CMOS Digital Integrated Circuits   Silicon Monolithic

74VHC4066AFT

1. Functional Description

・ Quad Bilateral Switch

2. General

The 74VHC4066AFT is high-speed, low-voltage drive QUAD BILATERAL SWITCH fabricated with silicon gate C^{2}MOS technology.

In 3 V and 5 V systems these can achieve high-speed operation with the low power dissipation that is a feature of CMOS.

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

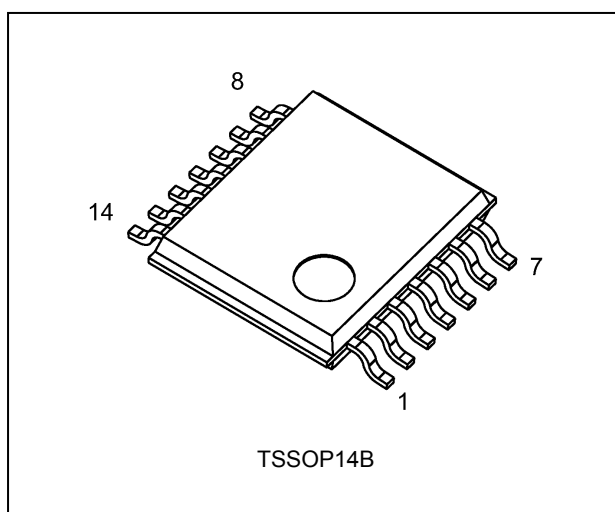The switches for each channel are turned ON by the control pin digital signals.

Control pin is equipped with a newly developed input protection circuit that avoids the need for a diode on the plus side (forward side from the input to the V_{CC}). As a result, for example, 5.5 V signals can be permitted on the inputs even when the power supply voltage to the circuits is off. As a result of this input power protection, the 74VHC4066AFT can be used in a variety of applications, including in the system which has two power supplies, and in battery backup circuits.

3. Features

(1)   AEC-Q100 (Rev. H) (Note 1)

(2)   Wide operating temperature range: T_{opr} = -40 to 125 ℃

(3)   Low ON resistance: R_{ON} = 45 Ω (typ.) at V_{CC} = 3.0 V

: R_{ON} = 24 Ω (typ.) at V_{CC} = 4.5 V

(4)   Low power dissipation: I_{CC} = 2.0 μA (max) at T_a = 25 ℃

(5)   Input level: V_{IL} = 0.8 V (max) at V_{CC} = 3.0 V

: V_{IH} = 2.0 V (min) at V_{CC} = 3.0 V

(6)   Power-down protection is provided on all control inputs.

Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.
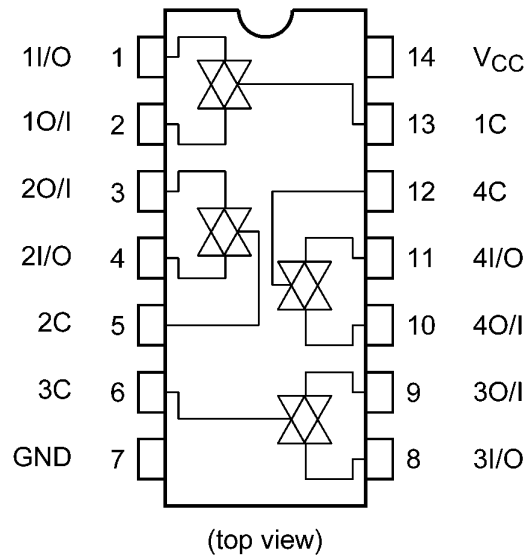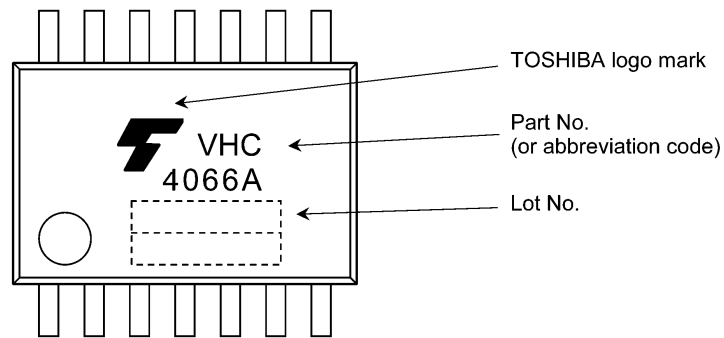
4. Packaging

TSSOP14B

Start of commercial production
2014-10

2017-02-22
Rev.3.0

5. Pin Assignment

1I/O	1		14	V_{CC}
1O/I	2		13	1C
2O/I	3		12	4C
2I/O	4		11	4I/O
2C	5		10	4O/I
3C	6		9	3O/I
GND	7		8	3I/O

(top view)

6. Marking

VHC
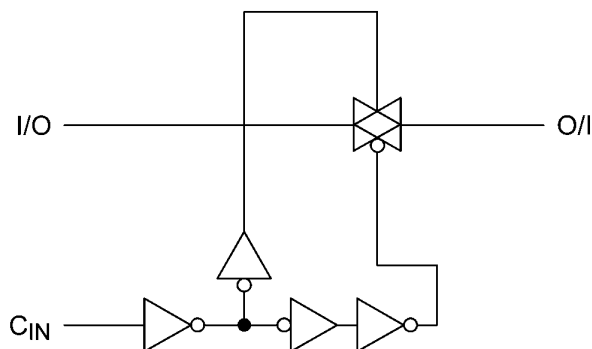4066A

TOSHIBA logo mark

Part No.
(or abbreviation code)

Lot No.

7. Truth Table

Control	Switch Function
H	On
L	Off

8. System Diagram (per circuit)

I/O ———————— O/I

C_{IN}

2017-02-22
Rev.3.0

9. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 7.0	V
Input voltage	V_{IN}		-0.5 to 7.0	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	$I_{I/OK}$		±25	mA
Switch through current	I_T		±25	mA
V_{CC}/ground current	I_{CC}		±50	mA
Power dissipation	P_D	(Note 1)	180	mW
Storage temperature	T_{stg}		-65 to 150	℃

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: 180 mW in the range of T_a = -40 to 85 ℃. From T_a = 85 to 125 ℃ a derating factor of -3.25 mW/℃ shall be applied until 50 mW.

10. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Rating	Unit
Supply voltage	V_{CC}		2.0 to 5.5	V
Input voltage	V_{IN}		0 to 5.5	V
Switch I/O voltage	$V_{I/O}$		0 to V_{CC}	V
Operating temperature	T_{opr}		-40 to 125	℃
Input rise and fall times	dt/dv	V_{CC} = 2.5 ± 0.2 V	0 to 200	ns/V
		V_{CC} = 3.3 ± 0.3 V	0 to 100	
		V_{CC} = 5.0 ± 0.5 V	0 to 20	

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.

11. Electrical Characteristics

11.1. DC Characteristics (Unless otherwise specified, T_a = 25 ℃)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Typ.	Max	Unit
High-level input voltage	V_{IH}	—	2.0	1.5	—	—	V
			3.0	2.0	—	—	
			4.5	3.15	—	—	
			5.5	3.85	—	—	
Low-level input voltage	V_{IL}	—	2.0	—	—	0.5	V
			3.0	—	—	0.8	
			4.5	—	—	1.35	
			5.5	—	—	1.65	
ON-resistance	R_{ON}	V_{IN} = V_{IH} $V_{I/O}$ = V_{CC} to GND $I_{I/O}$ = 2 mA	2.3	—	200	—	Ω
			3.0	—	45	86	
			4.5	—	24	37	
		V_{IN} = V_{IH} $V_{I/O}$ = V_{CC} or GND $I_{I/O}$ = 2 mA	2.3	—	28	73	
			3.0	—	22	38	
			4.5	—	17	27	
Difference of ON-resistance between switches	ΔR_{ON}	V_{IN} = V_{IH} $V_{I/O}$ = V_{CC} to GND $I_{I/O}$ = 2 mA	2.3	—	10	25	Ω
			3.0	—	5	15	
			4.5	—	5	13	
Input/Output leakage current (Switch OFF)	I_{OFF}	V_{OS} = V_{CC} or GND V_{IS} = GND to V_{CC} V_{IN} = V_{IL}	5.5	—	—	±0.1	μA
Input/Output leakage current (Switch ON, output open)	$I_{I/O}$	V_{OS} = V_{CC} or GND V_{IN} = V_{IH}	5.5	—	—	±0.1	μA
Control input leakage current	I_{IN}	V_{IN} = V_{CC} or GND	5.5	—	—	±0.1	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND	5.5	—	—	2.0	μA

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

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	—	2.0	1.5	—	V
			3.0	2.0	—	
			4.5	3.15	—	
			5.5	3.85	—	
Low-level input voltage	V_{IL}	—	2.0	—	0.5	V
			3.0	—	0.8	
			4.5	—	1.35	
			5.5	—	1.65	
ON-resistance	R_{ON}	V_{IN} = V_{IH} $V_{I/O}$ = V_{CC} to GND $I_{I/O}$ = 2 mA	2.3	—	—	Ω
			3.0	—	108	
			4.5	—	46	
		V_{IN} = V_{IH} $V_{I/O}$ = V_{CC} or GND $I_{I/O}$ = 2 mA	2.3	—	84	
			3.0	—	44	
			4.5	—	31	
Difference of ON-resistance between switches	ΔR_{ON}	V_{IN} = V_{IH} $V_{I/O}$ = V_{CC} to GND $I_{I/O}$ = 2 mA	2.3	—	35	Ω
			3.0	—	20	
			4.5	—	18	
Input/Output leakage current (Switch OFF)	I_{OFF}	V_{OS} = V_{CC} or GND V_{IS} = GND to V_{CC} V_{IN} = V_{IL}	5.5	—	±1.0	μA
Input/Output leakage current (Switch ON, output open)	$I_{I/O}$	V_{OS} = V_{CC} or GND V_{IN} = V_{IH}	5.5	—	±1.0	μA
Control input leakage current	I_{IN}	V_{IN} = V_{CC} or GND	5.5	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND	5.5	—	20.0	μA

11.3. DC Characteristics (Unless otherwise specified, T_a = -40 to 125 ℃)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	—	2.0	1.5	—	V
			3.0	2.0	—	
			4.5	3.15	—	
			5.5	3.85	—	
Low-level input voltage	V_{IL}	—	2.0	—	0.5	V
			3.0	—	0.8	
			4.5	—	1.35	
			5.5	—	1.65	
ON-resistance	R_{ON}	V_{IN} = V_{IH} $V_{I/O}$ = V_{CC} to GND $I_{I/O}$ = 2 mA	2.3	—	—	Ω
			3.0	—	125	
			4.5	—	54	
		V_{IN} = V_{IH} $V_{I/O}$ = V_{CC} or GND $I_{I/O}$ = 2 mA	2.3	—	105	Ω
			3.0	—	55	
			4.5	—	39	
Difference of ON-resistance between switches	ΔR_{ON}	V_{IN} = V_{IH} $V_{I/O}$ = V_{CC} to GND $I_{I/O}$ = 2 mA	2.3	—	45	Ω
			3.0	—	25	
			4.5	—	23	
Input/Output leakage current (Switch OFF)	I_{OFF}	V_{OS} = V_{CC} or GND V_{IS} = GND to V_{CC} V_{IN} = V_{IL}	5.5	—	±4.0	μA
Input/Output leakage current (Switch ON, output open)	$I_{I/O}$	V_{OS} = V_{CC} or GND V_{IN} = V_{IH}	5.5	—	±4.0	μA
Control input leakage current	I_{IN}	V_{IN} = V_{CC} or GND	5.5	—	±2.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND	5.5	—	40.0	μA

11.4. AC Characteristics (Unless otherwise specified, T_a = 25 °C, Input: $t_r = t_f$ = 3 ns)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Min	Typ.	Max	Unit
Phase difference between input to output	$\varphi_{I/O}$		C_L = 15 pF R_L = 1 kΩ	2.5 ± 0.2	—	1.2	10	ns
				3.3 ± 0.3	—	0.8	6	
				5.0 ± 0.5	—	0.3	4	
			C_L = 50 pF R_L = 1 kΩ	2.5 ± 0.2	—	2.6	12	
				3.3 ± 0.3	—	1.5	9	
				5.0 ± 0.5	—	0.6	6	
Output enable time	t_{PZL}, t_{PZH}		C_L = 15 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	3.3	15	ns
				3.3 ± 0.3	—	2.3	11	
				5.0 ± 0.5	—	1.6	7	
			C_L = 50 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	4.2	25	
				3.3 ± 0.3	—	3.0	18	
				5.0 ± 0.5	—	2.1	12	
Output disable time	t_{PLZ}, t_{PHZ}		C_L = 15 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	6	15	ns
				3.3 ± 0.3	—	4.5	11	
				5.0 ± 0.5	—	3.2	7	
			C_L = 50 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	9.6	25	
				3.3 ± 0.3	—	7.2	18	
				5.0 ± 0.5	—	5.1	12	
Control input capacitance	C_{IN}		All types		—	3	—	pF
Switch terminal capacitance	C_{OS}		See 12. AC Test Circuit, Figure 2		—	5.5	—	pF
Feedthrough capacitance	C_{IOS}		See 12. AC Test Circuit, Figure 2		—	0.5	—	pF
Power dissipation capacitance	C_{PD}	(Note 1)	See 12. AC Test Circuit, Figure 2		—	4.5	—	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.

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

11.5. AC Characteristics
(Unless otherwise specified, T_a = –40 to 85 ℃, Input: t_r = t_f = 3 ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
Phase difference between input to output	$\varphi_{I/O}$	C_L = 15 pF R_L = 1 kΩ	2.5 ± 0.2	—	16	ns
			3.3 ± 0.3	—	10	
			5.0 ± 0.5	—	7	
		C_L = 50 pF R_L = 1 kΩ	2.5 ± 0.2	—	18	
			3.3 ± 0.3	—	12	
			5.0 ± 0.5	—	8	
Output enable time	t_{PZL}, t_{PZH}	C_L = 15 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	20	ns
			3.3 ± 0.3	—	15	
			5.0 ± 0.5	—	10	
		C_L = 50 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	32	
			3.3 ± 0.3	—	22	
			5.0 ± 0.5	—	16	
Output disable time	t_{PLZ}, t_{PHZ}	C_L = 15 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	23	ns
			3.3 ± 0.3	—	15	
			5.0 ± 0.5	—	10	
		C_L = 50 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	32	
			3.3 ± 0.3	—	22	
			5.0 ± 0.5	—	16	

11.6. AC Characteristics
(Unless otherwise specified, T_a = –40 to 125 ℃, Input: t_r = t_f = 3 ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
Phase difference between input to output	$\varphi_{I/O}$	C_L = 15 pF R_L = 1 kΩ	2.5 ± 0.2	—	20	ns
			3.3 ± 0.3	—	13	
			5.0 ± 0.5	—	9	
		C_L = 50 pF R_L = 1 kΩ	2.5 ± 0.2	—	22	
			3.3 ± 0.3	—	14	
			5.0 ± 0.5	—	9.5	
Output enable time	t_{PZL}, t_{PZH}	C_L = 15 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	23.5	ns
			3.3 ± 0.3	—	18	
			5.0 ± 0.5	—	12	
		C_L = 50 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	37	
			3.3 ± 0.3	—	25	
			5.0 ± 0.5	—	19	
Output disable time	t_{PLZ}, t_{PHZ}	C_L = 15 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	28.5	ns
			3.3 ± 0.3	—	18	
			5.0 ± 0.5	—	12	
		C_L = 50 pF R_L = 1 kΩ See 12. AC Test Circuit, Figure 1	2.5 ± 0.2	—	37	
			3.3 ± 0.3	—	25	
			5.0 ± 0.5	—	19	

11.7. Analog Switch Characteristics (T$_a$ = 25 ℃) (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$_{IN}$ = 2.0 V$_{p-p}$	3.0	0.1	%
			V$_{IN}$ = 4.0 V$_{p-p}$	4.5	0.03	
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, sine wave See 12. AC Test Circuit, Figure 3		3.0	250	MHz
				4.5	290	
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		3.0	-45	dB
				4.5	-45	
		R$_L$ = 50 Ω, C$_L$ = 10 pF, f$_{IN}$ = 1 MHz, sine wave		3.0	-65	
				4.5	-65	
Crosstalk (control input to signal output)	X$_{talk}$	R$_L$ = 600 Ω, C$_L$ = 50 pF, f$_{IN}$ = 1 MHz, square wave (tr = tf = 6 ns) See 12. AC Test Circuit, Figure 5		3.0	60	mV
				4.5	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		3.0	-45	dB
				4.5	-45	

Note: These characteristics are determined by design of devices.
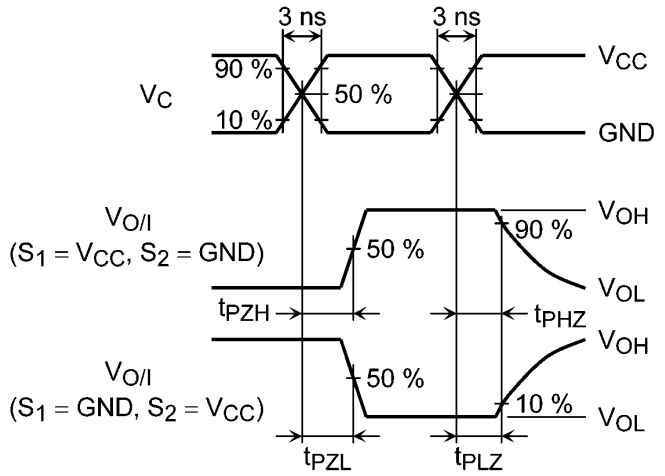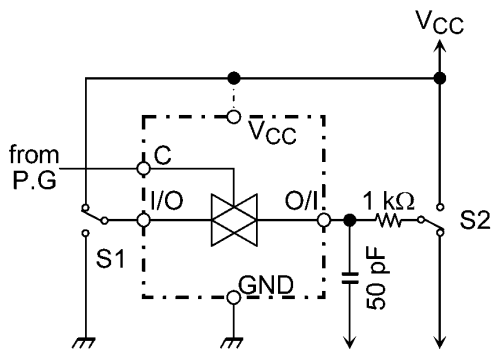
12. AC Test Circuit

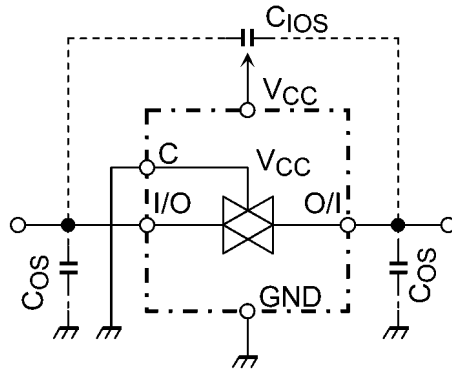Figure 1 t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}

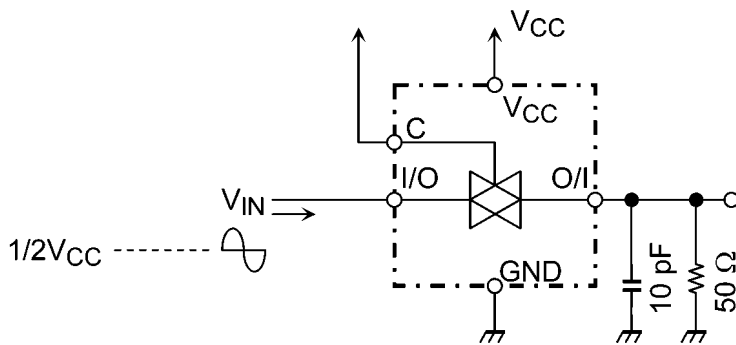Figure 2 C_{IOS}, C_{OS}
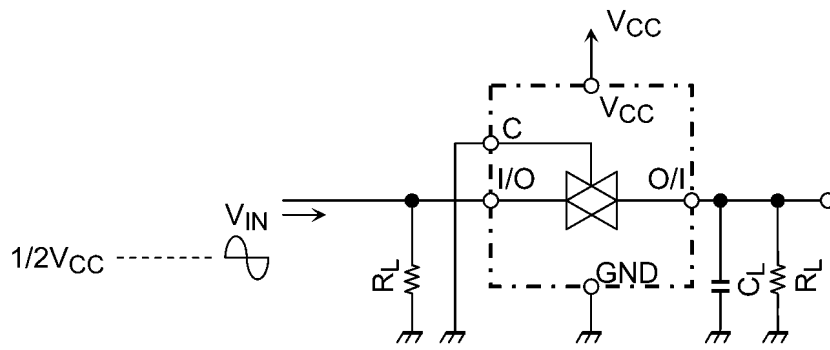

Figure 3 Frequency Response (switch on)
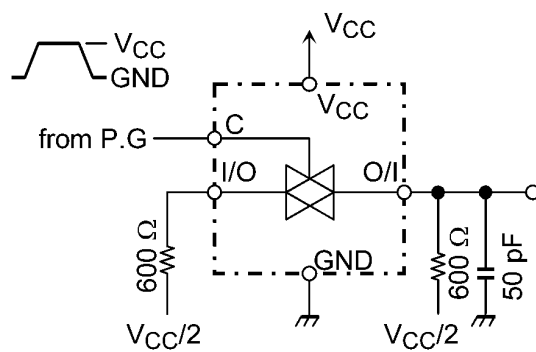
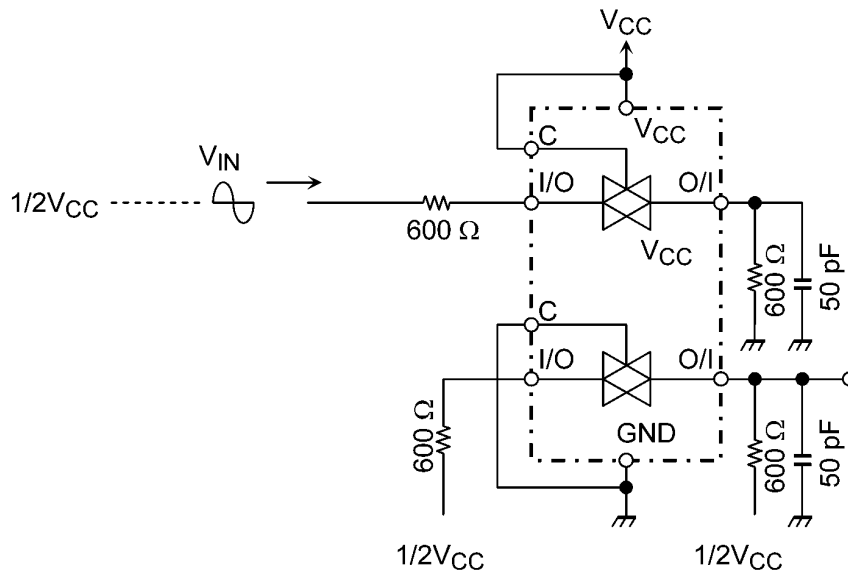Figure 4 Feedthrough
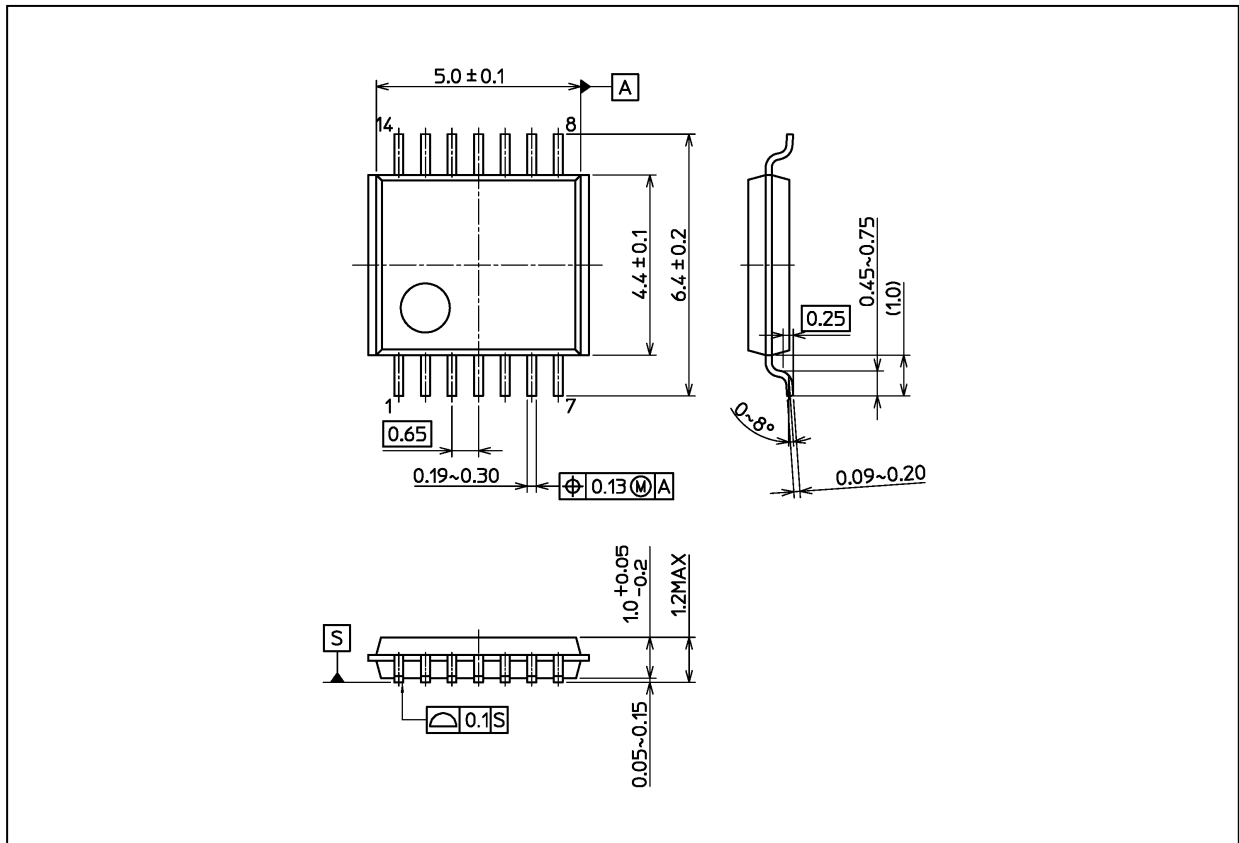

Figure 5 Cross Talk (control input to output signal)

Figure 6 Cross Talk (between any two switches)

Package Dimensions

Unit: mm

Weight: 0.054 g (typ.)

Package Name(s)
Nickname: TSSOP14B

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