CMOS Digital Integrated Circuits Silicon Monolithic

74HC4066D

1. Functional Description

- Quad Bilateral Switch

2. General

The 74HC4066D is high-speed CMOS QUAD BILATERAL SWITCH fabricated with silicon gate C^{2}MOS 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 μA (max) at V_{CC} = 6.0 V, T_a = 25 °C

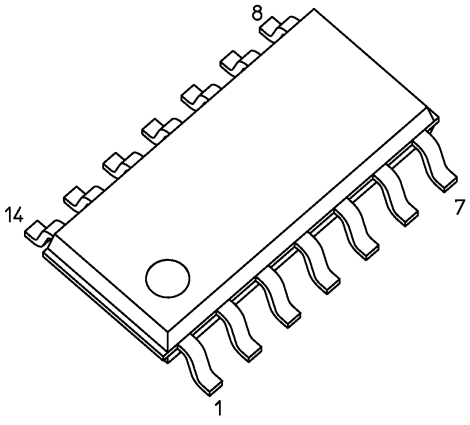
(3) High noise immunity: $V_{NIH} = V_{NIL}$ = 28 % V_{CC} (min)

(4) Low ON resistance: R_{ON} = 50 Ω (typ.) at V_{CC} = 9.0 V, $V_{I/O} = V_{CC}$ 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.

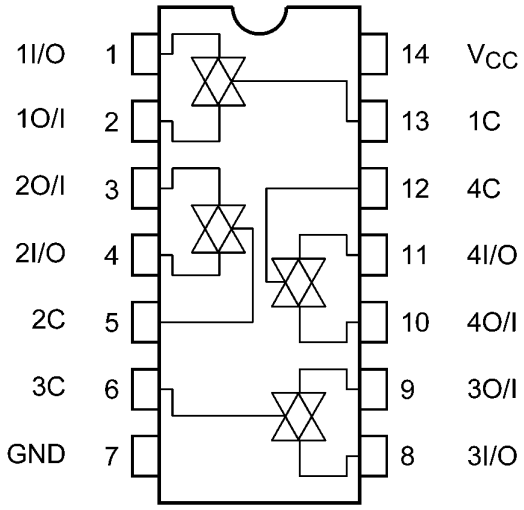
4. Packaging



SOIC14

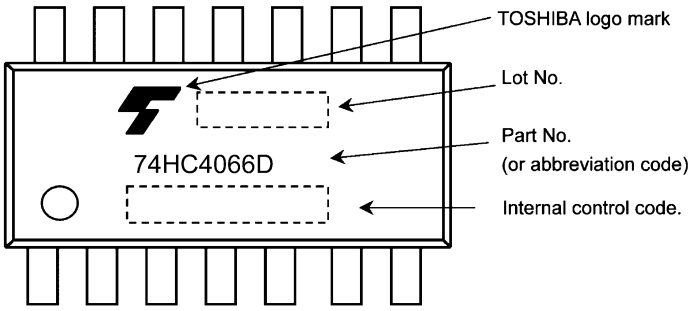
Start of commercial production
2020-07

5. Pin Assignment



(top view)

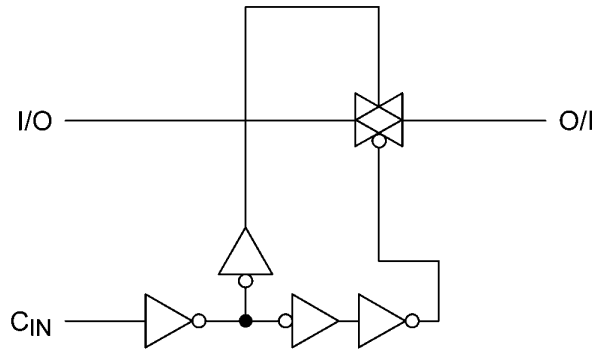
6. Marking



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 °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 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 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 mA	4.5	—	10	30	Ω
			9.0	—	5	12	
			12.0	—	5	10	
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	—	—	±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 $I_{I/O}$ ≤ 1 mA	4.5	—	200	Ω
			9.0	—	100	
			12.0	—	90	
		V_{IN} = V_{IH} $V_{I/O}$ = V_{CC} or GND $I_{I/O}$ ≤ 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 $I_{I/O}$ ≤ 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 pF, T_a = 25 °C, Input: $t_r = t_f$ = 6 ns)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Min	Typ.	Max	Unit
Phase difference between input to output	$\varphi_{I/O}$		—	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 kΩ 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 kΩ 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.

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

11.5. AC Characteristics
(Unless otherwise specified, C_L = 50 pF, T_a = -40 to 85 °C, Input: $t_r = t_f$ = 6 ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
Phase difference between input to output	$\varphi_{I/O}$	—	2.0	—	65	ns
			4.5	—	13	
			9.0	—	10	
			12.0	—	9	
Output enable time	t_{PZL},t_{PZH}	R_L = 1 kΩ 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 kΩ 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 pF, T_a = -40 to 125 °C, Input: $t_r = t_f$ = 6 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 kΩ 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 kΩ 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 °C to 125 °C is applicable only for the products which manufactured after July 2020.

11.7. Analog Switch Characteristics (T_a = 25 °C) (Note)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Typ.	Unit
Sine Wave Distortion	THD	R_L = 10 kΩ, C_L = 50 pF, f_{IN} = 1 kHz	V_{IN} = 4.5 V_{p-p}	4.5	0.05	%
			V_{IN} = 9.0 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 Ω, C_L = 10 pF, f_{IN} = 1 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 Ω, C_L = 50 pF, f_{IN} = 1 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 Ω, C_L = 50 pF, f_{IN} = 1 MHz, square wave ($t_r = t_f$ = 6 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 Ω, C_L = 50 pF, f_{IN} = 1 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

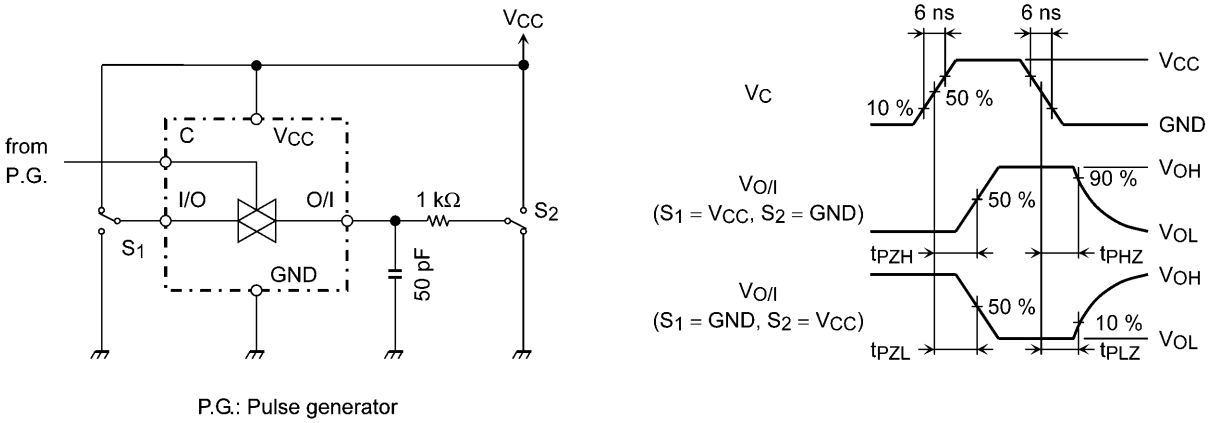


Figure 1 t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}

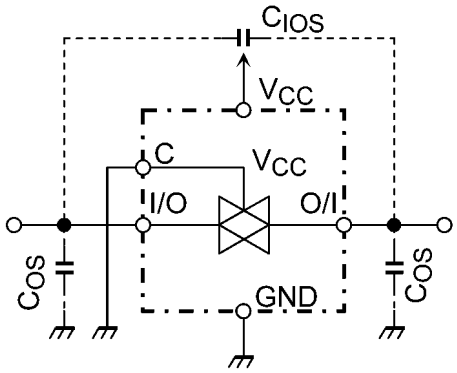


Figure 2 C_{IOS}, C_{OS}

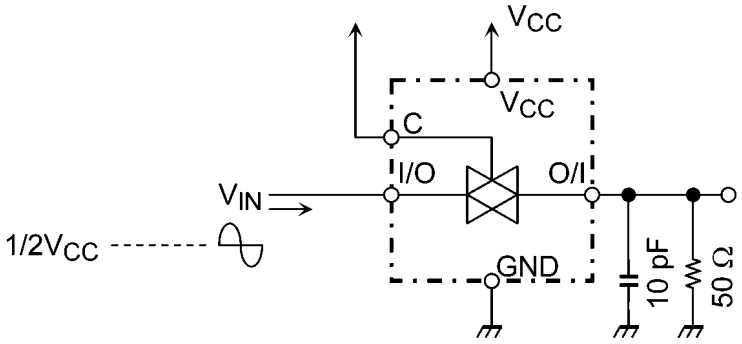


Figure 3 Frequency Response (switch on)

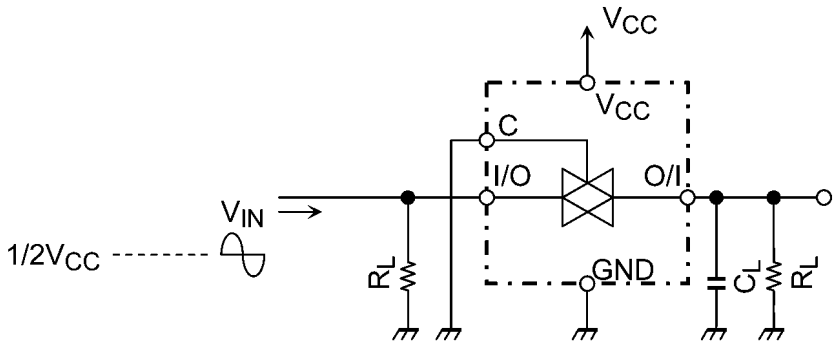


Figure 4 Feedthrough

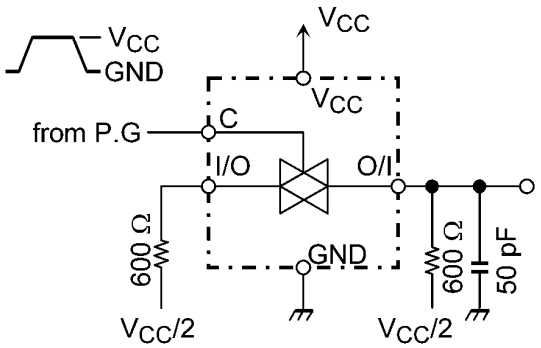


Figure 5 Cross Talk (control input to output signal)

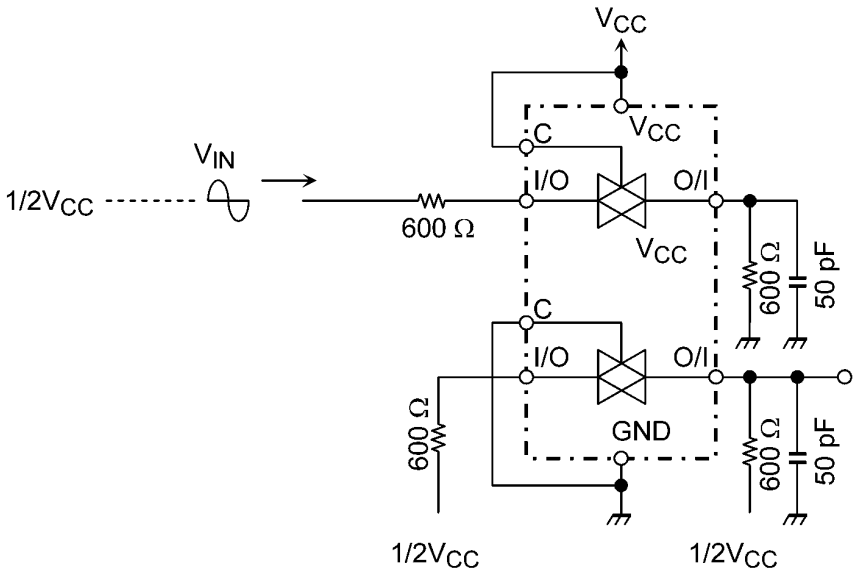
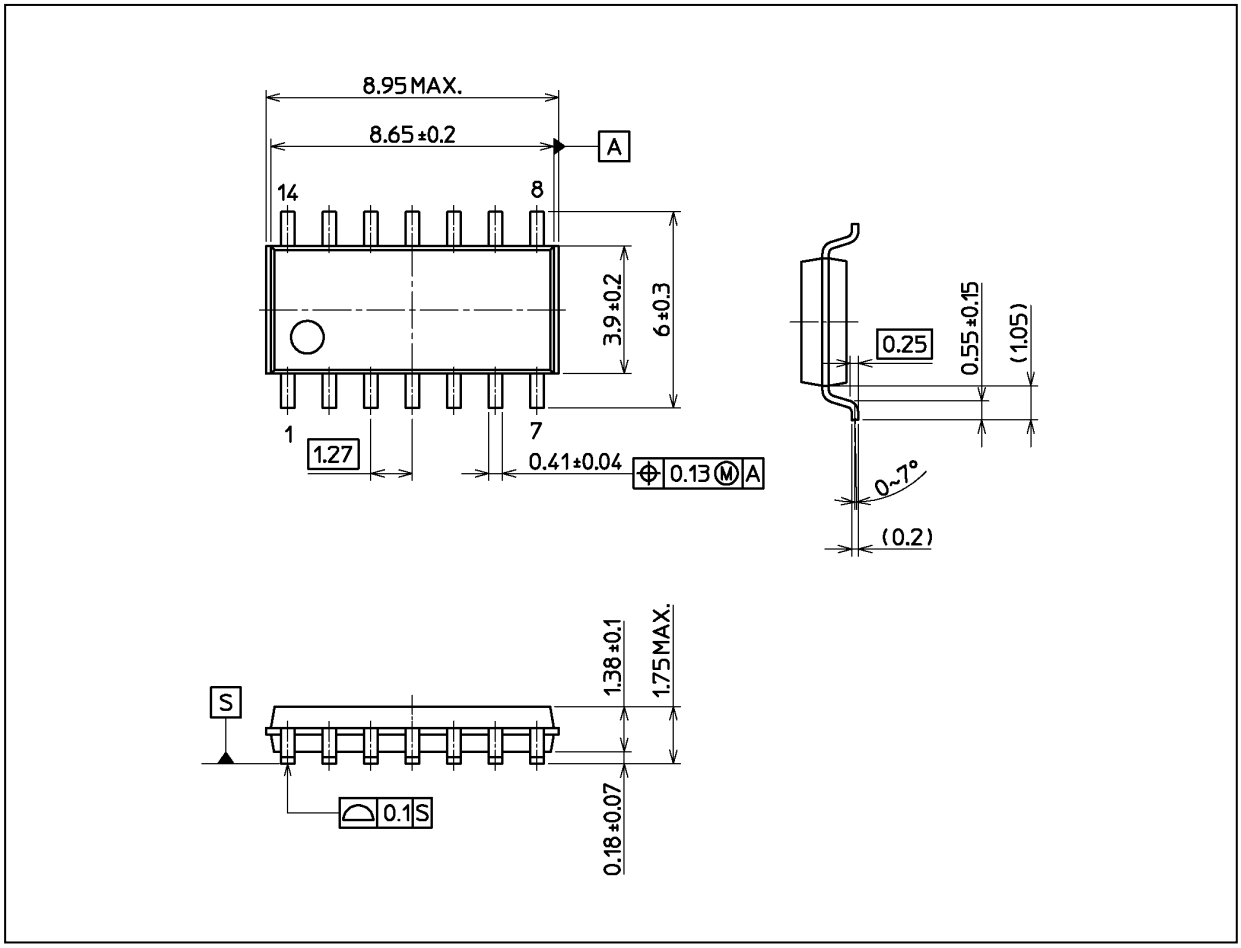


Figure 6 Cross Talk (between any two switches)

Package Dimensions

Unit: mm



Weight: 0.13 g (typ.)

Package Name(s)
Nickname: SOIC14

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