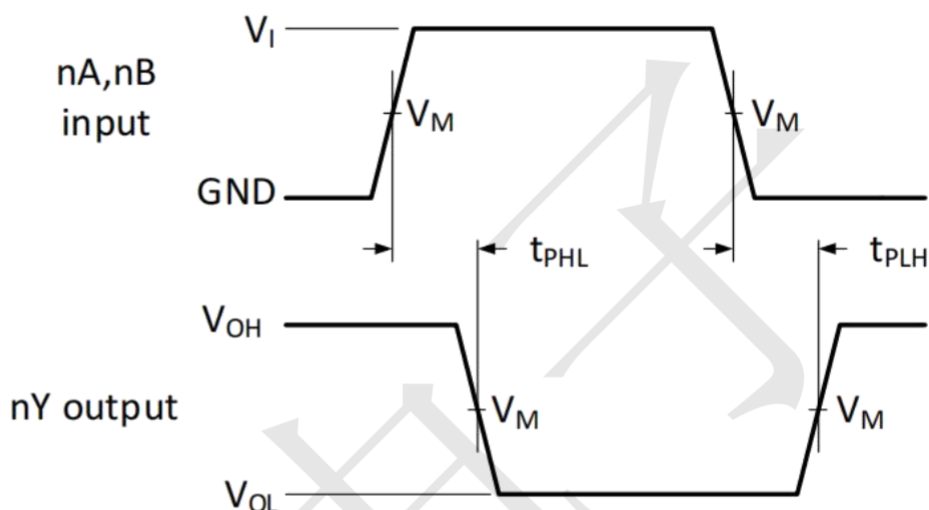
### Dynamic Characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see

| Symbol      | Parameter                     | Conditions                                   | -40 °C to +85 °C |      |      | -40 °C to +125 °C |      | Unit |
|-------------|-------------------------------|----------------------------------------------|------------------|------|------|-------------------|------|------|
|             |                               |                                              | Min              | Typ  | Max  | Min               | Max  |      |
| $t_{pd}$    | propagation delay             | nA to nY;                                    |                  |      |      |                   |      |      |
|             |                               | $V_{CC} = 1.2 \text{ V}$                     | --               | 36   | --   | --                | --   | ns   |
|             |                               | $V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$ | 3.4              | 11.4 | 22   | 3.4               | 22.5 | ns   |
|             |                               | $V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$   | 2.7              | 6.3  | 10.5 | 2.7               | 11   | ns   |
|             |                               | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$   | 2.0              | 4.6  | 7.5  | 2.0               | 8.0  | ns   |
|             |                               | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$   | 1.5              | 3.3  | 5    | 1.5               | 5.5  | ns   |
| $t_{sk(o)}$ | output skew time              | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$   | --               | --   | 1.0  | --                | 1.5  | ns   |
| $C_{PD}$    | power dissipation capacitance | per gate ;<br>$V_I = \text{GND to } V_{CC}$  |                  |      |      |                   |      |      |
|             |                               | $V_{CC} = 1.65 \text{ V to } 1.95 \text{ V}$ | --               | 12.7 | --   | --                | --   | pF   |
|             |                               | $V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$   | --               | 13.4 | --   | --                | --   | pF   |
|             |                               | $V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$   | --               | 14.3 | --   | --                | --   | pF   |
|             |                               | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$   | --               | 16.2 | --   | --                | --   | pF   |

**Note:** Typical values are measured at  $T_{amb} = 25^\circ\text{C}$  and  $V_{CC} = 1.2 \text{ V}, 1.8 \text{ V}, 2.5 \text{ V}, 3.3 \text{ V}$  and  $5.0 \text{ V}$  respectively.

### Waveforms and test circuit

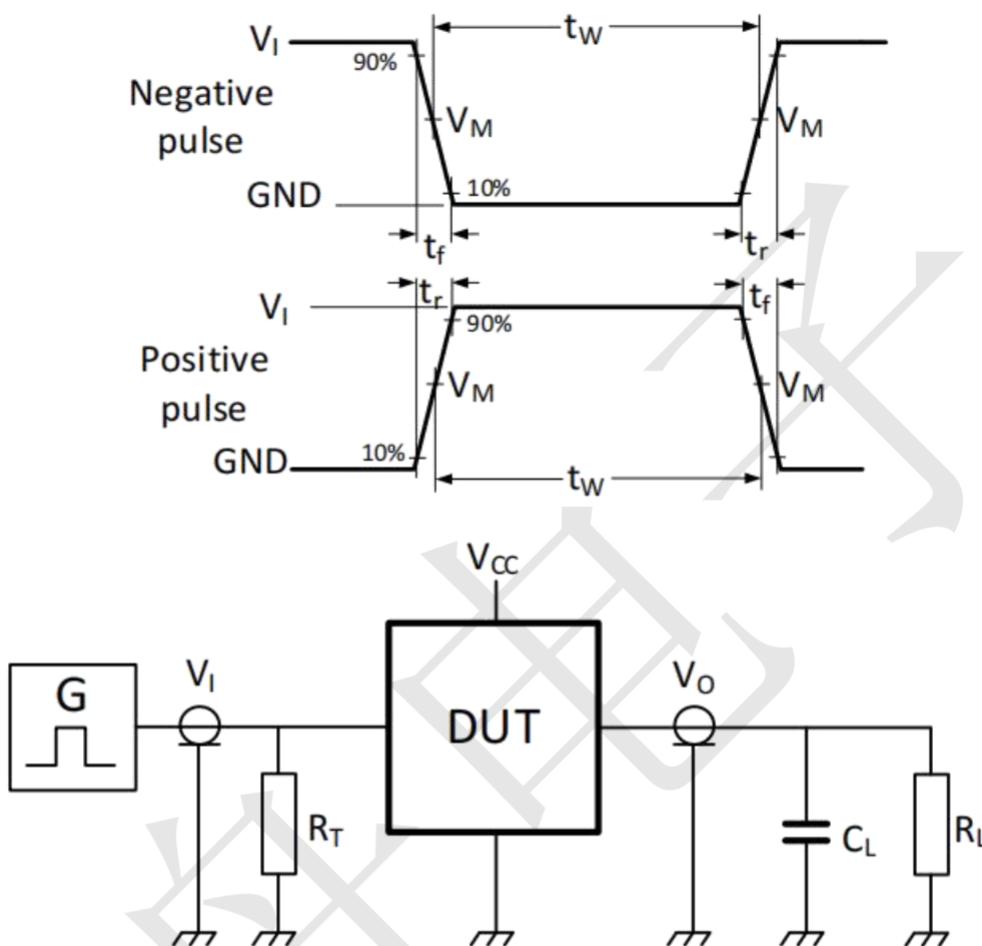


Measurement points are given in Table 8.

$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

### Measurement points

| Supply voltage   | Input       | Output      |
|------------------|-------------|-------------|
| $V_{CC}$         | $V_M$       | $V_M$       |
| 1.2 V            | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 1.65 V to 1.95 V | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 2.3 V to 2.7 V   | $0.5V_{CC}$ | $0.5V_{CC}$ |
| 3.0 V to 3.6 V   | 1.5 V       | 1.5 V       |
| 4.5 V to 5.5 V   | $0.5V_{CC}$ | $0.5V_{CC}$ |



Test data is given in Table 9.

Definitions for test circuit:

$R_L$  = Load resistance.

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

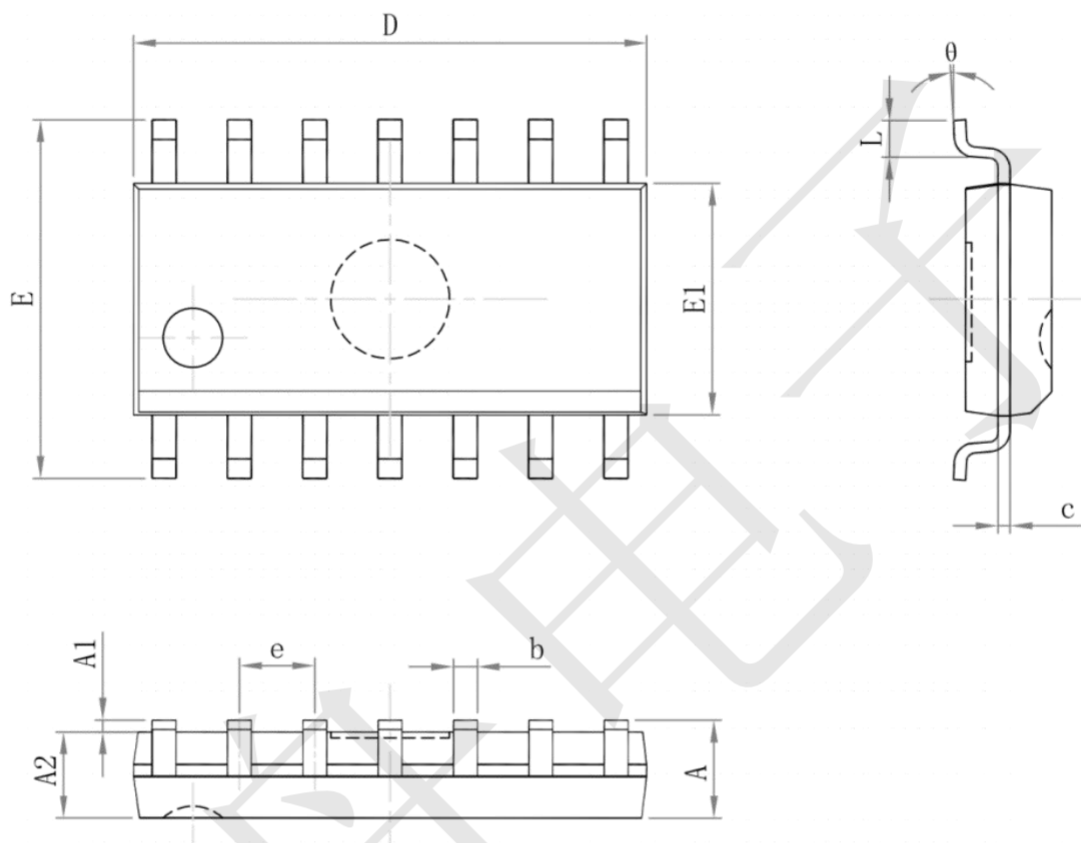
$R_T$  = Termination resistance should be equal to the output impedance  $Z_o$  of the pulse generator.

### Test data

| Supply voltage   | Input    |               | Load  |              |
|------------------|----------|---------------|-------|--------------|
| $V_{CC}$         | $V_I$    | $t_r = t_f$   | $C_L$ | $R_L$        |
| 1.2 V            | $V_{CC}$ | $\leq 2.0$ ns | 15 pF | 500 $\Omega$ |
| 1.65 V to 1.95 V | $V_{CC}$ | $\leq 2.0$ ns | 15 pF | 500 $\Omega$ |
| 2.3 V to 2.7 V   | $V_{CC}$ | $\leq 2.0$ ns | 15 pF | 500 $\Omega$ |
| 3.0 V to 3.6 V   | 3 V      | $\leq 2.0$ ns | 15 pF | 500 $\Omega$ |
| 4.5 V to 5.5 V   | $V_{CC}$ | $\leq 2.0$ ns | 15 pF | 500 $\Omega$ |

### Package information

#### SOP-14



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | —                         | 1.750 | —                    | 0.069 |
| A1     | 0.100                     | 0.250 | 0.004                | 0.010 |
| A2     | 1.250                     | —     | 0.049                | —     |
| b      | 0.310                     | 0.510 | 0.012                | 0.020 |
| c      | 0.100                     | 0.250 | 0.004                | 0.010 |
| D      | 8.450                     | 8.850 | 0.333                | 0.348 |
| E      | 5.800                     | 6.200 | 0.228                | 0.244 |
| E1     | 3.800                     | 4.000 | 0.150                | 0.157 |
| e      | 1.270(BSC)                |       | 0.050(BSC)           |       |
| L      | 0.400                     | 1.270 | 0.016                | 0.050 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |