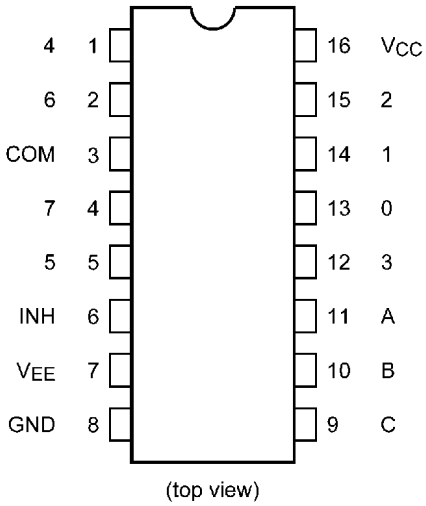
5. Pin Assignment

74HCT4051D



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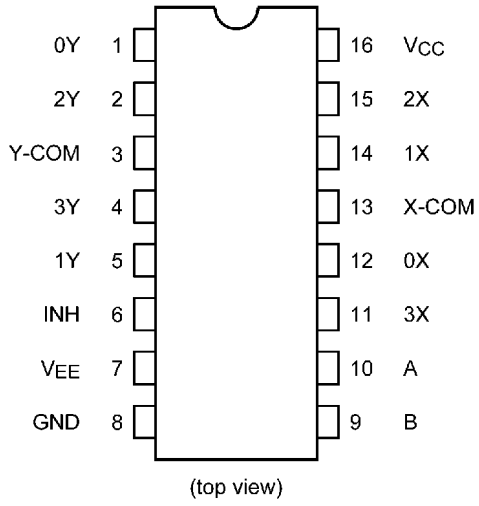
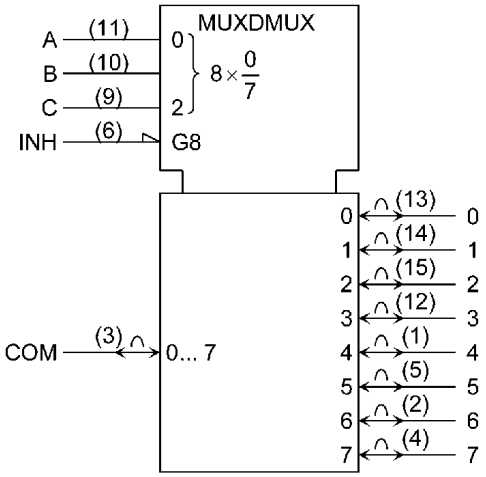


6. IEC Logic Symbol

74HCT4051D



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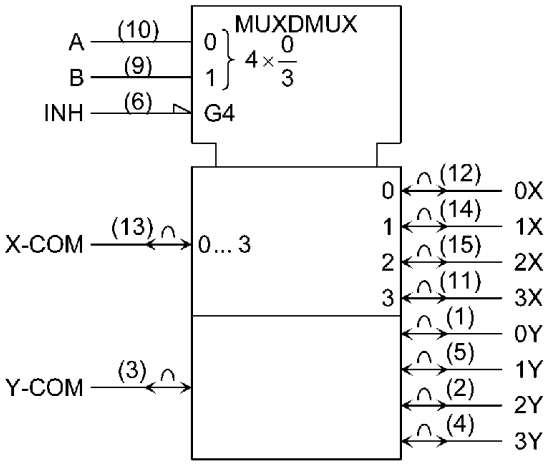
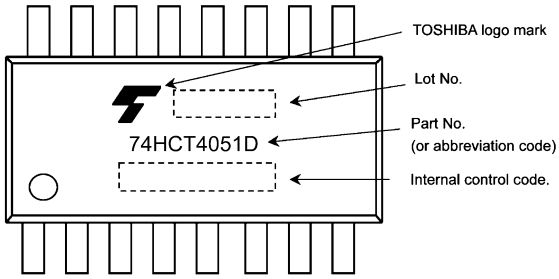


7. Marking

74HCT4051D



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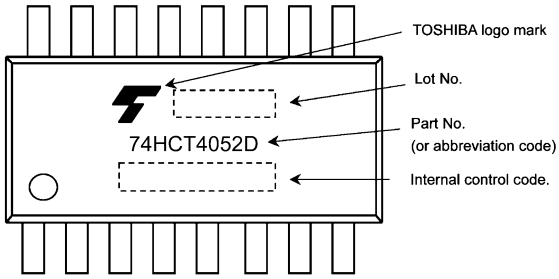
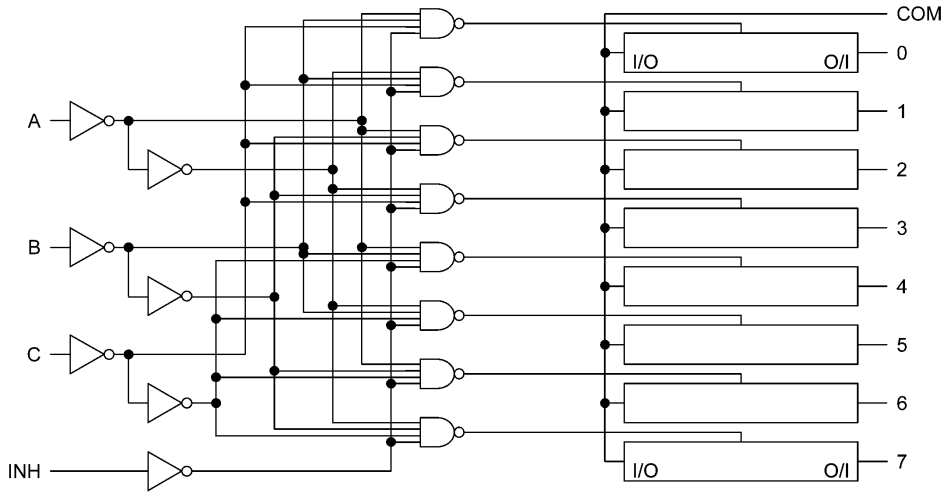
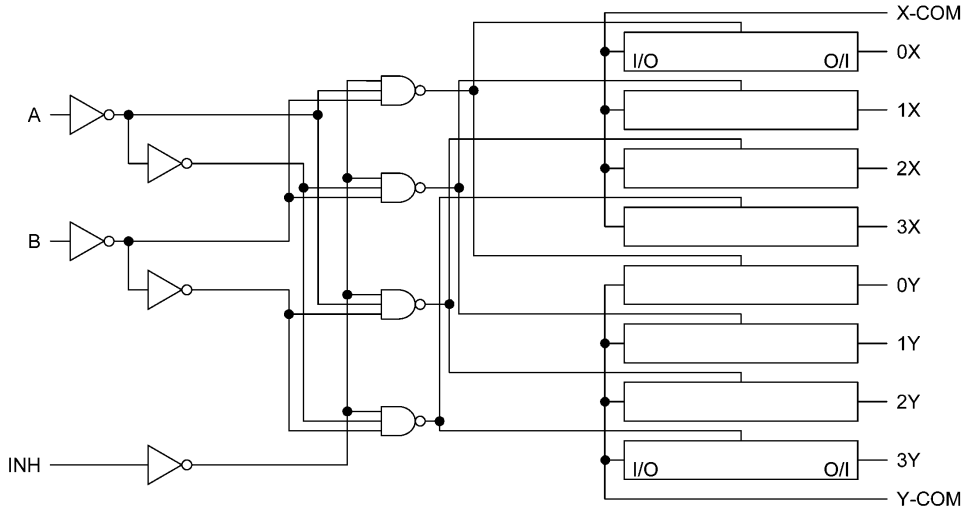


8. System Diagram

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}		±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.

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 °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} or V_{IL} $V_{I/O}$ = V_{CC} to V_{EE} $I_{I/O}$ ≤ 2 mA	GND	4.5	—	180	240	Ω
			-4.5	4.5	—	140	190	
			-5.5	5.5	—	135	180	
		V_{IN} = V_{IH} or V_{IL} $V_{I/O}$ = V_{EE} $I_{I/O}$ ≤ 2 mA	GND	4.5	—	150	200	
			-4.5	4.5	—	135	170	
			-5.5	5.5	—	125	170	
		V_{IN} = V_{IH} or V_{IL} $V_{I/O}$ = V_{CC} $I_{I/O}$ ≤ 2 mA	GND	4.5	—	95	130	
			-4.5	4.5	—	75	100	
			-5.5	5.5	—	70	100	
Difference of ON-resistance between switches	ΔR_{ON}	V_{IN} = V_{IH} or V_{IL} $V_{I/O}$ = V_{CC} to V_{EE} $I_{I/O}$ ≤ 2 mA	GND	4.5	—	10	30	Ω
			-4.5	4.5	—	5	12	
			-5.5	5.5	—	5	11	
Input/Output leakage current (Switch OFF)	I_{OFF}	V_{OS} = V_{CC} or GND V_{IS} = GND or V_{CC} V_{IN} = V_{IH} or V_{IL}	GND	5.5	—	—	±0.06	μA
			-5.5	5.5	—	—	±0.1	
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	—	—	±0.06	μA
			-5.5	5.5	—	—	±0.1	
Control input leakage current	I_{IN}	V_{IN} = V_{CC} or GND	GND	5.5	—	—	±0.1	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND	GND	5.5	—	—	4.0	μA
			-5.5	5.5	—	—	8.0	
		Per input: V_{IN} = 0.5 V or 2.4 V Other input: V_{CC} or GND	GND	5.5	—	—	2.0	mA

12.2. DC Characteristics (Unless otherwise specified, T_a = -40 to 85 °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 mA	GND	4.5	—	300	Ω
			-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 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 mA	GND	4.5	—	165	
			-4.5	4.5	—	125	
			-5.5	5.5	—	125	
Difference of ON-resistance between switches	ΔR_{ON}	V_{IN} = V_{IH} or V_{IL} $V_{I/O}$ = V_{CC} to V_{EE} $I_{I/O} \leq$ 2 mA	GND	4.5	—	35	Ω
			-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} = GND or V_{CC} V_{IN} = V_{IH} or V_{IL}	GND	5.5	—	±0.6	μA
			-5.5	5.5	—	±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	—	±0.6	μA
			-5.5	5.5	—	±1.0	
Control input leakage current	I_{IN}	V_{IN} = V_{CC} or GND	GND	5.5	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND	GND	5.5	—	40.0	μA
			-5.5	5.5	—	80.0	
		Per input: V_{IN} = 0.5 V or 2.4 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 °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 mA	GND	4.5	—	340	Ω
			-4.5	4.5	—	275	
			-5.5	5.5	—	255	
		V_{IN} = V_{IH} or V_{IL} $V_{I/O}$ = V_{EE} $I_{I/O} \leq$ 2 mA	GND	4.5	—	285	
			-4.5	4.5	—	245	
			-5.5	5.5	—	245	
		V_{IN} = V_{IH} or V_{IL} $V_{I/O}$ = V_{CC} $I_{I/O} \leq$ 2 mA	GND	4.5	—	190	
			-4.5	4.5	—	145	
			-5.5	5.5	—	145	
Difference of ON-resistance between switches	ΔR_{ON}	V_{IN} = V_{IH} or V_{IL} $V_{I/O}$ = V_{CC} to V_{EE} $I_{I/O} \leq$ 2 mA	GND	4.5	—	35	Ω
			-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} = GND or V_{CC} V_{IN} = V_{IH} or V_{IL}	GND	5.5	—	±3.0	μA
			-5.5	5.5	—	±5.0	
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	—	±3.0	μA
			-5.5	5.5	—	±5.0	
Control input leakage current	I_{IN}	V_{IN} = V_{CC} or GND	GND	5.5	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND	GND	5.5	—	80.0	μA
			-5.5	5.5	—	160.0	
		Per input: V_{IN} = 0.5 V or 2.4 V Other input: V_{CC} or GND	GND	5.5	—	2.9	mA

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

12.4. AC Characteristics
(Unless otherwise specified, C_L = 50 pF, T_a = 25 °C, Input: $t_r = t_f$ = 6 ns)

Characteristics	Part Number	Symbol	Test Condition	V_{EE} (V)	V_{CC} (V)	Min	Typ.	Max	Unit
Phase difference between input to output		$\varphi_{I/O}$	—	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 kΩ Figure 1	GND	4.5	—	30	45	ns
				GND	5.5	—	26	35	
				-4.5	4.5	—	25	35	
	74HCT4052D		R_L = 1 kΩ 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 kΩ Figure 1	GND	4.5	—	22	30	ns
				GND	5.5	—	21	28	
				-4.5	4.5	—	21	28	
	74HCT4052D		R_L = 1 kΩ 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 pF, T_a = -40 to 85 °C, Input: $t_r = t_f$ = 6 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	—	15	ns
				GND	5.5	—	13	
				-4.5	4.5	—	—	
Output enable time	74HCT4051D	t_{PZL},t_{PZH}	R_L = 1 kΩ Figure 1	GND	4.5	—	55	ns
				GND	5.5	—	42	
				-4.5	4.5	—	41	
	74HCT4052D		R_L = 1 kΩ 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 kΩ Figure 1	GND	4.5	—	37	ns
				GND	5.5	—	34	
				-4.5	4.5	—	34	
	74HCT4052D		R_L = 1 kΩ 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, CL = 50 pF, T_a = -40 to 125 °C, Input: t_r = t_f = 6 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 kΩ Figure 1	GND	4.5	—	62	ns
				GND	5.0	—	47	
				-4.5	4.5	—	45	
	74HCT4052D		R_L = 1 kΩ 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 kΩ Figure 1	GND	4.5	—	42	ns
				GND	5.0	—	38	
				-4.5	4.5	—	38	
	74HCT4052D		R_L = 1 kΩ 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 °C to 125 °C is applicable only for the products which manufactured after July 2020.

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

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

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

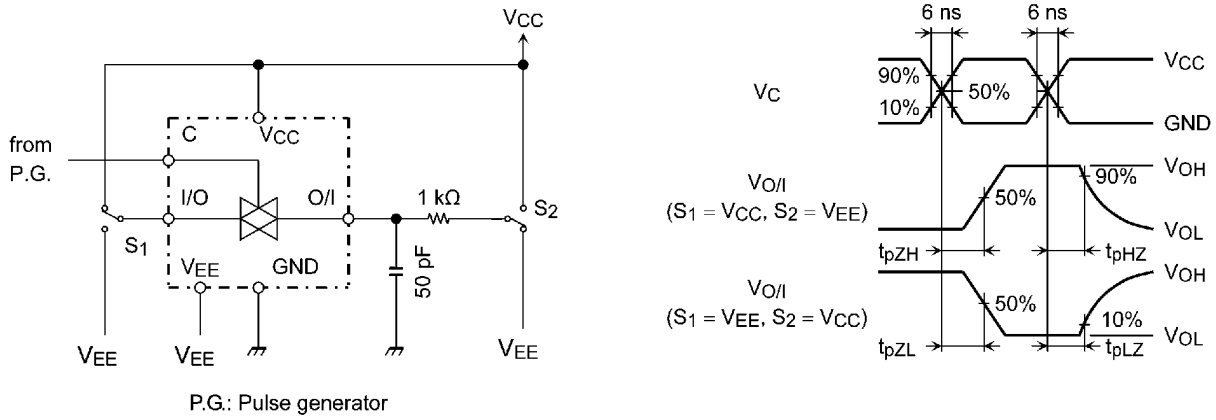


Figure 1 t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}

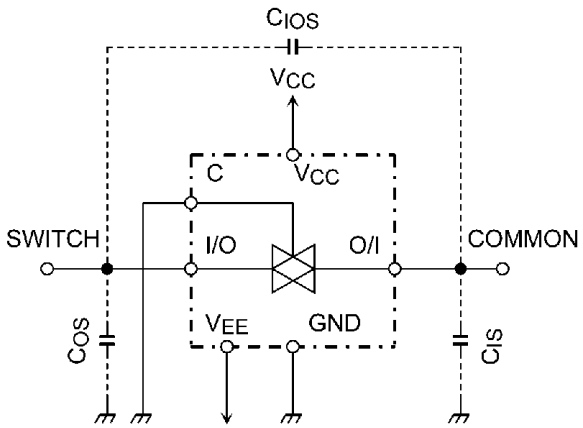


Figure 2 C_{IOS}, C_{IS}, C_{OS}

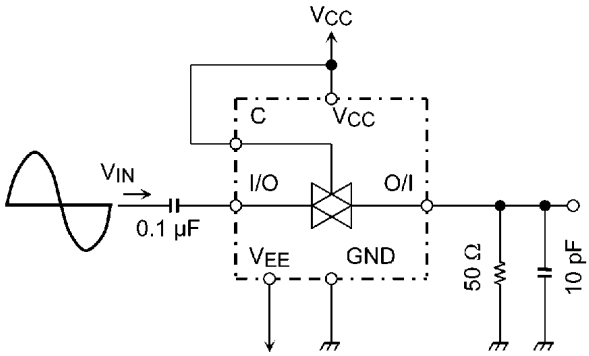


Figure 3 Frequency Response

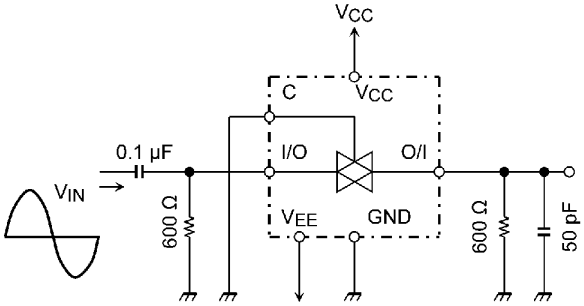
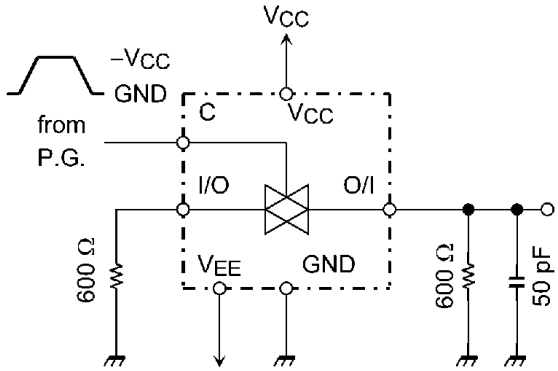


Figure 4 Feedthrough Attenuation



P.G.: Pulse generator

Figure 5 Cross Talk (control input to output signal)

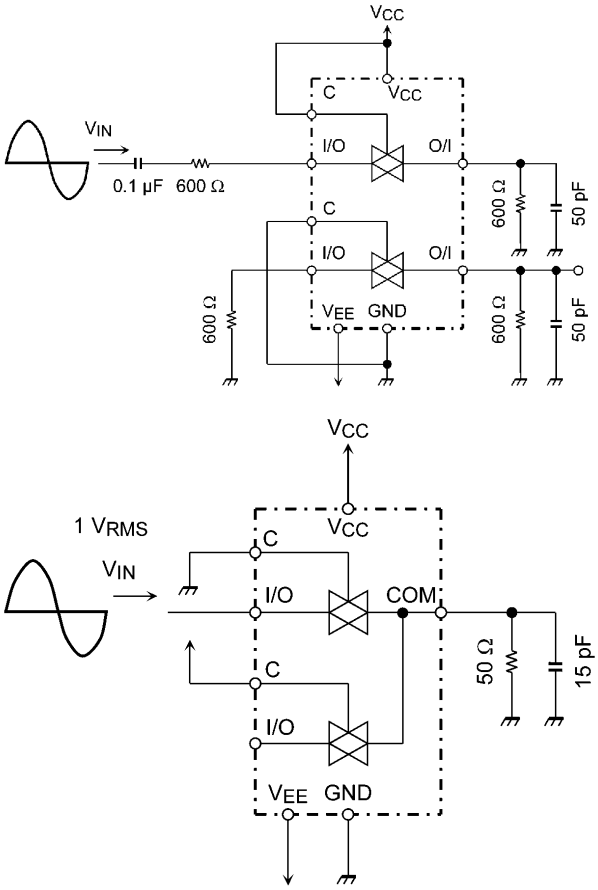
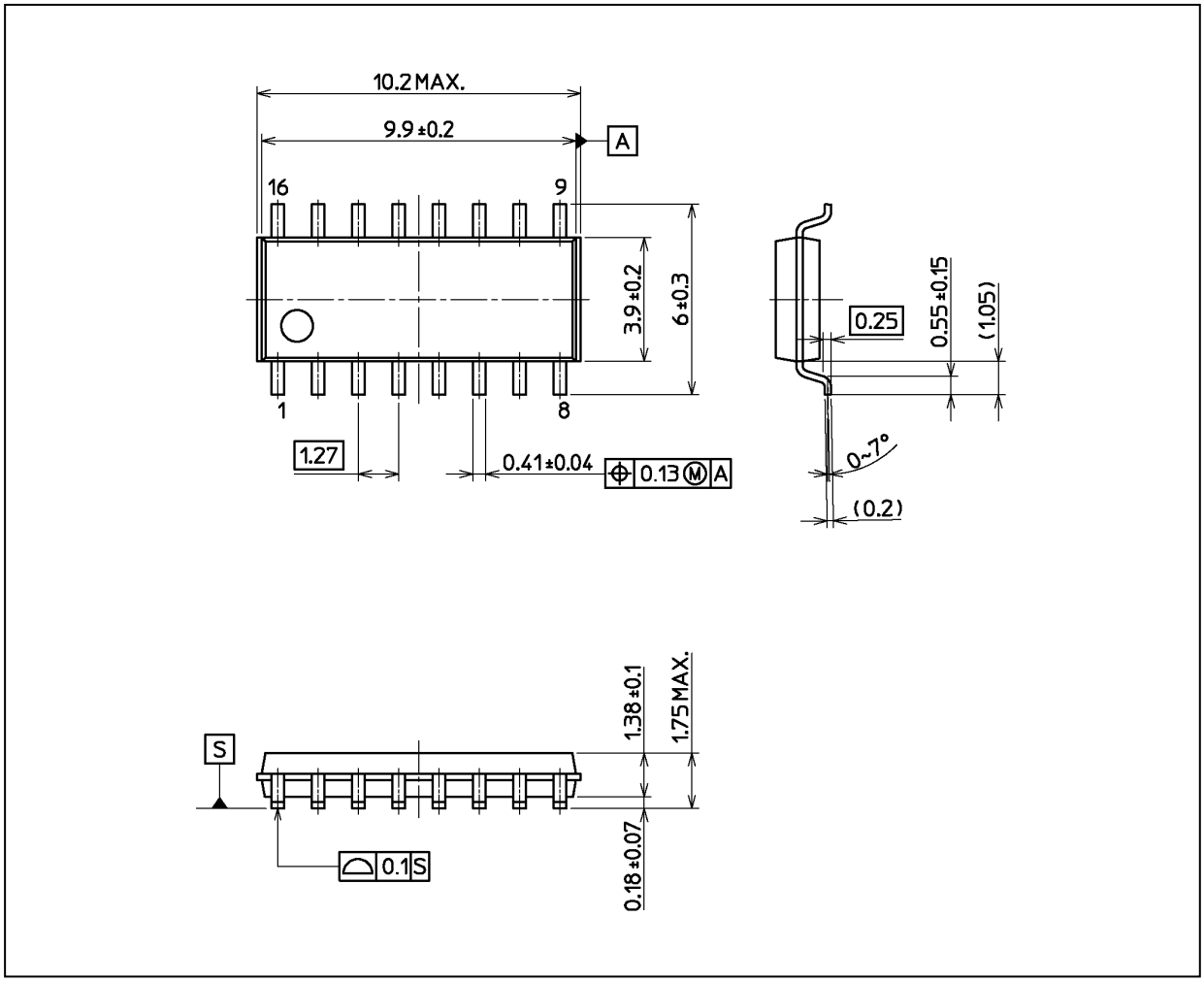


Figure 6 Cross Talk (between any two switches)

Package Dimensions

Unit: mm



Weight: 0.15 g (typ.)

Package Name(s)
Nickname: SOIC16

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