

74HC4066D

1. Functional Description

- Quad Bilateral Switch

2. General

The 74HC4066D is high-speed CMOS QUAD BILATERAL SWITCH fabricated with silicon gate C²MOS technology.

It consists of four independent high speed switches capable of controlling either digital or analog signals while maintaining the CMOS low power dissipation.

Control input(C) is provided to control the switch. The switch turns ON while the C input is High, and the switch turns OFF while low.

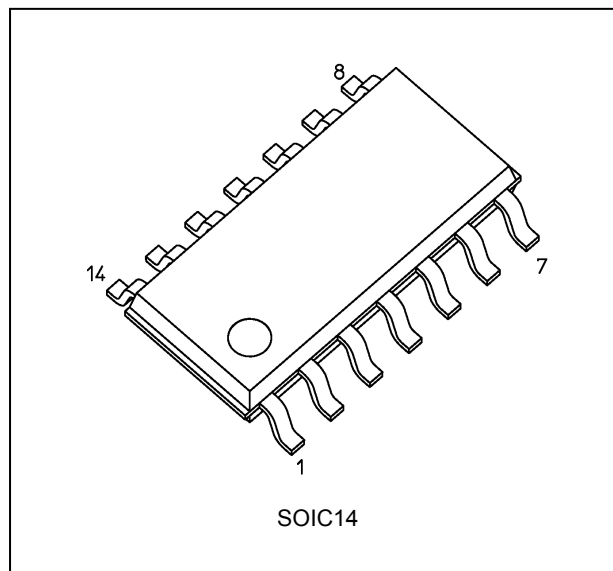
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

3. Features

- (1) Wide operating temperature range: $T_{opr} = -40$ to 125 °C (Note 1)
- (2) Low power dissipation: $I_{CC} = 1.0$ μ A (max) at $V_{CC} = 6.0$ V, $T_a = 25$ °C
- (3) High noise immunity: $V_{NIH} = V_{NIL} = 28$ % V_{CC} (min)
- (4) Low ON resistance: $R_{ON} = 50$ Ω (typ.) at $V_{CC} = 9.0$ V, $V_{IO} = V_{CC}$ or GND
- (5) High degree of linearity: THD = 0.05 % (typ.) at $V_{CC} = 4.5$ V

Note 1: Operating Range spec of $T_{opr} = -40$ °C to 125 °C is applicable only for the products which manufactured after July 2020.

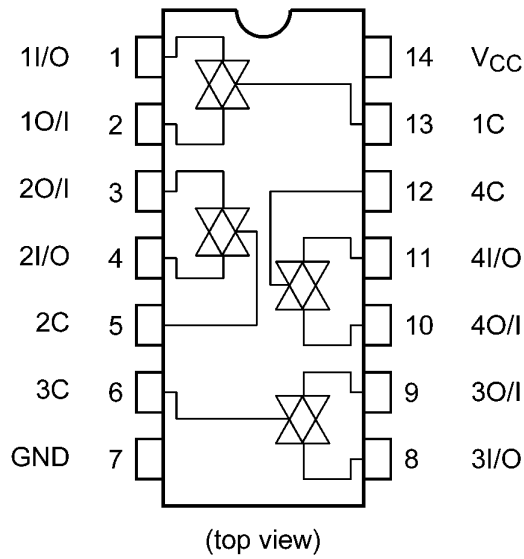
4. Packaging



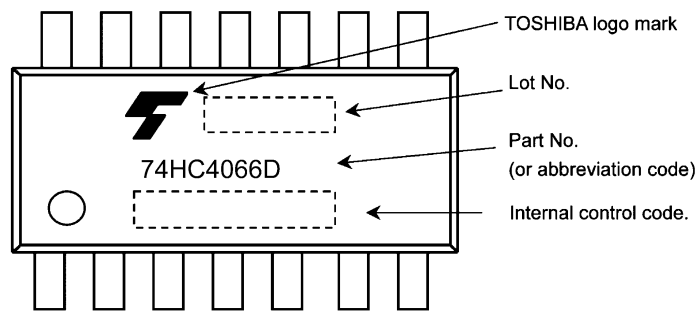
Start of commercial production

2020-07

5. Pin Assignment



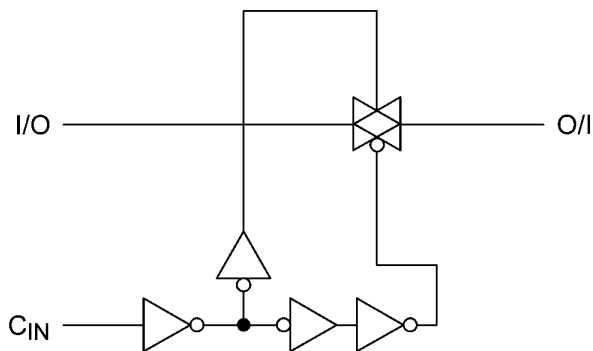
6. Marking



7. Truth Table

| Control | Switch Function |
|---------|-----------------|
| H | On |
| L | Off |

8. System Diagram (per circuit)



9. Absolute Maximum Ratings (Note)

| Characteristics | Symbol | Note | Rating | Unit |
|--------------------------|------------|----------|------------------------|------|
| Supply voltage | V_{CC} | | -0.5 to 13.0 | V |
| Input voltage | V_{IN} | | -0.5 to $V_{CC} + 0.5$ | V |
| Switch I/O voltage | $V_{I/O}$ | | -0.5 to $V_{CC} + 0.5$ | V |
| Input diode current | I_{IK} | | ± 20 | mA |
| I/O diode current | $I_{I/OK}$ | | ± 20 | mA |
| Switch through current | I_T | | ± 25 | mA |
| V_{CC} /ground current | I_{CC} | | ± 50 | mA |
| Power dissipation | P_D | (Note 1) | 500 | mW |
| Storage temperature | T_{stg} | | -65 to 150 | °C |

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: P_D derates linearly with -8 mW/°C above 85 °C.

10. Operating Ranges (Note)

| Characteristics | Symbol | Note | Rating | Unit |
|---------------------------|------------|----------|---------------|------|
| Supply voltage | V_{CC} | | 2.0 to 12 | V |
| Input voltage | V_{IN} | | 0 to V_{CC} | V |
| Switch I/O voltage | $V_{I/O}$ | | 0 to V_{CC} | V |
| Operating temperature | T_{opr} | (Note 1) | -40 to 125 | °C |
| Input rise and fall times | t_r, t_f | | 0 to 50 | μs |

Note: The operating ranges must be maintained to ensure the normal operation of the device.

Unused control inputs must be tied to either V_{CC} or GND.

Note 1: Operating Range spec of $T_{opr} = -40$ °C to 125 °C is applicable only for the products which manufactured after July 2020.

11. Electrical Characteristics

11.1. DC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$)

| Characteristics | Symbol | Test Condition | V_{CC} (V) | Min | Typ. | Max | Unit |
|---|-----------|--|--|-----------------|--|-----------|---------------|
| High-level input voltage | V_{IH} | — | 2.0 | 1.50 | — | — | V |
| | | | 4.5 | 3.15 | — | — | |
| | | | 9.0 | 6.30 | — | — | |
| | | | 12.0 | 8.40 | — | — | |
| Low-level input voltage | V_{IL} | — | 2.0 | — | — | 0.50 | V |
| | | | 4.5 | — | — | 1.35 | |
| | | | 9.0 | — | — | 2.70 | |
| | | | 12.0 | — | — | 3.60 | |
| ON-resistance | R_{ON} | $V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ to GND $I_{I/O} \leq 1\text{ mA}$ | 4.5 | — | 96 | 170 | Ω |
| | | | 9.0 | — | 55 | 85 | |
| | | | 12.0 | — | 45 | 80 | |
| | | $V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ or GND $I_{I/O} \leq 1\text{ mA}$ | 2.0 | — | 160 | — | |
| | | | 4.5 | — | 70 | 100 | |
| | | | 9.0 | — | 50 | 75 | |
| | | | 12.0 | — | 45 | 70 | |
| | | | Difference of ON-resistance between switches | ΔR_{ON} | $V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ to GND $I_{I/O} \leq 1\text{ mA}$ | 4.5 | |
| 9.0 | — | 5 | | | | 12 | |
| 12.0 | — | 5 | | | | 10 | |
| Input/Output leakage current (Switch OFF) | I_{OFF} | $V_{OS} = V_{CC}$ or GND $V_{IS} = \text{GND}$ to V_{CC} $V_{IN} = V_{IL}$ | 12.0 | — | — | ± 0.1 | μA |
| Input/Output leakage current (Switch ON, output open) | $I_{I/O}$ | $V_{OS} = V_{CC}$ or GND $V_{IN} = V_{IH}$ | 12.0 | — | — | ± 0.1 | μA |
| Control input leakage current | I_{IN} | $V_{IN} = V_{CC}$ or GND | 12.0 | — | — | ± 0.1 | μA |
| Quiescent supply current | I_{CC} | $V_{IN} = V_{CC}$ or GND | 6.0 | — | — | 1.0 | μA |
| | | | 9.0 | — | — | 4.0 | |
| | | | 12.0 | — | — | 8.0 | |

11.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to 85 °C)

| Characteristics | Symbol | Test Condition | V_{CC} (V) | Min | Max | Unit |
|---|-----------------|---|--------------|------|-----------|----------|
| High-level input voltage | V_{IH} | — | 2.0 | 1.50 | — | V |
| | | | 4.5 | 3.15 | — | |
| | | | 9.0 | 6.30 | — | |
| | | | 12.0 | 8.40 | — | |
| Low-level input voltage | V_{IL} | — | 2.0 | — | 0.50 | V |
| | | | 4.5 | — | 1.35 | |
| | | | 9.0 | — | 2.70 | |
| | | | 12.0 | — | 3.60 | |
| ON-resistance | R_{ON} | $V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ to GND $I_{I/O} \leq 1$ mA | 4.5 | — | 200 | Ω |
| | | | 9.0 | — | 100 | |
| | | | 12.0 | — | 90 | |
| | | $V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ or GND $I_{I/O} \leq 1$ mA | 4.5 | — | 130 | |
| | | | 9.0 | — | 95 | |
| | | | 12.0 | — | 90 | |
| Difference of ON-resistance between switches | ΔR_{ON} | $V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ to GND $I_{I/O} \leq 1$ mA | 4.5 | — | 35 | Ω |
| | | | 9.0 | — | 15 | |
| | | | 12.0 | — | 12 | |
| Input/Output leakage current (Switch OFF) | I_{OFF} | $V_{OS} = V_{CC}$ or GND $V_{IS} =$ GND to V_{CC} $V_{IN} = V_{IL}$ | 12.0 | — | ± 1.0 | μA |
| Input/Output leakage current (Switch ON, output open) | $I_{I/O}$ | $V_{OS} = V_{CC}$ or GND $V_{IN} = V_{IH}$ | 12.0 | — | ± 1.0 | μA |
| Control input leakage current | I_{IN} | $V_{IN} = V_{CC}$ or GND | 12.0 | — | ± 1.0 | μA |
| Quiescent supply current | I_{CC} | $V_{IN} = V_{CC}$ or GND | 6.0 | — | 10.0 | μA |
| | | | 9.0 | — | 40.0 | |
| | | | 12.0 | — | 80.0 | |

11.3. DC Characteristics (Note) (Unless otherwise specified, $T_a = -40$ to 125 °C)

| Characteristics | Symbol | Test Condition | V_{CC} (V) | Min | Max | Unit |
|---|-----------------|---|--------------|------|-----------|----------|
| High-level input voltage | V_{IH} | — | 2.0 | 1.50 | — | V |
| | | | 4.5 | 3.15 | — | |
| | | | 9.0 | 6.30 | — | |
| | | | 12.0 | 8.40 | — | |
| Low-level input voltage | V_{IL} | — | 2.0 | — | 0.50 | V |
| | | | 4.5 | — | 1.35 | |
| | | | 9.0 | — | 2.70 | |
| | | | 12.0 | — | 3.60 | |
| ON-resistance | R_{ON} | $V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ to GND $I_{I/O} \leq 1$ mA | 4.5 | — | 220 | Ω |
| | | | 9.0 | — | 110 | |
| | | | 12.0 | — | 100 | |
| | | $V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ or GND $I_{I/O} \leq 1$ mA | 4.5 | — | 150 | |
| | | | 9.0 | — | 110 | |
| | | | 12.0 | — | 105 | |
| Difference of ON-resistance between switches | ΔR_{ON} | $V_{IN} = V_{IH}$ $V_{I/O} = V_{CC}$ to GND $I_{I/O} \leq 1$ mA | 4.5 | — | 35 | Ω |
| | | | 9.0 | — | 15 | |
| | | | 12.0 | — | 12 | |
| Input/Output leakage current (Switch OFF) | I_{OFF} | $V_{OS} = V_{CC}$ or GND $V_{IS} = GND$ to V_{CC} $V_{IN} = V_{IL}$ | 12.0 | — | ± 5.0 | μA |
| Input/Output leakage current (Switch ON, output open) | $I_{I/O}$ | $V_{OS} = V_{CC}$ or GND $V_{IN} = V_{IH}$ | 12.0 | — | ± 5.0 | μA |
| Control input leakage current | I_{IN} | $V_{IN} = V_{CC}$ or GND | 12.0 | — | ± 5.0 | μA |
| Quiescent supply current | I_{CC} | $V_{IN} = V_{CC}$ or GND | 6.0 | — | 20.0 | μA |
| | | | 9.0 | — | 80.0 | |
| | | | 12.0 | — | 160.0 | |

Note: Operating Range spec of $T_{opr} = -40$ °C to 125 °C is applicable only for the products which manufactured after July 2020.

11.4. AC Characteristics

(Unless otherwise specified, $C_L = 50 \text{ pF}$, $T_a = 25 \text{ }^\circ\text{C}$, Input: $t_r = t_f = 6 \text{ ns}$)

| Characteristics | Symbol | Note | Test Condition | V_{CC} (V) | Min | Typ. | Max | Unit |
|--|--------------------------|----------|---|--------------|-----|------|-----|------|
| Phase difference between input to output | $\phi_{I/O}$ | | — | 2.0 | — | 10 | 50 | ns |
| | | | | 4.5 | — | 4 | 10 | |
| | | | | 9.0 | — | 3 | 8 | |
| | | | | 12.0 | — | 3 | 7 | |
| Output enable time | t_{PZL} , t_{PZH} | | $R_L = 1 \text{ k}\Omega$ See 12. AC Test Circuit, Figure 1 | 2.0 | — | 18 | 100 | ns |
| | | | | 4.5 | — | 8 | 20 | |
| | | | | 9.0 | — | 6 | 12 | |
| | | | | 12.0 | — | 6 | 12 | |
| Output disable time | t_{PLZ} , t_{PHZ} | | $R_L = 1 \text{ k}\Omega$ See 12. AC Test Circuit, Figure 1 | 2.0 | — | 20 | 115 | ns |
| | | | | 4.5 | — | 10 | 23 | |
| | | | | 9.0 | — | 8 | 20 | |
| | | | | 12.0 | — | 8 | 12 | |
| Control input capacitance | C_{IN} | | — | 5.0 | — | 3 | 10 | pF |
| Switch terminal capacitance | C_{OS} | | See 12. AC Test Circuit, Figure 2 | 5.0 | — | 6 | 20 | pF |
| Feedthrough capacitance | C_{IOS} | | See 12. AC Test Circuit, Figure 2 | 5.0 | — | 0.5 | 2 | pF |
| Power dissipation capacitance | C_{PD} | (Note 1) | See 12. AC Test Circuit, Figure 2 | 5.0 | — | 5 | — | pF |

Note 1: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation.

$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/4 \text{ (per bit)}$$

11.5. AC Characteristics

(Unless otherwise specified, $C_L = 50 \text{ pF}$, $T_a = -40 \text{ to } 85 \text{ }^\circ\text{C}$, Input: $t_r = t_f = 6 \text{ ns}$)

| Characteristics | Symbol | Test Condition | V_{CC} (V) | Min | Max | Unit |
|--|--------------------|--|--------------|-----|-----|------|
| Phase difference between input to output | $\phi_{I/O}$ | — | 2.0 | — | 65 | ns |
| | | | 4.5 | — | 13 | |
| | | | 9.0 | — | 10 | |
| | | | 12.0 | — | 9 | |
| Output enable time | t_{PZL}, t_{PZH} | $R_L = 1 \text{ k}\Omega$ See 12. AC Test Circuit, Figure 1 | 2.0 | — | 125 | ns |
| | | | 4.5 | — | 25 | |
| | | | 9.0 | — | 22 | |
| | | | 12.0 | — | 18 | |
| Output disable time | t_{PLZ}, t_{PHZ} | $R_L = 1 \text{ k}\Omega$ See 12. AC Test Circuit, Figure 1 | 2.0 | — | 145 | ns |
| | | | 4.5 | — | 29 | |
| | | | 9.0 | — | 25 | |
| | | | 12.0 | — | 22 | |
| Control input capacitance | C_{IN} | — | 5.0 | — | 10 | pF |
| Switch terminal capacitance | C_{OS} | See 12. AC Test Circuit, Figure 2 | 5.0 | — | 20 | pF |
| Feedthrough capacitance | C_{IOS} | See 12. AC Test Circuit, Figure 2 | 5.0 | — | 2 | pF |

11.6. AC Characteristics (Note)

(Unless otherwise specified, $C_L = 50 \text{ pF}$, $T_a = -40 \text{ to } 125 \text{ }^\circ\text{C}$, Input: $t_r = t_f = 6 \text{ ns}$)

| Characteristics | Symbol | Test Condition | V_{CC} (V) | Min | Max | Unit |
|--|--------------------|--|--------------|-----|-----|------|
| Phase difference between input to output | $\varphi_{I/O}$ | — | 2.0 | — | 75 | ns |
| | | | 4.5 | — | 15 | |
| | | | 9.0 | — | 12 | |
| | | | 12.0 | — | 11 | |
| Output enable time | t_{PZL}, t_{PZH} | $R_L = 1 \text{ k}\Omega$ See 12. AC Test Circuit, Figure 1 | 2.0 | — | 145 | ns |
| | | | 4.5 | — | 29 | |
| | | | 9.0 | — | 29 | |
| | | | 12.0 | — | 22 | |
| Output disable time | t_{PLZ}, t_{PHZ} | $R_L = 1 \text{ k}\Omega$ See 12. AC Test Circuit, Figure 1 | 2.0 | — | 165 | ns |
| | | | 4.5 | — | 33 | |
| | | | 9.0 | — | 29 | |
| | | | 12.0 | — | 29 | |
| Control input capacitance | C_{IN} | — | 5.0 | — | 10 | pF |
| Switch terminal capacitance | C_{OS} | See 12. AC Test Circuit, Figure 2 | 5.0 | — | 20 | pF |
| Feedthrough capacitance | C_{IOS} | See 12. AC Test Circuit, Figure 2 | 5.0 | — | 2 | pF |

Note: Operating Range spec of $T_{opr} = -40 \text{ }^\circ\text{C}$ to $125 \text{ }^\circ\text{C}$ is applicable only for the products which manufactured after July 2020.

11.7. Analog Switch Characteristics ($T_a = 25 \text{ }^\circ\text{C}$) (Note)

| Characteristics | Symbol | Test Condition | V_{CC} (V) | Typ. | Unit | |
|--|----------------|--|--------------------------------|------|------|---|
| Sine Wave Distortion | THD | $R_L = 10 \text{ k}\Omega$, $C_L = 50 \text{ pF}$, $f_{IN} = 1 \text{ kHz}$ | $V_{IN} = 4.5 \text{ V}_{p-p}$ | 4.5 | 0.05 | % |
| | | | $V_{IN} = 9.0 \text{ V}_{p-p}$ | 9.0 | 0.04 | |
| Maximum frequency response (switch ON) | $f_{MAX(I/O)}$ | V_{IN} is centered at $(V_{CC}/2)$. Adjust input for 0dBm. Increase f_{IN} frequency until dB meter reads -3dB. $R_L = 50 \text{ }\Omega$, $C_L = 10 \text{ pF}$, $f_{IN} = 1 \text{ MHz}$, sine wave See 12. AC Test Circuit, Figure 3 | 4.5 | 200 | MHz | |
| | | | 9.0 | 200 | | |
| Feed through attenuation (switch OFF) | FTH | V_{IN} is centered at $(V_{CC}/2)$. Adjust input for 0dBm. $R_L = 600 \text{ }\Omega$, $C_L = 50 \text{ pF}$, $f_{IN} = 1 \text{ MHz}$, sine wave See 12. AC Test Circuit, Figure 4 | 4.5 | -60 | dB | |
| | | | 9.0 | -60 | | |
| Crosstalk (control input to signal output) | X_{talk} | $R_L = 600 \text{ }\Omega$, $C_L = 50 \text{ pF}$, $f_{IN} = 1 \text{ MHz}$, square wave ($t_r = t_f = 6 \text{ ns}$) See 12. AC Test Circuit, Figure 5 | 4.5 | 60 | mV | |
| | | | 9.0 | 100 | | |
| Crosstalk (between any switches) | X_{talk} | V_{IN} is centered at $(V_{CC}/2)$. Adjust input for 0dBm. $R_L = 600 \text{ }\Omega$, $C_L = 50 \text{ pF}$, $f_{IN} = 1 \text{ MHz}$, sine wave See 12. AC Test Circuit, Figure 6 | 4.5 | -60 | dB | |
| | | | 9.0 | -60 | | |

Note: These characteristics are determined by design of devices.

12. AC Test Circuit

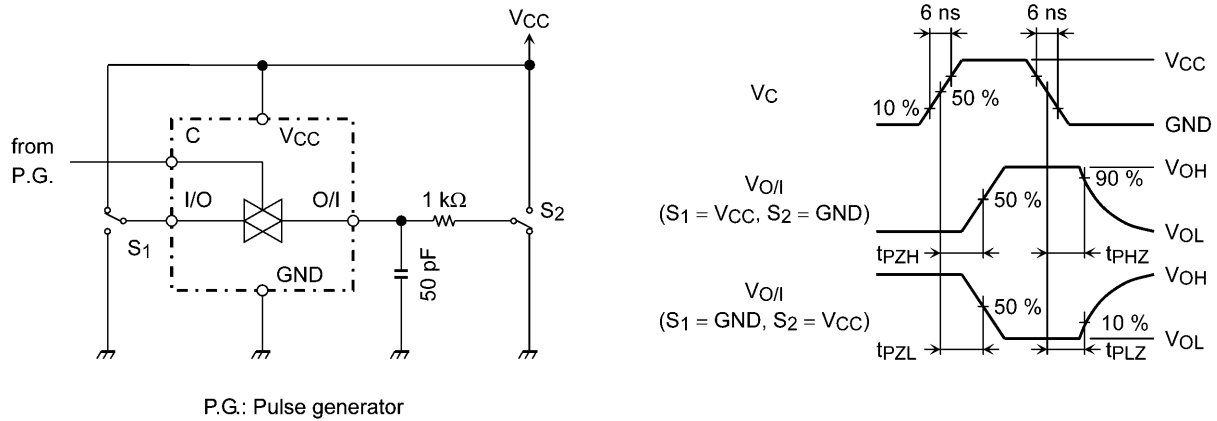


Figure 1 t_{PLZ} , t_{PHZ} , t_{PZL} , t_{PZH}

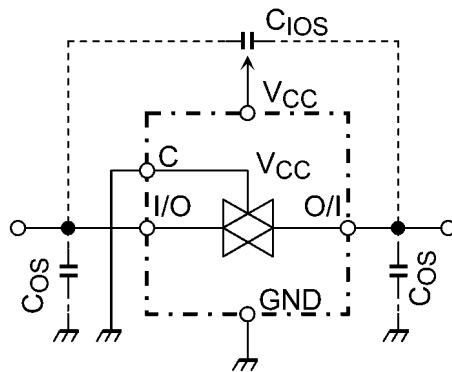


Figure 2 C_{ios} , C_{os}

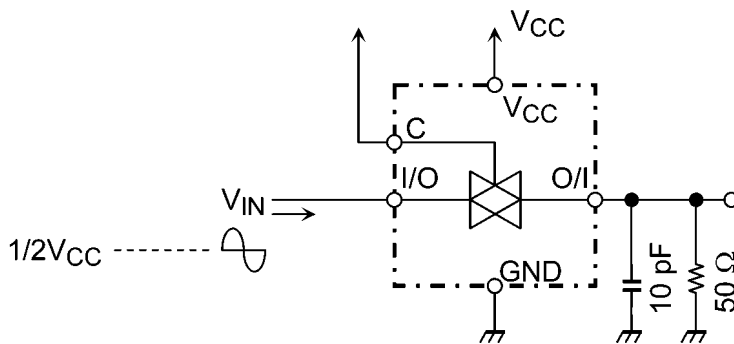


Figure 3 Frequency Response (switch on)

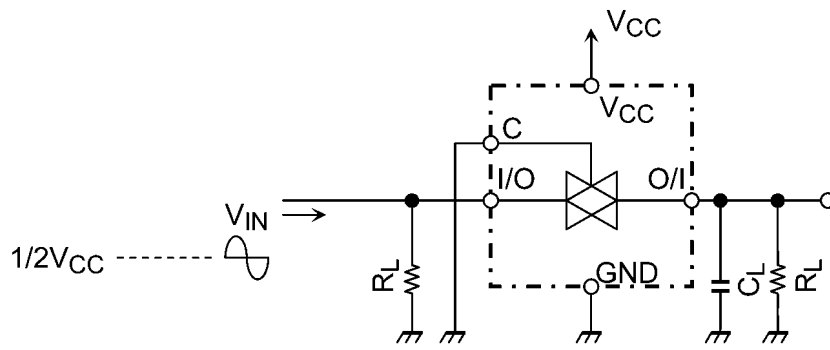


Figure 4 Feedthrough

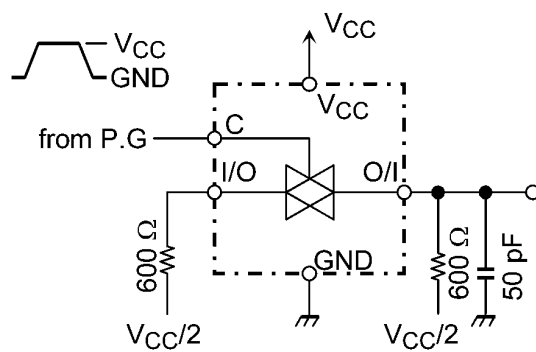


Figure 5 Cross Talk (control input to output signal)

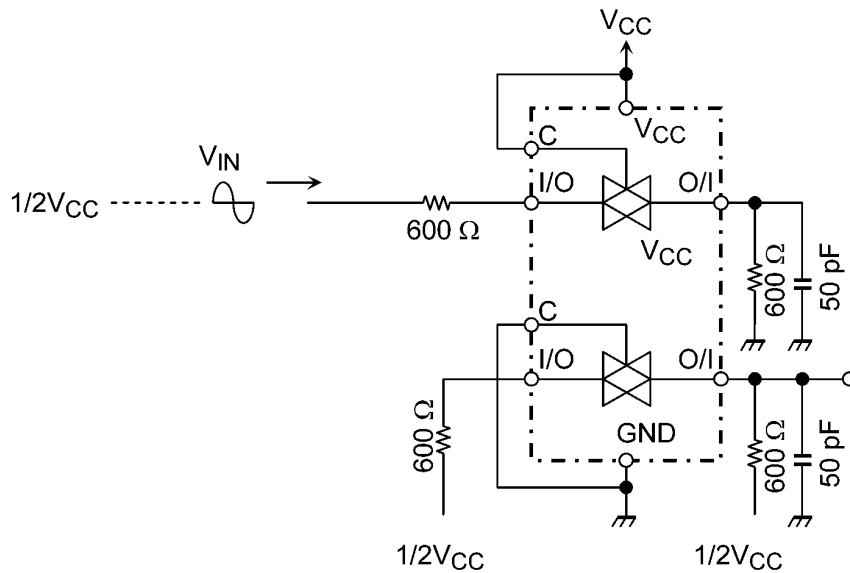
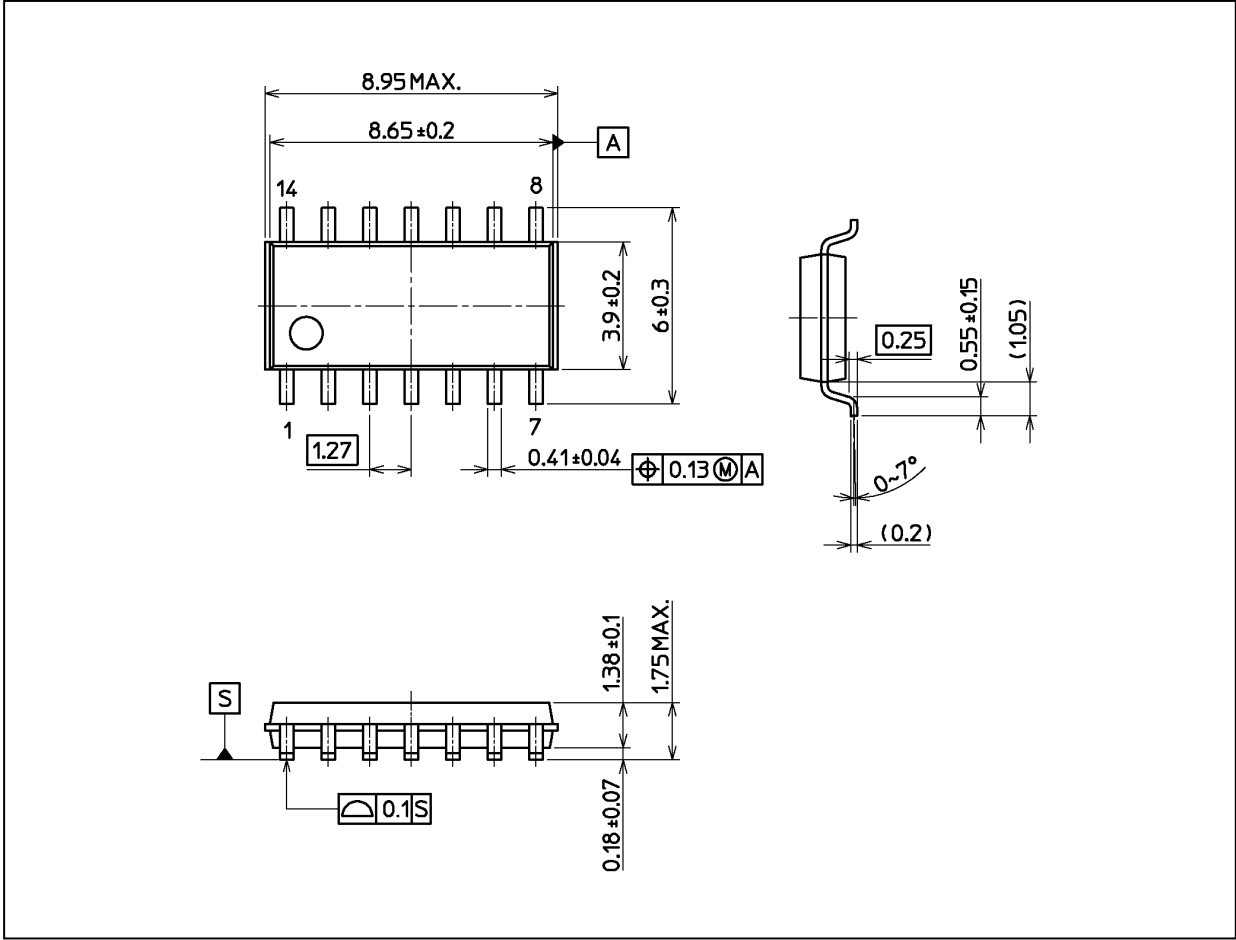


Figure 6 Cross Talk (between any two switches)

Package Dimensions

Unit: mm



Weight: 0.13 g (typ.)

| |
|------------------|
| Package Name(s) |
| Nickname: SOIC14 |

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