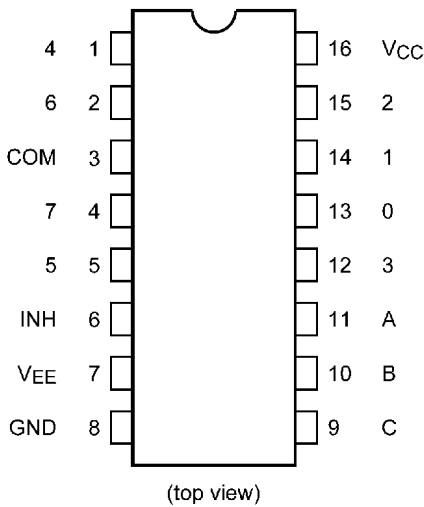


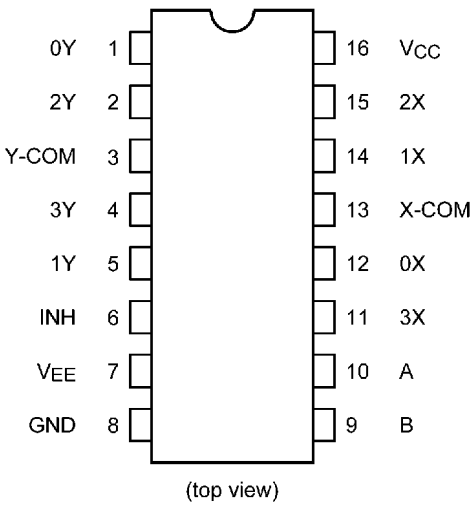
5. Pin Assignment

74HCT4051D



(top view)

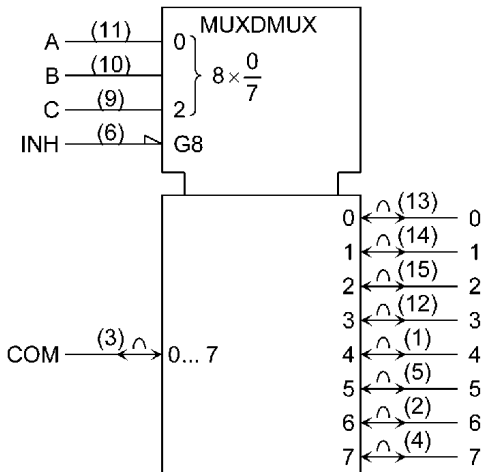
74HCT4052D



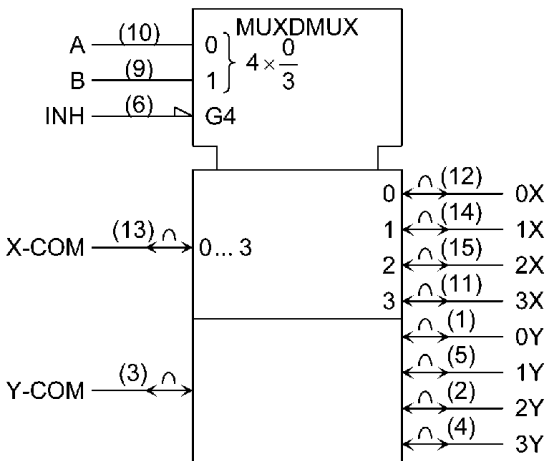
(top view)

6. IEC Logic Symbol

74HCT4051D

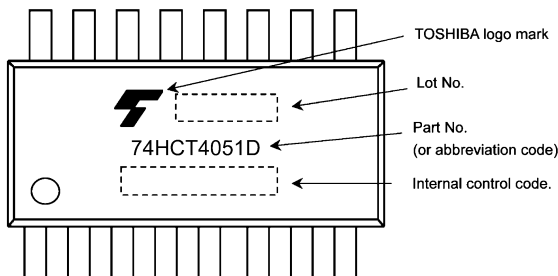


74HCT4052D

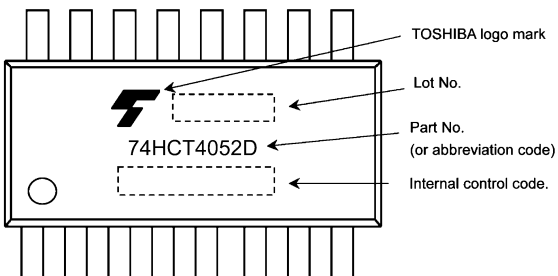


7. Marking

74HCT4051D

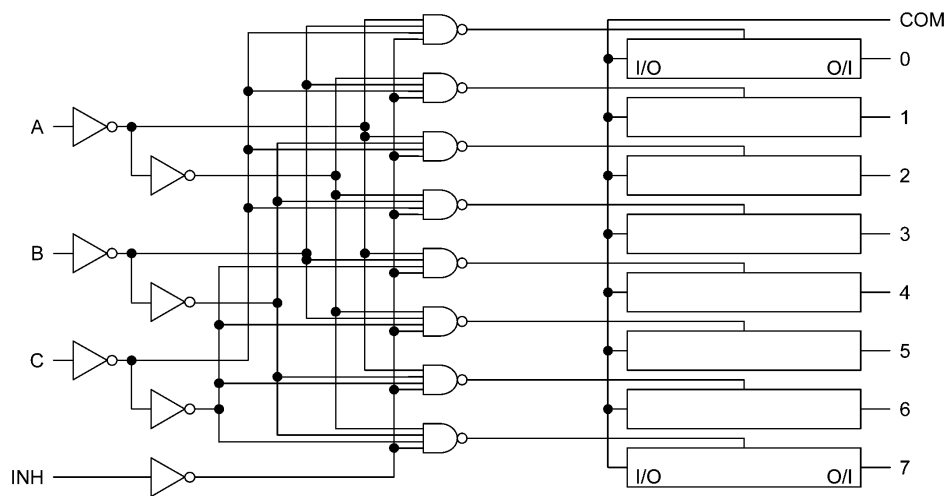


74HCT4052D

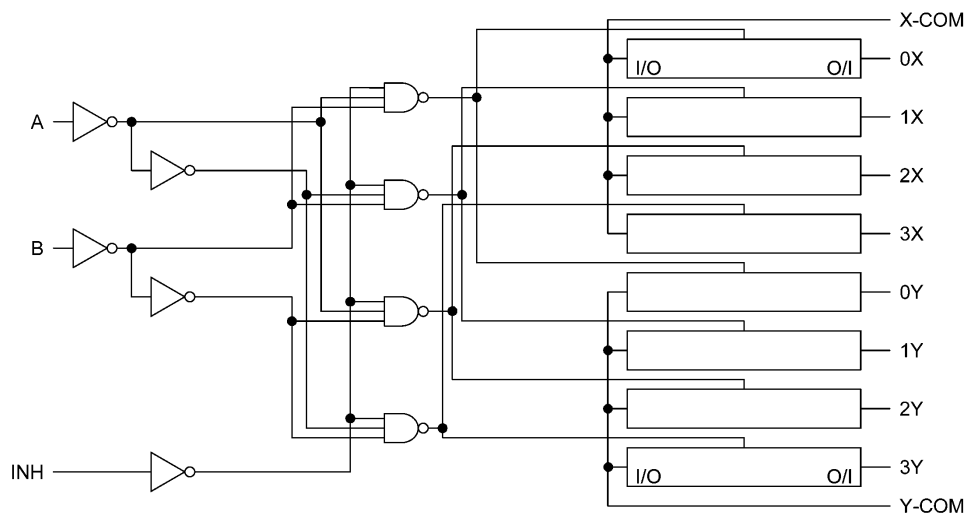


## 8. System Diagram

74HCT4051D



74HCT4052D



### 9. Truth Table

Input Inhibit	Input C*	Input B	Input A	ON Channel 74HCT4051D	ON Channel 74HCT4052D
L	L	L	L	0	0X, 0Y
L	L	L	H	1	1X, 1Y
L	L	H	L	2	2X, 2Y
L	L	H	H	3	3X, 3Y
L	H	L	L	4	—
L	H	L	H	5	—
L	H	H	L	6	—
L	H	H	H	7	—
H	X	X	X	None	None

X: Don't care

\*: Except 74HCT4052D

### 10. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	$V_{CC}$		-0.5 to 7.0	V
Supply voltage	$V_{EE}$		-7.0 to 0	V
Supply voltage	$V_{CC}-V_{EE}$		-0.5 to 13.0	V
Input voltage	$V_{IN}$		-0.5 to $V_{CC} + 0.5$	V
Switch I/O voltage	$V_{I/O}$		$V_{EE} - 0.5$ to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$		$\pm 20$	mA
I/O diode current	$I_{I/OK}$		$\pm 20$	mA
Switch through current	$I_T$		$\pm 25$	mA
$V_{CC}$ /ground current	$I_{CC}$		$\pm 50$	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.

### 11. Operating Ranges (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	$V_{CC}$		4.5 to 5.5	V
Supply voltage	$V_{EE}$		-6.0 to 0	V
Supply voltage	$V_{CC}-V_{EE}$		4.5 to 11.0	V
Input voltage	$V_{IN}$		0 to $V_{CC}$	V
Switch I/O voltage	$V_{I/O}$		$V_{EE}$ 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 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.

### 12. Electrical Characteristics

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

Characteristics	Symbol	Test Condition	$V_{EE}$ (V)	$V_{CC}$ (V)	Min	Typ.	Max	Unit
High-level input voltage	$V_{IH}$	—		4.5 to 5.5	2.0	—	—	V
Low-level input voltage	$V_{IL}$	—		4.5 to 5.5	—	—	0.8	V
ON-resistance	$R_{ON}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{I/O} = V_{CC} \text{ to } V_{EE}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	180	240	$\Omega$
			-4.5	4.5	—	140	190	
			-5.5	5.5	—	135	180	
		$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{I/O} = V_{EE}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	150	200	
			-4.5	4.5	—	135	170	
			-5.5	5.5	—	125	170	
		$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{I/O} = V_{CC}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	95	130	
			-4.5	4.5	—	75	100	
			-5.5	5.5	—	70	100	
Difference of ON-resistance between switches	$\Delta R_{ON}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{I/O} = V_{CC} \text{ to } V_{EE}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	10	30	$\Omega$
			-4.5	4.5	—	5	12	
			-5.5	5.5	—	5	11	
Input/Output leakage current (Switch OFF)	$I_{OFF}$	$V_{OS} = V_{CC} \text{ or } GND$ $V_{IS} = GND \text{ or } V_{CC}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	GND	5.5	—	—	$\pm 0.06$	$\mu\text{A}$
			-5.5	5.5	—	—	$\pm 0.1$	
Input/Output leakage current (Switch ON)	$I_{I/O}$	$V_{OS} = V_{CC} \text{ or } GND$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	GND	5.5	—	—	$\pm 0.06$	$\mu\text{A}$
			-5.5	5.5	—	—	$\pm 0.1$	
Control input leakage current	$I_{IN}$	$V_{IN} = V_{CC} \text{ or } GND$	GND	5.5	—	—	$\pm 0.1$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC} \text{ or } GND$	GND	5.5	—	—	4.0	$\mu\text{A}$
			-5.5	5.5	—	—	8.0	
		Per input: $V_{IN} = 0.5\text{ V or } 2.4\text{ V}$ Other input: $V_{CC} \text{ or } GND$	GND	5.5	—	—	2.0	mA

### 12.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to $85\text{ }^\circ\text{C}$ )

Characteristics	Symbol	Test Condition	$V_{EE}$ (V)	$V_{CC}$ (V)	Min	Max	Unit
High-level input voltage	$V_{IH}$	—		4.5 to 5.5	2.0	—	V
Low-level input voltage	$V_{IL}$	—		4.5 to 5.5	—	0.8	V
ON-resistance	$R_{ON}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{I/O} = V_{CC}$ to $V_{EE}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	300	$\Omega$
			-4.5	4.5	—	240	
			-5.5	5.5	—	225	
		$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{I/O} = V_{EE}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	250	
			-4.5	4.5	—	215	
			-5.5	5.5	—	215	
		$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{I/O} = V_{CC}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	165	
			-4.5	4.5	—	125	
Difference of ON-resistance between switches	$\Delta R_{ON}$	$V_{IN} = V_{IH}$ or $V_{IL}$ $V_{I/O} = V_{CC}$ to $V_{EE}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	35	$\Omega$
			-4.5	4.5	—	15	
			-5.5	5.5	—	14	
Input/Output leakage current (Switch OFF)	$I_{OFF}$	$V_{OS} = V_{CC}$ or GND $V_{IS} = \text{GND}$ or $V_{CC}$ $V_{IN} = V_{IH}$ or $V_{IL}$	GND	5.5	—	$\pm 0.6$	$\mu\text{A}$
			-5.5	5.5	—	$\pm 1.0$	
Input/Output leakage current (Switch ON)	$I_{I/O}$	$V_{OS} = V_{CC}$ or GND $V_{IN} = V_{IH}$ or $V_{IL}$	GND	5.5	—	$\pm 0.6$	$\mu\text{A}$
			-5.5	5.5	—	$\pm 1.0$	
Control input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	GND	5.5	—	$\pm 1.0$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND	GND	5.5	—	40.0	$\mu\text{A}$
			-5.5	5.5	—	80.0	
		Per input: $V_{IN} = 0.5\text{ V}$ or $2.4\text{ V}$ Other input: $V_{CC}$ or GND	GND	5.5	—	2.9	mA

### 12.3. DC Characteristics (Note) (Unless otherwise specified, $T_a = -40$ to $125\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Test Condition	$V_{EE}$ (V)	$V_{CC}$ (V)	Min	Max	Unit
High-level input voltage	$V_{IH}$	—		4.5 to 5.5	2.0	—	V
Low-level input voltage	$V_{IL}$	—		4.5 to 5.5	—	0.8	V
ON-resistance	$R_{ON}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{I/O} = V_{CC} \text{ to } V_{EE}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	340	$\Omega$
			-4.5	4.5	—	275	
			-5.5	5.5	—	255	
		$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{I/O} = V_{EE}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	285	
			-4.5	4.5	—	245	
			-5.5	5.5	—	245	
		$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{I/O} = V_{CC}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	190	
			-4.5	4.5	—	145	
			-5.5	5.5	—	145	
Difference of ON-resistance between switches	$\Delta R_{ON}$	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{I/O} = V_{CC} \text{ to } V_{EE}$ $I_{I/O} \leq 2\text{ mA}$	GND	4.5	—	35	$\Omega$
			-4.5	4.5	—	15	
			-5.5	5.5	—	14	
Input/Output leakage current (Switch OFF)	$I_{OFF}$	$V_{OS} = V_{CC} \text{ or GND}$ $V_{IS} = \text{GND or } V_{CC}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	GND	5.5	—	$\pm 3.0$	$\mu\text{A}$
			-5.5	5.5	—	$\pm 5.0$	
Input/Output leakage current (Switch ON)	$I_{I/O}$	$V_{OS} = V_{CC} \text{ or GND}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	GND	5.5	—	$\pm 3.0$	$\mu\text{A}$
			-5.5	5.5	—	$\pm 5.0$	
Control input leakage current	$I_{IN}$	$V_{IN} = V_{CC} \text{ or GND}$	GND	5.5	—	$\pm 1.0$	$\mu\text{A}$
Quiescent supply current	$I_{CC}$	$V_{IN} = V_{CC} \text{ or GND}$	GND	5.5	—	80.0	$\mu\text{A}$
			-5.5	5.5	—	160.0	
		Per input: $V_{IN} = 0.5\text{ V or } 2.4\text{ V}$ Other input: $V_{CC} \text{ or GND}$	GND	5.5	—	2.9	mA

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.

### 12.4. 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	Part Number	Symbol	Test Condition	$V_{EE}$ (V)	$V_{CC}$ (V)	Min	Typ.	Max	Unit
Phase difference between input to output		$\phi_{I/O}$	—	GND	4.5	—	7	12	ns
				GND	5.5	—	6	10	
				-4.5	4.5	—	5	—	
Output enable time	74HCT4051D	$t_{PZL}, t_{PZH}$	$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	30	45	ns
				GND	5.5	—	26	35	
				-4.5	4.5	—	25	35	
	74HCT4052D		$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	30	45	ns
				GND	5.5	—	26	35	
				-4.5	4.5	—	25	35	
Output disable time	74HCT4051D	$t_{PLZ}, t_{PHZ}$	$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	22	30	ns
				GND	5.5	—	21	28	
				-4.5	4.5	—	21	28	
	74HCT4052D		$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	22	30	ns
				GND	5.5	—	21	28	
				-4.5	4.5	—	21	28	
Control input capacitance		$C_{IN}$	—	—	—	—	5	10	pF
Common terminal capacitance	74HCT4051D	$C_{IS}$	Figure 2	-5.0	5.0	—	36	70	pF
	74HCT4052D					—	19	40	
Switch terminal capacitance	74HCT4051D	$C_{OS}$	Figure 2	-5.0	5.0	—	7	15	pF
	74HCT4052D					—	7	15	
Feedthrough capacitance	74HCT4051D	$C_{IOS}$	Figure 2	-5.0	5.0	—	0.75	2	pF
	74HCT4052D					—	0.75	2	
Power dissipation capacitance	74HCT4051D	$C_{PD}$	Figure 2 (Note 1)	GND	5.0	—	11	—	pF
	74HCT4052D					—	19	—	

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.

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

### 12.5. 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	Part Number	Symbol	Test Condition	$V_{EE}$ (V)	$V_{CC}$ (V)	Min	Max	Unit
Phase difference between input to output		$\phi_{I/O}$	—	GND	4.5	—	15	ns
				GND	5.5	—	13	
				-4.5	4.5	—	—	
Output enable time	74HCT4051D	$t_{PZL}, t_{PZH}$	$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	55	ns
				GND	5.5	—	42	
				-4.5	4.5	—	41	
	74HCT4052D		$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	55	ns
				GND	5.5	—	42	
				-4.5	4.5	—	41	
Output disable time	74HCT4051D	$t_{PLZ}, t_{PHZ}$	$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	37	ns
				GND	5.5	—	34	
				-4.5	4.5	—	34	
	74HCT4052D		$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	37	ns
				GND	5.5	—	34	
				-4.5	4.5	—	34	
Control input capacitance		$C_{IN}$	—	—	—	—	10	pF
Common terminal capacitance	74HCT4051D	$C_{IS}$	Figure 2	-5.0	5.0	—	70	pF
	74HCT4052D					—	40	
Switch terminal capacitance	74HCT4051D	$C_{OS}$	Figure 2	-5.0	5.0	—	15	pF
	74HCT4052D					—	15	
Feedthrough capacitance	74HCT4051D	$C_{IOS}$	Figure 2	-5.0	5.0	—	2	pF
	74HCT4052D					—	2	



### 12.6. 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	Part Number	Symbol	Test Condition	$V_{EE}$ (V)	$V_{CC}$ (V)	Min	Max	Unit
Phase difference between input to output		$\varphi_{I/O}$	—	GND	4.5	—	17	ns
				GND	5.0	—	15	
				-4.5	4.5	—	—	
Output enable time	74HCT4051D	$t_{PZL}, t_{PZH}$	$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	62	ns
				GND	5.0	—	47	
				-4.5	4.5	—	45	
	74HCT4052D		$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	62	ns
				GND	5.0	—	47	
				-4.5	4.5	—	45	
Output disable time	74HCT4051D	$t_{PLZ}, t_{PHZ}$	$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	42	ns
				GND	5.0	—	38	
				-4.5	4.5	—	38	
	74HCT4052D		$R_L = 1 \text{ k}\Omega$ Figure 1	GND	4.5	—	42	ns
				GND	5.0	—	38	
				-4.5	4.5	—	38	
Control input capacitance		$C_{IN}$	—	—	—	—	10	pF
Common terminal capacitance	74HCT4051D	$C_{IS}$	Figure 2	-5.0	5.0	—	70	pF
	74HCT4052D					—	40	
Switch terminal capacitance	74HCT4051D	$C_{OS}$	Figure 2	-5.0	5.0	—	15	pF
	74HCT4052D					—	15	
Feedthrough capacitance	74HCT4051D	$C_{IOS}$	Figure 2	-5.0	5.0	—	2	pF
	74HCT4052D					—	2	

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.

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

Characteristics	Part Number	Symbol	Test Condition		V <sub>EE</sub> (V)	V <sub>CC</sub> (V)	Typ.	Unit
Sine Wave Distortion		THD	R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 50 pF f <sub>IN</sub> = 1 kHz	V <sub>IN</sub> = 8.0 V <sub>p-p</sub>	-4.5	4.5	0.020	%
				V <sub>IN</sub> = 11.0 V <sub>p-p</sub>	-5.5	5.5	0.019	
Maximum frequency response		f <sub>MAX(I/O)</sub>	Adjust f <sub>IN</sub> voltage to obtain 0 dBm at V <sub>OS</sub> Increase f <sub>IN</sub> frequency until dB meter reads -3 dB R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 10 pF f <sub>IN</sub> = 1 MHz, sine wave Figure 3	(Note 1)	-4.5	4.5	190	MHz
	(Note 2)			70				
				110				
				(Note 1)	-5.5	5.5	200	
	74HCT4051D			(Note 2)			80	
	74HCT4052D						135	
Feed through attenuation (switch OFF)		FTH	V <sub>IN</sub> is centered at (V <sub>CC</sub> /2). Adjust input for 0 dBm. R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1 MHz, sine wave Figure 4		-4.5	4.5	-50	dB
					-5.5	5.5	-50	
Crosstalk (control input to signal output)		X <sub>talk</sub>	R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1 MHz, square wave (t <sub>r</sub> = t <sub>f</sub> = 6 ns) Figure 5		-4.5	4.5	140	mV
					-5.5	5.5	180	
Crosstalk (between any switches)		X <sub>talk</sub>	Adjust V <sub>IN</sub> to obtain 0 dBm at input. R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1 MHz, sine wave Figure 6		-4.5	4.5	-50	dB
					-5.5	5.5	-50	
				R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 15 pF, f <sub>IN</sub> = 100 KHz, V <sub>SWITCH</sub> = 1 V <sub>RMS</sub> Figure 6		-4.5	4.5	-90

Note: These characteristics are determined by design of devices.

Note 1: Input COMMON terminal, and measured at SWITCH terminal.

Note 2: Input SWITCH terminal, and measured at COMMON terminal.

### 13. AC Test Circuit

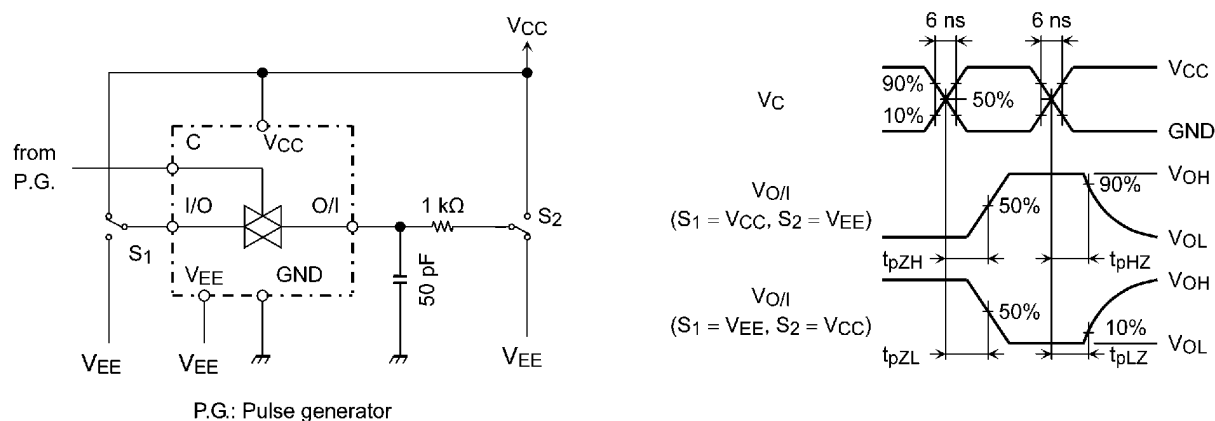


Figure 1  $t_{pLZ}$ ,  $t_{pHZ}$ ,  $t_{pZL}$ ,  $t_{pZH}$

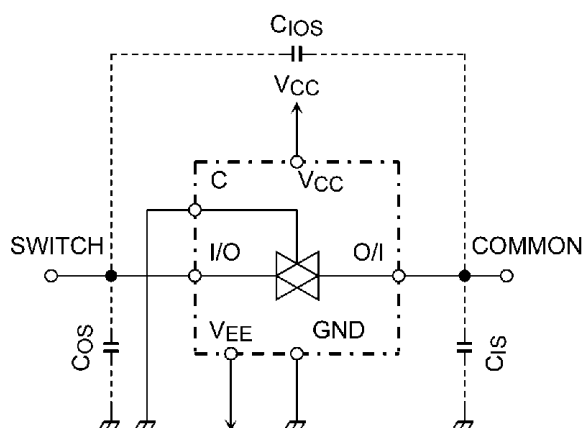


Figure 2  $C_{ios}$ ,  $C_{is}$ ,  $C_{os}$

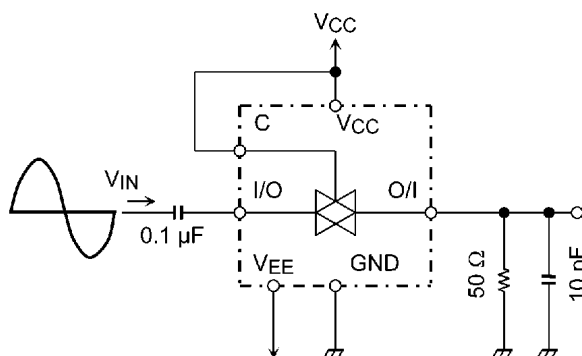


Figure 3 Frequency Response

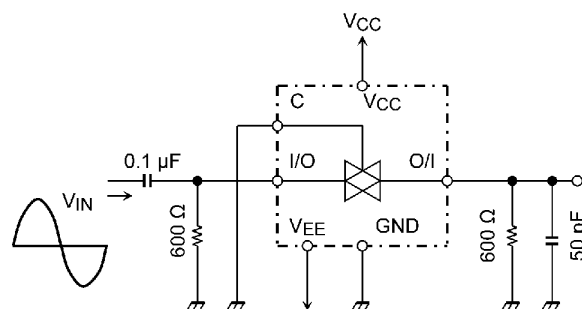
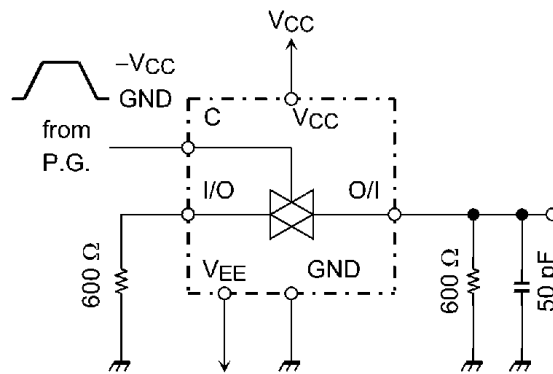
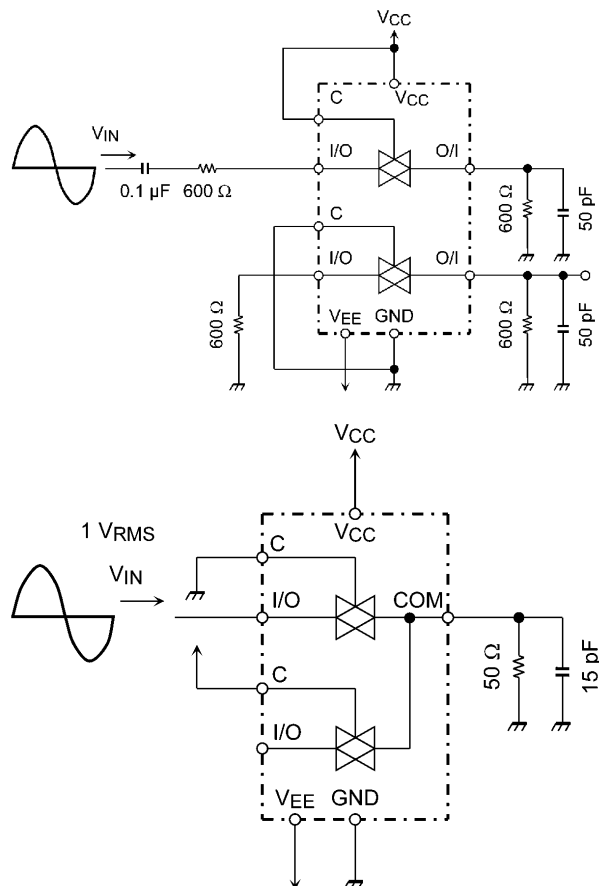


Figure 4 Feedthrough Attenuation



P.G.: Pulse generator

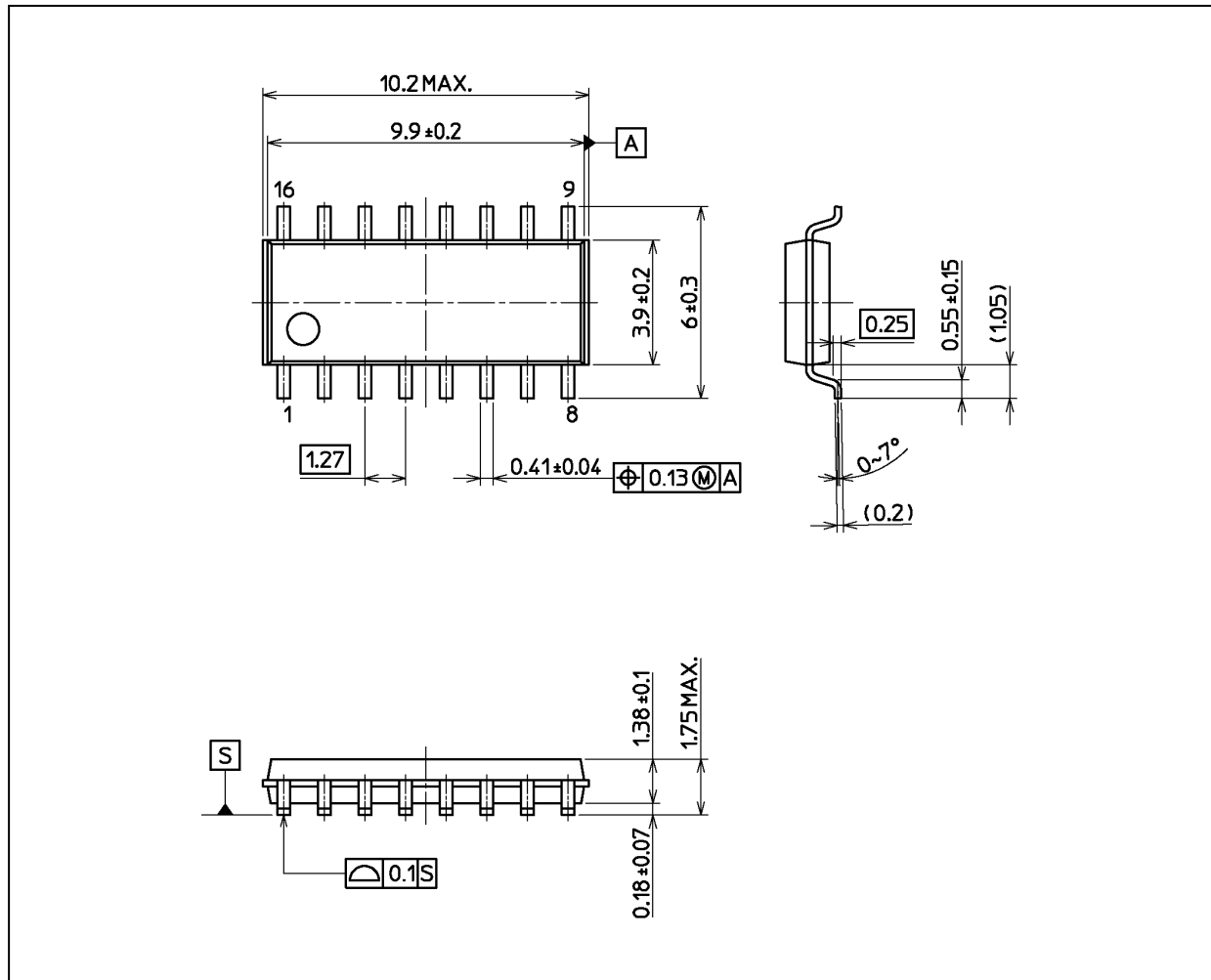
**Figure 5 Cross Talk (control input to output signal)**



**Figure 6 Cross Talk (between any two switches)**

## Package Dimensions

Unit: mm



Weight: 0.15 g (typ.)

Package Name(s)
Nickname: SOIC16

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