

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74VHC4066AF, TC74VHC4066AFK**Quad Bilateral Switch**

The TC74VHC4066A is high-speed, low-voltage drive QUAD BILATERAL SWITCH fabricated with silicon gate C²MOS 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.

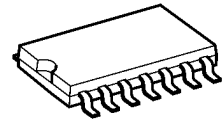
The switches for each channel are turned ON by the control pin digital signals.

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 VCC). 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 TC74VHC4066AFT can be used in a variety of applications, including in the system which has two power supplies, and in battery backup circuits.

Features

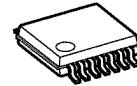
- Low ON resistance: $R_{on} = 45 \Omega$ (typ.) ($V_{CC} = 3.0 \text{ V}$)
 $R_{on} = 24 \Omega$ (typ.) ($V_{CC} = 4.5 \text{ V}$)
- Low power dissipation: $I_{CC} = 2.0 \mu\text{A}$ (max) ($T_a = 25^\circ\text{C}$)
- Input level: $V_{IL} = 0.8 \text{ V}$ (max) ($V_{CC} = 3 \text{ V}$)
 $V_{IH} = 2.0 \text{ V}$ (min) ($V_{CC} = 3 \text{ V}$)
- Power down protection is provided on all control inputs

TC74VHC4066AF



SOP14-P-300-1.27A

TC74VHC4066AFK



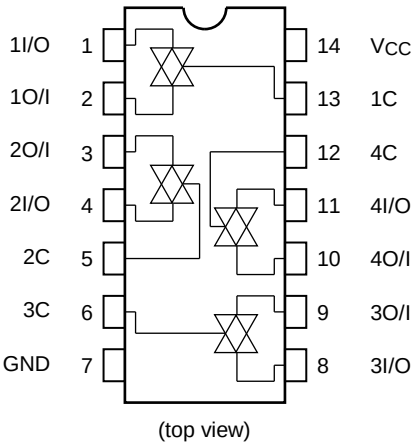
VSSOP14-P-0030-0.50

Weight

SOP14-P-300-1.27A	: 0.18 g (typ.)
VSSOP14-P-0030-0.50	: 0.02g (typ.)

Start of commercial production
2007-01

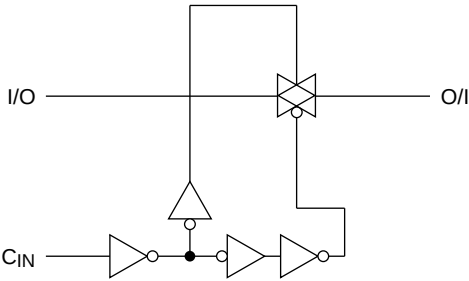
Pin Assignment (top view)



Truth Table

Control	Switch Function
H	On
L	Off

System Diagram (1/4 Package)



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	-0.5 to 7.0	V
Control 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_{IOK}	± 25	mA
Switch through current	I_T	± 25	mA
DC V_{CC} or ground current	I_{CC}	± 50	mA
Power dissipation	P_D	180	mW
Storage temperature	T_{stg}	-65 to 150	°C

Note: Exceeding any of the absolute maximum ratings, even briefly, may 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).

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	2 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 85	°C
Input rise and fall time	dt/dv	0 to 200 ($V_{CC} = 2.5 \pm 0.2$ V) 0 to 100 ($V_{CC} = 3.3 \pm 0.3$ V) 0 to 20 ($V_{CC} = 5 \pm 0.5$ V)	ns/V

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.

Electrical Characteristics

DC Electrical Characteristics

Characteristics		Symbol	Test Condition	Ta = 25°C				Ta = –40 to 85°C		Unit
				V _{CC} (V)	Min	Typ.	Max	Min	Max	
Input voltage	High level	V _{IH}	—	2.0	1.5	—	—	1.5	—	V
				3.0	2.0	—	—	2.0	—	
				4.5	3.15	—	—	3.15	—	
				5.5	3.85	—	—	3.85	—	
	Low level	V _{IL}	—	2.0	—	—	0.5	—	0.5	
				3.0	—	—	0.8	—	0.8	
				4.5	—	—	1.35	—	1.35	
				5.5	—	—	1.65	—	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
			V _{IN} = V _{IH} V _{I/O} = V _{CC} or GND I _{I/O} = 2 mA	3.0	—	45	86	—	108	
				4.5	—	24	37	—	46	
				2.3	—	28	73	—	84	
				3.0	—	22	38	—	44	
				4.5	—	17	27	—	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	—	10	25	—	35	Ω
				3.0	—	5	15	—	20	
				4.5	—	5	13	—	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	—	—	±0.1	—	±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	—	—	±0.1	—	±1.0	μA
Control input current		I _{IN}	V _{IN} = V _{CC} or GND	5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND	5.5	—	—	2.0	—	20.0	μA

AC Electrical Characteristics (Input: $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
				VCC (V)	Min	Typ.	Max	Min		Max
Phase difference between input and output	ϕI/O	CL = 15 pF RL = 1 kΩ		2.5±0.2	—	1.2	10	—	16	ns
				3.3±0.3	—	0.8	6	—	10	
				5.0±0.5	—	0.3	4	—	7	
		CL = 50 pF RL = 1 kΩ		2.5±0.2	—	2.6	12	—	18	
				3.3±0.3	—	1.5	9	—	12	
				5.0±0.5	—	0.6	6	—	8	
Output enable time	tpZL tpZH	CL = 15 pF RL = 1 kΩ	Figure 1	2.5±0.2	—	3.3	15	—	20	ns
				3.3±0.3	—	2.3	11	—	15	
				5.0±0.5	—	1.6	7	—	10	
		CL = 50 pF RL = 1 kΩ	Figure 1	2.5±0.2	—	4.2	25	—	32	
				3.3±0.3	—	3.0	18	—	22	
				5.0±0.5	—	2.1	12	—	16	
Output disable time	tpLZ tpHZ	CL = 15 pF RL = 1 kΩ	Figure 1	2.5±0.2	—	6	15	—	23	ns
				3.3±0.3	—	4.5	11	—	15	
				5.0±0.5	—	3.2	7	—	10	
		CL = 50 pF RL = 1 kΩ	Figure 1	2.5±0.2	—	9.6	25	—	32	
				3.3±0.3	—	7.2	18	—	22	
				5.0±0.5	—	5.1	12	—	16	
Control input capacitance	CIN	All types		—	—	3	—	—	pF	
SWITCH terminal capacitance	COS	Figure 2		—	5.5	—	—	—	pF	
Feed through capacitance	CIOS	Figure 2		—	0.5	—	—	—	pF	
Power dissipation capacitance	CPD	Figure 2 (Note)		—	4.5	—	—	—	pF	

Note: CPD is defined as the value of the internal equivalent capacitance of IC which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

Analog Switch Characteristics (Ta = 25°C) (Note)

Characteristics	Test Condition		V _{CC} (V)	Typ.	Unit
Sine Wave Distortion (T.H.D)	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	
Frequency response (switch ON)	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 Figure 3		3.0	250	MHz
			4.5	290	
Feed through attenuation (switch OFF)	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 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)	R _L = 600 Ω, C _L = 50 pF, f _{IN} = 1 MHz, square wave (t _r = t _f = 6 ns) Figure 5		3.0	60	mV
			4.5	100	
Crosstalk (between any switches)	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 Figure 6		3.0	-45	dB
			4.5	-45	

Note: These characteristics are determined by design of devices.

AC Test Circuit

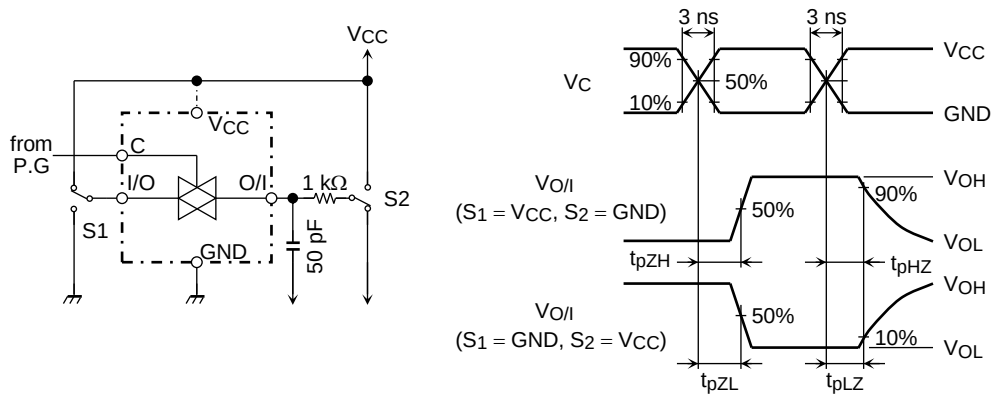


Figure 1 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}

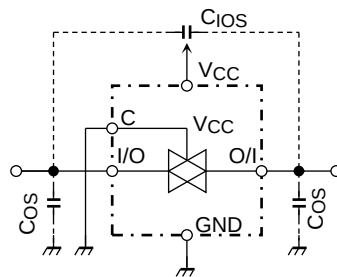


Figure 2 C_{ios} , C_{os}

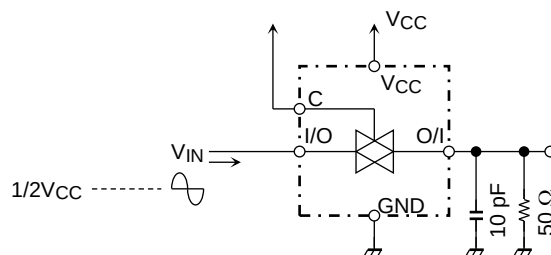


Figure 3 Frequency Response (switch on)

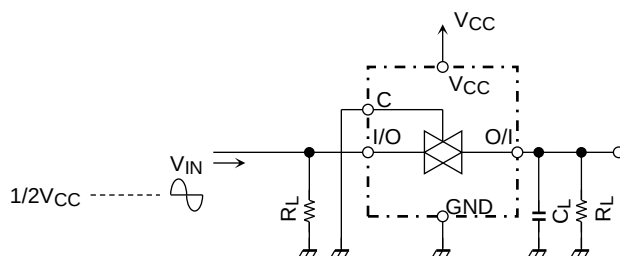


Figure 4 Feedthrough

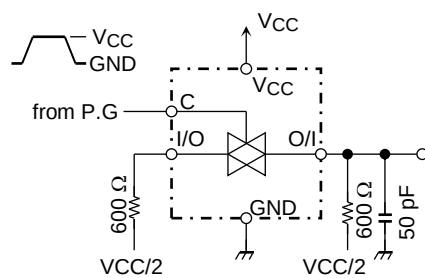


Figure 5 Cross Talk (control input to output signal)

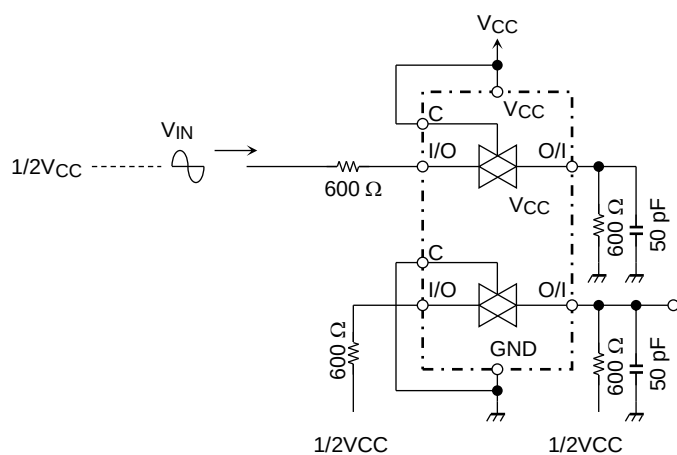
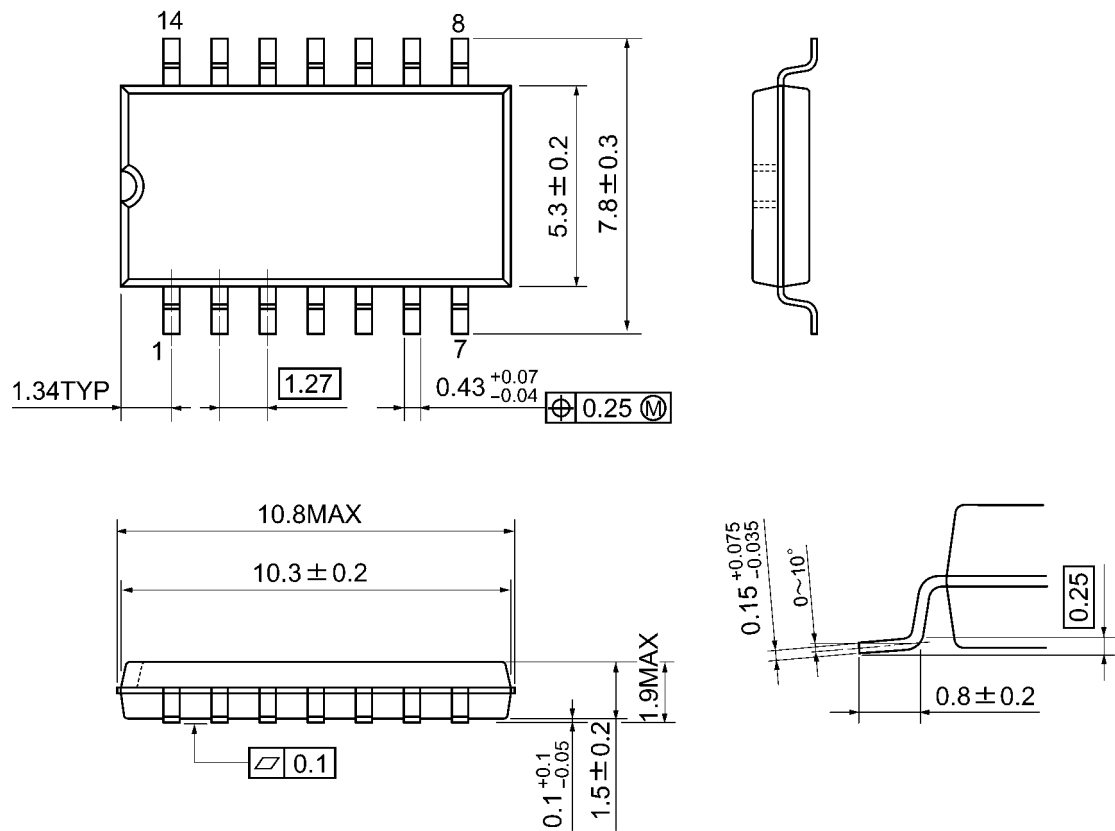


Figure 6 Cross Talk (between any two switches)

Package Dimensions

SOP14-P-300-1.27A

Unit: mm

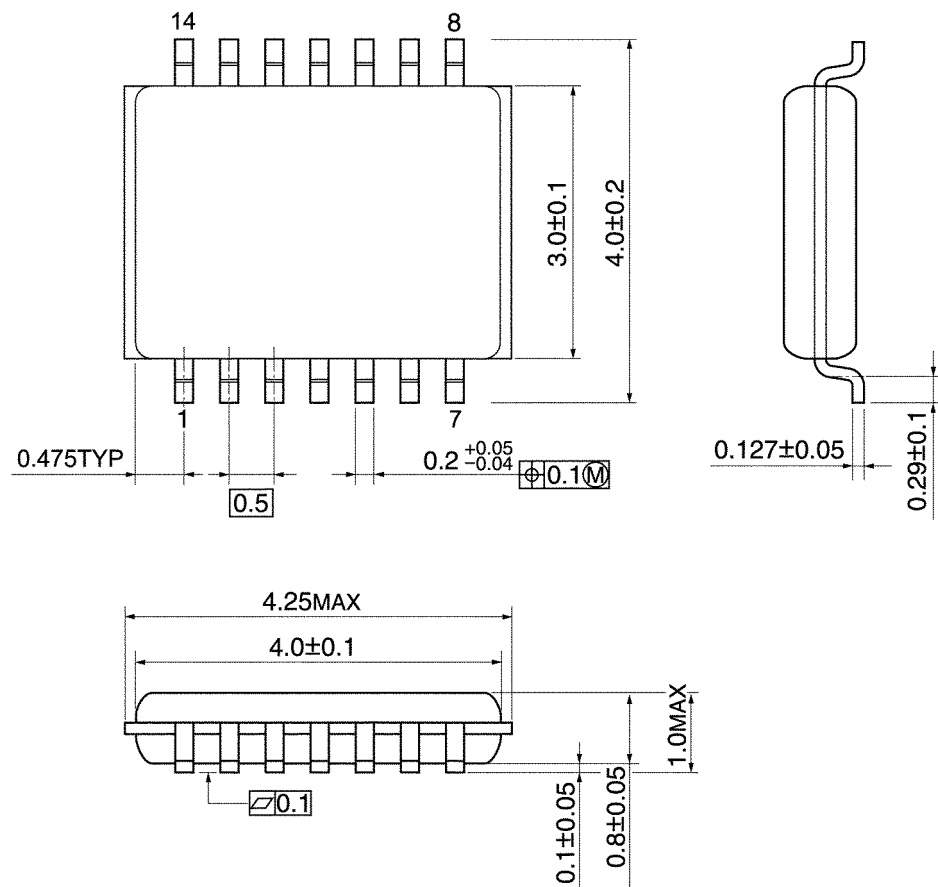


Weight: 0.18 g (typ.)

Package Dimensions

VSSOP14-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

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