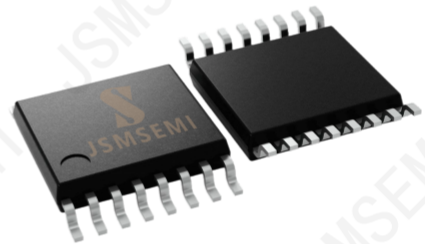
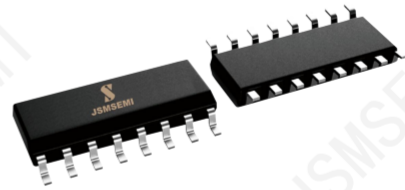
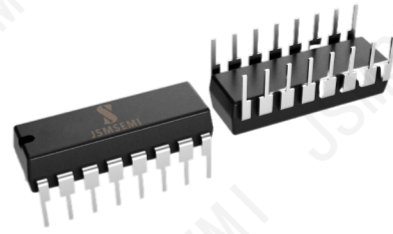


1、General Description

The 74HC/HCT4051 is a single-pole octal-throw analog switch (SP8T) suitable for use in analog or digital 8:1 multiplexer/demultiplexer applications. The switch features three digital select inputs (S0, S1 and S2), eight independent inputs/outputs (Yn), a common input/output (Z) and a digital enable input (\bar{E}). When \bar{E} is HIGH, the switches are turned off. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .



Features:

- Wide analog input voltage range from -5 V to +5 V
- Wide supply voltage range
74HC4051: from 3V to 9V
74HCT4051: from 4.5V to 5.5V
- Low ON resistance:
 - 80 Ω (typical) at $V_{CC} - V_{EE} = 4.5$ V
 - 70 Ω (typical) at $V_{CC} - V_{EE} = 6.0$ V
 - 60 Ω (typical) at $V_{CC} - V_{EE} = 9.0$ V
- Logic level translation: to enable 5 V logic to communicate with ± 5 V analog signals
- Typical “break before make” built-in
- Specified from -40°C to +125°C
- Packaging information: DIP16/SOP16/TSSOP16/DHVQFN16

Applications:

- Analog multiplexing and demultiplexing
- Digital multiplexing and demultiplexing
- Signal gating

2、Block Diagram And Pin Description

2.1、Block Diagram

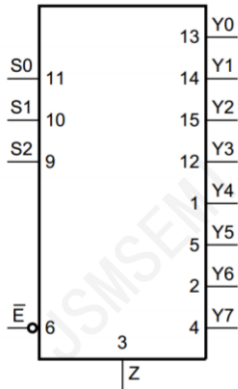


Figure 1. Logic symbol

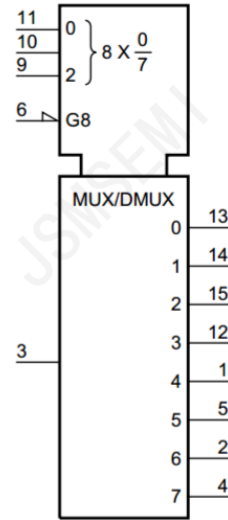


Figure 2. IEC logic symbol

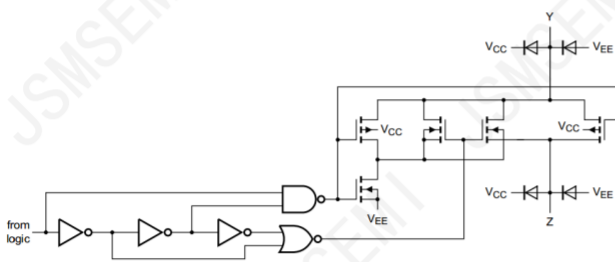


Figure 3. Schematic diagram (one switch)

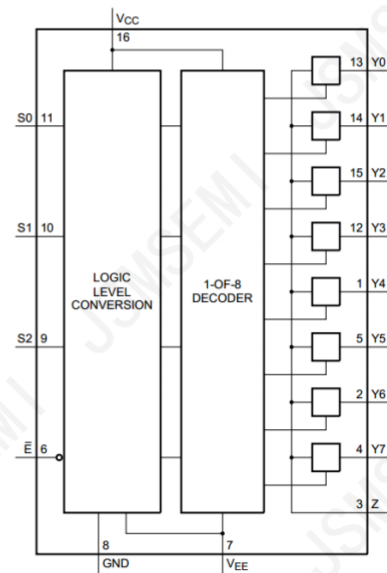
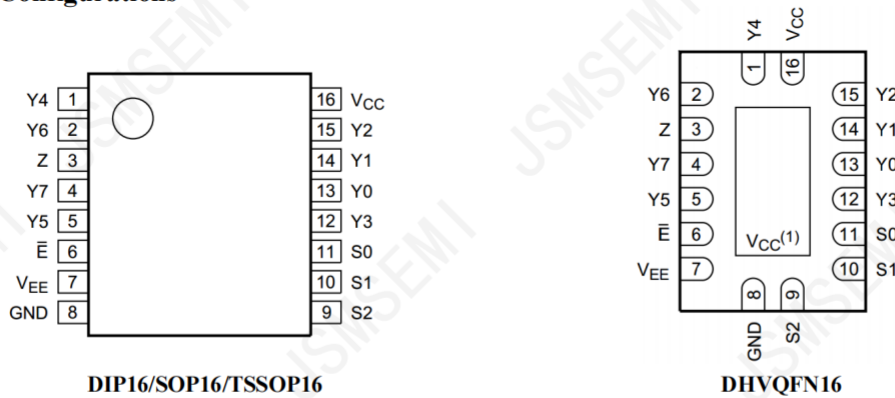


Figure 4. Functional diagram

2.2、Pin Configurations



Note:

(1) This is not a supply pin. The substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land should remain floating or be connected to V_{CC} .

2.3、Pin Description

Pin No.	Pin Name	Description
1	Y4	independent input or output
2	Y6	independent input or output
3	Z	common output or input
4	Y7	independent input or output
5	Y5	independent input or output
6	\bar{E}	enable input (active LOW)
7	V_{EE}	supply voltage
8	GND	ground supply voltage
9	S2	select input
10	S1	select input
11	S0	select input
12	Y3	independent input or output
13	Y0	independent input or output
14	Y1	independent input or output
15	Y2	independent input or output
16	V_{CC}	supply voltage

2.4、Function Table

\bar{E}	Input			Channel ON
	S2	S1	S0	
L	L	L	L	Y0 to Z
L	L	L	H	Y1 to Z
L	L	H	L	Y2 to Z
L	L	H	H	Y3 to Z
L	H	L	L	Y4 to Z
L	H	L	H	Y5 to Z
L	H	H	L	Y6 to Z
L	H	H	H	Y7 to Z
H	X	X	X	switches off

Note: H=HIGH voltage level; L=LOW voltage level; X=don't care.

3、Electrical Parameter

3.1、Absolute Maximum Ratings

(Voltages are referenced to $V_{SS}=0V$ (ground), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Max.	Unit
supply voltage	V_{CC}	- [1]	-0.5	+11	V
input clamping current	I_{IK}	$V_I < -0.5 V$ or $V_I > V_{CC} + 0.5 V$	-	± 20	mA
switch clamping current	I_{SK}	$V_{SW} < -0.5 V$ or $V_{SW} > V_{CC} + 0.5 V$	-	± 20	mA
switch current	I_{SW}	$-0.5 V < V_{SW} < V_{CC} + 0.5 V$	-	± 25	mA
supply current	I_{EE}	-	-	± 20	mA
supply current	I_{CC}	-	-	50	mA
ground current	I_{GND}	-	-	-50	mA
storage temperature	T_{stg}	-	-65	+150	$^{\circ}C$
total power dissipation	P_{tot}	-	-	500	mW
power dissipation	P	per switch	-	100	mW
Soldering temperature	T_L	10s	DIP	245	$^{\circ}C$
			SOP/TSSOP	260	$^{\circ}C$
			DHVQFN	260	$^{\circ}C$

Note:

[1] To avoid drawing V_{CC} current out of terminal Z, when switch current flows into terminals Y_n , the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal Z, no V_{CC} current will flow out of terminals Y_n , and in this case there is no limit for the voltage drop across the switch, but the voltages at Y_n and Z may not exceed V_{CC} or V_{EE} .

3.2、Recommended Operating Conditions

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
74HC4051						
supply voltage	V_{CC}	$V_{CC} - GND$	3.0	5.0	9.0	V
		$V_{CC} - V_{EE}$	3.0	5.0	9.0	V
input voltage	V_I	-	0	-	V_{CC}	V
switch voltage	V_{SW}	-	V_{EE}	-	V_{CC}	V
ambient temperature	T_{amb}	in free air	-40	-	+125	$^{\circ}C$
input transition rise and fall rate	$\Delta t/\Delta V$	$V_{CC} = 4.5 V$	-	1.67	139	ns/V
		$V_{CC} = 6.0 V$	-	-	83	ns/V
		$V_{CC} = 9.0 V$	-	-	31	ns/V
74HCT4051						
supply voltage	V_{CC}	$V_{CC} - GND$	4.5	5.0	5.5	V
		$V_{CC} - V_{EE}$	3.0	5.0	9.0	V
input voltage	V_I	-	0	-	V_{CC}	V
switch voltage	V_{SW}	-	V_{EE}	-	V_{CC}	V
ambient temperature	T_{amb}	in free air	-40	-	+125	$^{\circ}C$
input transition rise and fall rate	$\Delta t/\Delta V$	$V_{CC} = 4.5 V$	-	1.67	139	ns/V
		$V_{CC} = 6.0 V$	-	-	-	ns/V
		$V_{CC} = 9.0 V$	-	-	-	ns/V

3.3. Electrical Characteristics

3.3.1. DC Characteristics 1

($T_{amb}=25^{\circ}\text{C}$, voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
ON resistance (peak)	$R_{ON(peak)}$	$V_{is} = V_{CC} \text{ to } V_{EE};$ $I_{SW} = 1000 \text{ uA}$	$V_{CC} = 4.5 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	100	180	Ω
			$V_{CC} = 6.0 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	90	160	Ω
			$V_{CC} = 4.5 \text{ V};$ $V_{EE} = -4.5 \text{ V}$	-	70	130	Ω
ON resistance (rail)	$R_{ON(rail)}$	$V_{is} = V_{EE};$ $I_{SW} = 1000 \text{ uA}$	$V_{CC} = 4.5 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	80	140	Ω
			$V_{CC} = 6.0 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	70	120	Ω
			$V_{CC} = 4.5 \text{ V};$ $V_{EE} = -4.5 \text{ V}$	-	60	105	Ω
		$V_{is} = V_{CC};$ $I_{SW} = 1000 \text{ uA}$	$V_{CC} = 4.5 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	90	160	Ω
			$V_{CC} = 6.0 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	80	140	Ω
			$V_{CC} = 4.5 \text{ V};$ $V_{EE} = -4.5 \text{ V}$	-	65	120	Ω
ON resistance mismatch between channels	ΔR_{ON}	$V_{is} = V_{CC} \text{ to } V_{EE}$	$V_{CC} = 4.5 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	9	-	Ω
			$V_{CC} = 6.0 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	8	-	Ω
			$V_{CC} = 4.5 \text{ V};$ $V_{EE} = -4.5 \text{ V}$	-	6	-	Ω
74HC4051							
HIGH-level input voltage	V_{IH}	$V_{CC} = 4.5 \text{ V}$	3.15	2.4	-	V	
		$V_{CC} = 6.0 \text{ V}$	4.2	3.2	-	V	
		$V_{CC} = 9.0 \text{ V}$	6.3	4.7	-	V	
LOW-level input voltage	V_{IL}	$V_{CC} = 4.5 \text{ V}$	-	2.1	1.35	V	
		$V_{CC} = 6.0 \text{ V}$	-	2.8	1.8	V	
		$V_{CC} = 9.0 \text{ V}$	-	4.3	2.7	V	
input leakage current	I_I	$V_{EE} = 0 \text{ V};$ $V_I = V_{CC} \text{ or } \text{GND}$	$V_{CC} = 6.0 \text{ V}$	-	-	± 1.0	μA
			$V_{CC} = 9.0 \text{ V}$	-	-	± 1.0	μA

OFF-state leakage current	$I_{S(OFF)}$	$V_{CC}=9.0\text{ V};$ $V_{EE}=0\text{ V};$ $V_I=V_{IH}\text{ or }V_{IL};$ $ V_{SW} =V_{CC}-V_{EE};$ see Figure 7	per channel	-	-	± 1.0	μA
			all channels	-	-	± 1.0	μA
ON-state leakage current	$I_{S(ON)}$	$V_I=V_{IH}\text{ or }V_{IL};$ $ V_{SW} =V_{CC}-V_{EE}; V_{CC}=9.0\text{ V};$ $V_{EE}=0\text{ V};$ see Figure 8	-	-	± 1.0	μA	
supply current	I_{CC}	$V_{EE}=0\text{ V};$ $V_I=V_{CC}\text{ or GND};$ $V_{is}=V_{EE}\text{ or }V_{CC};$ $V_{os}=V_{CC}\text{ or }V_{EE}$	$V_{CC}=6.0\text{ V}$	-	-	8.0	μA
			$V_{CC}=9.0\text{ V}$	-	-	16.0	μA
input capacitance	C_I	-	-	3.5	-	pF	
switch capacitance	C_{SW}	independent pins Yn	-	5	-	pF	
		common pins Z	-	25	-	pF	
74HCT4051							
HIGH-level input voltage	V_{IH}	$V_{CC}=4.5\text{ V to }5.5\text{ V}$	2.0	1.6	-	V	
LOW-level input voltage	V_{IL}	$V_{CC}=4.5\text{ V to }5.5\text{ V}$	-	1.2	0.8	V	
input leakage current	I_I	$V_I=V_{CC}\text{ or GND};$ $V_{CC}=5.5\text{ V}; V_{EE}=0\text{ V}$	-	-	± 1.0	μA	
OFF-state leakage current	$I_{S(OFF)}$	$V_{CC}=9.0\text{ V};$ $V_{EE}=0\text{ V};$ $V_I=V_{IH}\text{ or }V_{IL};$ $ V_{SW} =V_{CC}-V_{EE};$ see Figure 7	per channel	-	-	± 1.0	μA
			all channels	-	-	± 1.0	μA
ON-state leakage current	$I_{S(ON)}$	$V_{CC}=9.0\text{ V}; V_{EE}=0\text{ V};$ $V_I=V_{IH}\text{ or }V_{IL}; V_{SW} =V_{CC}-V_{EE};$ see Figure 8	-	-	± 1.0	μA	
supply current	I_{CC}	$V_I=V_{CC}\text{ or GND};$ $V_{is}=V_{EE}\text{ or }V_{CC};$ $V_{os}=V_{CC}\text{ or }V_{EE};$	$V_{CC}=5.5\text{V};$ $V_{EE}=0\text{ V}$	-	-	8.0	μA
			$V_{CC}=4.5\text{V};$ $V_{EE}=-4.5\text{V}$	-	-	16.0	μA
additional supply current	ΔI_{CC}	per input; $V_I=V_{CC}-2.1\text{V};$ other inputs at $V_{CC}\text{ or GND};$ $V_{CC}=4.5\text{ V to }5.5\text{ V}; V_{EE}=0\text{ V}$	-	50	180	μA	
input capacitance	C_I	-	-	3.5	-	pF	
switch capacitance	C_{SW}	independent pins Yn	-	5	-	pF	
		common pins Z	-	25	-	pF	

Note: [1] $V_I=V_{IH}\text{ or }V_{IL};$ for test circuit see Figure 5.

[2] V_{is} is the input voltage at a Yn or Z terminal, whichever is assigned as an input.

[3] V_{os} is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

3.3.2、DC Characteristics 2

($T_{amb} = -40^{\circ}\text{C} \sim 85^{\circ}\text{C}$, voltages are reference to GND (ground=0V), unless otherwise specified, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
ON resistance (peak)	$R_{ON(peak)}$	$V_{is} = V_{CC} \text{ to } V_{EE};$ $I_{SW} = 1000 \mu\text{A}$	$V_{CC} = 4.5 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	225	Ω
			$V_{CC} = 6.0 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	200	Ω
			$V_{CC} = 4.5 \text{ V};$ $V_{EE} = -4.5 \text{ V}$	-	-	165	Ω
ON resistance (rail)	$R_{ON(rail)}$	$V_{is} = V_{EE};$ $I_{SW} = 1000 \mu\text{A}$	$V_{CC} = 4.5 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	175	Ω
			$V_{CC} = 6.0 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	150	Ω
			$V_{CC} = 4.5 \text{ V};$ $V_{EE} = -4.5 \text{ V}$	-	-	130	Ω
		$V_{is} = V_{CC};$ $I_{SW} = 1000 \mu\text{A}$	$V_{CC} = 4.5 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	200	Ω
			$V_{CC} = 6.0 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	175	Ω
			$V_{CC} = 4.5 \text{ V};$ $V_{EE} = -4.5 \text{ V}$	-	-	150	Ω
74HC4051							
HIGH-level input voltage	V_{IH}	$V_{CC} = 4.5 \text{ V}$	3.15	-	-	V	
		$V_{CC} = 6.0 \text{ V}$	4.2	-	-	V	
		$V_{CC} = 9.0 \text{ V}$	6.3	-	-	V	
LOW-level input voltage	V_{IL}	$V_{CC} = 4.5 \text{ V}$	-	-	1.35	V	
		$V_{CC} = 6.0 \text{ V}$	-	-	1.8	V	
		$V_{CC} = 9.0 \text{ V}$	-	-	2.7	V	
input leakage current	I_I	$V_{EE} = 0 \text{ V};$ $V_I = V_{CC} \text{ or GND}$	$V_{CC} = 6.0 \text{ V}$	-	-	± 1.0	μA
			$V_{CC} = 9.0 \text{ V}$	-	-	± 2.0	μA
OFF-state leakage current	$I_{S(OFF)}$	$V_{CC} = 9.0 \text{ V};$ $V_{EE} = 0 \text{ V};$ $V_I = V_{IH} \text{ or } V_{IL};$ $ V_{SW} = V_{CC} - V_{EE};$ see Figure 7	per channel	-	-	± 1.0	μA
			all channels	-	-	± 4.0	μA

ON-state leakage current	$I_{S(ON)}$	$V_I = V_{IH}$ or V_{IL} ; $ V_{SW} = V_{CC} - V_{EE}$; $V_{CC} = 9.0$ V; $V_{EE} = 0$ V; see Figure 8	-	-	± 4.0	μ A	
supply current	I_{CC}	$V_{EE} = 0$ V; $V_I = V_{CC}$ or GND; $V_{is} = V_{EE}$ or V_{CC} ; $V_{os} = V_{CC}$ or V_{EE}	$V_{CC} = 6.0$ V	-	-	80.0	μ A
			$V_{CC} = 9.0$ V	-	-	160.0	μ A
74HCT4051							
HIGH-level input voltage	V_{IH}	$V_{CC} = 4.5$ V to 5.5 V	2.0	-	-	V	
LOW-level input voltage	V_{IL}	$V_{CC} = 4.5$ V to 5.5 V	-	-	0.8	V	
input leakage current	I_I	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5$ V; $V_{EE} = 0$ V	-	-	± 1.0	μ A	
OFF-state leakage current	$I_{S(OFF)}$	$V_{CC} = 9.0$ V; $V_{EE} = 0$ V; $V_I = V_{IH}$ or V_{IL} ; $ V_{SW} = V_{CC} - V_{EE}$; see Figure 7	per channel	-	-	± 1.0	μ A
			all channels	-	-	± 4.0	μ A
ON-state leakage current	$I_{S(ON)}$	$V_{CC} = 9.0$ V; $V_{EE} = 0$ V; $V_I = V_{IH}$ or V_{IL} ; $ V_{SW} = V_{CC} - V_{EE}$; see Figure 8	-	-	± 4.0	μ A	
supply current	I_{CC}	$V_I = V_{CC}$ or GND; $V_{is} = V_{EE}$ or V_{CC} ; $V_{os} = V_{CC}$ or V_{EE}	$V_{CC} = 5.5$ V; $V_{EE} = 0$ V	-	-	80.0	μ A
			$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V	-	-	160	μ A
additional supply current	ΔI_{CC}	per input; $V_I = V_{CC} - 2.1$ V; other inputs at V_{CC} or GND; $V_{CC} = 4.5$ V to 5.5 V; $V_{EE} = 0$ V	-	-	225	μ A	

Note:

[1] $V_I = V_{IH}$ or V_{IL} ; for test circuit see Figure 5.

[2] V_{is} is the input voltage at a Yn or Z terminal, whichever is assigned as an input.

[3] V_{os} is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

3.3.3、DC Characteristics 3

($T_{amb} = -40^{\circ}\text{C} \sim 125^{\circ}\text{C}$, voltages are reference to GND (ground=0V), unless otherwise specified, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
ON resistance (peak)	$R_{ON(peak)}$	$V_{is} = V_{CC} \text{ to } V_{EE};$ $I_{SW} = 1000 \text{ uA}$	$V_{CC} = 4.5 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	270	Ω
			$V_{CC} = 6.0 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	240	Ω
			$V_{CC} = 4.5 \text{ V};$ $V_{EE} = -4.5 \text{ V}$	-	-	195	Ω
ON resistance (rail)	$R_{ON(rail)}$	$V_{is} = V_{EE};$ $I_{SW} = 1000 \text{ uA}$	$V_{CC} = 4.5 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	210	Ω
			$V_{CC} = 6.0 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	180	Ω
			$V_{CC} = 4.5 \text{ V};$ $V_{EE} = -4.5 \text{ V}$	-	-	160	Ω
		$V_{is} = V_{CC};$ $I_{SW} = 1000 \text{ uA}$	$V_{CC} = 4.5 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	240	Ω
			$V_{CC} = 6.0 \text{ V};$ $V_{EE} = 0 \text{ V}$	-	-	210	Ω
			$V_{CC} = 4.5 \text{ V};$ $V_{EE} = -4.5 \text{ V}$	-	-	180	Ω
74HC4051							
HIGH-level input voltage	V_{IH}	$V_{CC} = 4.5 \text{ V}$	3.15	-	-	V	
		$V_{CC} = 6.0 \text{ V}$	4.2	-	-	V	
		$V_{CC} = 9.0 \text{ V}$	6.3	-	-	V	
LOW-level input voltage	V_{IL}	$V_{CC} = 4.5 \text{ V}$	-	-	1.35	V	
		$V_{CC} = 6.0 \text{ V}$	-	-	1.8	V	
		$V_{CC} = 9.0 \text{ V}$	-	-	2.7	V	
input leakage current	I_I	$V_{EE} = 0 \text{ V};$ $V_I = V_{CC} \text{ or } \text{GND}$	$V_{CC} = 6.0 \text{ V}$	-	-	± 1.0	μA
			$V_{CC} = 9.0 \text{ V}$	-	-	± 2.0	μA
OFF-state leakage current	$I_{S(OFF)}$	$V_{CC} = 9.0 \text{ V};$ $V_{EE} = 0 \text{ V};$ $V_I = V_{IH} \text{ or } V_{IL};$ $ V_{SW} = V_{CC} - V_{EE};$ see Figure 7	per channel	-	-	± 1.0	μA
			all channels	-	-	± 4.0	μA
ON-state leakage current	$I_{S(ON)}$	$V_I = V_{IH} \text{ or } V_{IL};$ $ V_{SW} = V_{CC} - V_{EE}; V_{CC} = 9.0 \text{ V};$ $V_{EE} = 0 \text{ V};$ see Figure 8	-	-	± 4.0	μA	
supply current	I_{CC}	$V_{EE} = 0 \text{ V};$ $V_{CC} = 6.0 \text{ V}$	-	-	160.0	μA	

		$V_I = V_{CC}$ or GND; $V_{is} = V_{EE}$ or V_{CC} ; $V_{os} = V_{CC}$ or V_{EE}	$V_{CC} = 9.0\text{ V}$	-	-	320.0	uA
74HCT4051							
HIGH-level input voltage	V_{IH}	$V_{CC} = 4.5\text{ V}$ to 5.5 V		2.0	-	-	V
LOW-level input voltage	V_{IL}	$V_{CC} = 4.5\text{ V}$ to 5.5 V		-	-	0.8	V
input leakage current	I_I	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5\text{ V}$; $V_{EE} = 0\text{ V}$		-	-	± 1.0	uA
OFF-state leakage current	$I_{S(OFF)}$	$V_{CC} = 9.0\text{ V}$; $V_{EE} = 0\text{ V}$; $V_I = V_{IH}$ or V_{IL} ; $ V_{SW} = V_{CC} - V_{EE}$; see Figure 7	per channel	-	-	± 1.0	uA
			all channels	-	-	± 4.0	uA
ON-state leakage current	$I_{S(ON)}$	$V_{CC} = 9.0\text{ V}$; $V_{EE} = 0\text{ V}$; $V_I = V_{IH}$ or V_{IL} ; $ V_{SW} = V_{CC} - V_{EE}$; see Figure 8		-	-	± 4.0	uA
supply current	I_{CC}	$V_I = V_{CC}$ or GND; $V_{is} = V_{EE}$ or V_{CC} ; $V_{os} = V_{CC}$ or V_{EE}	$V_{CC} = 5.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	160.0	uA
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	-	320.0	uA
additional supply current	ΔI_{CC}	per input; $V_I = V_{CC} - 2.1\text{ V}$; other inputs at V_{CC} or GND; $V_{CC} = 4.5\text{ V}$ to 5.5 V ; $V_{EE} = 0\text{ V}$		-	-	245	uA

Note:

[1] $V_I = V_{IH}$ or V_{IL} ; for test circuit see Figure 5.

[2] V_{is} is the input voltage at a Yn or Z terminal, whichever is assigned as an input.

[3] V_{os} is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

3.3.4、AC Characteristics 1

 ($T_{amb}=25^{\circ}\text{C}$, $\text{GND} = 0\text{ V}$; $t_r = t_f = 6\text{ ns}$; $C_L = 50\text{ pF}$; unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
74HC4051							
propagation delay	t_{pd}	V_{is} to V_{os} ; $R_L = \infty \Omega$; see Figure 9 ^[1]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	5	12	ns
			$V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	4	10	ns
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	4	8	ns
turn-on time	t_{on}	\bar{E} to V_{os} ; $R_L = \infty \Omega$; see Figure 10 ^[2]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	29	69	ns
			$V_{CC} = 5.0\text{ V}$; $V_{EE} = 0\text{ V}$; $C_L = 15\text{ pF}$	-	22	-	ns
			$V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	21	59	ns
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	18	51	ns
		Sn to V_{os} ; $R_L = \infty \Omega$; see Figure 10 ^[2]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	28	69	ns
			$V_{CC} = 5.0\text{ V}$; $V_{EE} = 0\text{ V}$; $C_L = 15\text{ pF}$	-	20	-	ns
			$V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	19	59	ns
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	16	51	ns
turn-off time	t_{off}	\bar{E} to V_{os} ; $R_L = 1\text{ k}\Omega$; see Figure 10 ^[3]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	31	58	ns
			$V_{CC} = 5.0\text{ V}$; $V_{EE} = 0\text{ V}$; $C_L = 15\text{ pF}$	-	18	-	ns
			$V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	17	49	ns
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	18	42	ns
		Sn to V_{os} ; $R_L = 1\text{ k}\Omega$; see Figure 10 ^[3]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	25	58	ns
			$V_{CC} = 5.0\text{ V}$; $V_{EE} = 0\text{ V}$; $C_L = 15\text{ pF}$	-	19	-	ns
			$V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$; $C_L = 15\text{ pF}$	-	19	-	ns

			$V_{CC} = 6.0\text{ V};$ $V_{EE} = 0\text{ V}$	-	18	49	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	18	42	ns
power dissipation capacitance	C_{PD}	per switch; $V_1 = \text{GND to } V_{CC}^{[4]}$		-	25	-	pF
74HCT4051							
propagation delay	t_{pd}	V_{is} to $V_{os};$ $R_L = \infty\ \Omega;$ see Figure 9 ^[1]	$V_{CC} = 4.5\text{ V};$ $V_{EE} = 0\text{ V}$	-	5	12	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	4	8	ns
turn-on time	t_{on}	\bar{E} to $V_{os};$ $R_L = \infty\ \Omega;$ see Figure 10 ^[2]	$V_{CC} = 4.5\text{ V};$ $V_{EE} = 0\text{ V}$	-	26	55	ns
			$V_{CC} = 5.0\text{ V};$ $V_{EE} = 0\text{ V};$ $C_L = 15\text{ pF}$	-	22	-	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	16	39	ns
		S_n to $V_{os};$ $R_L = \infty\ \Omega;$ see Figure 10 ^[2]	$V_{CC} = 4.5\text{ V};$ $V_{EE} = 0\text{ V}$	-	28	55	ns
			$V_{CC} = 5.0\text{ V};$ $V_{EE} = 0\text{ V};$ $C_L = 15\text{ pF}$	-	24	-	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	16	39	ns
turn-off time	t_{off}	\bar{E} to $V_{os};$ $R_L = 1\text{ k}\Omega;$ see Figure 10 ^[3]	$V_{CC} = 4.5\text{ V};$ $V_{EE} = 0\text{ V}$	-	19	45	ns
			$V_{CC} = 5.0\text{ V};$ $V_{EE} = 0\text{ V};$ $C_L = 15\text{ pF}$	-	16	-	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	16	32	ns
		S_n to $V_{os};$ $R_L = 1\text{ k}\Omega;$ see Figure 10 ^[3]	$V_{CC} = 4.5\text{ V};$ $V_{EE} = 0\text{ V}$	-	23	45	ns
			$V_{CC} = 5.0\text{ V};$ $V_{EE} = 0\text{ V};$ $C_L = 15\text{ pF}$	-	20	-	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	16	32	ns
power dissipation capacitance	C_{PD}	per switch; $V_1 = \text{GND to } V_{CC} - 1.5\text{ V}^{[4]}$		-	25	-	pF

Note:

[1] t_{pd} is the same as t_{PHL} and t_{PLH} .

[2] t_{on} is the same as t_{PZH} and t_{PZL} .

[3] t_{off} is the same as t_{PHZ} and t_{PLZ} .

[4] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum \{(C_L + C_{SW}) \times V_{CC}^2 \times f_o\} \text{ where:}$$

f_i = input frequency in MHz;

f_o = output frequency in MHz;

N = number of inputs switching;

$\sum \{(C_L + C_{SW}) \times V_{CC}^2 \times f_o\}$ = sum of outputs;

C_L = output load capacitance in pF;

C_{SW} = switch capacitance in pF;

V_{CC} = supply voltage in V.

[5] For test circuit see Figure 11.

[6] V_{is} is the input voltage at a Yn or Z terminal, whichever is assigned as an input.

[7] V_{os} is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

3.3.5、AC Characteristics 2

($T_{amb} = -40^\circ C \sim +85^\circ C$; GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF; unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
74HC4051							
propagation delay	t_{pd}	V_{is} to V_{os} ; $R_L = \infty \Omega$; see Figure 9 ^[1]	$V_{CC} = 4.5$ V; $V_{EE} = 0$ V	-	-	15	ns
			$V_{CC} = 6.0$ V; $V_{EE} = 0$ V	-	-	13	ns
			$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V	-	-	10	ns
turn-on time	t_{on}	\bar{E} to V_{os} ; $R_L = \infty \Omega$; see Figure 10 ^[2]	$V_{CC} = 4.5$ V; $V_{EE} = 0$ V	-	-	86	ns
			$V_{CC} = 6.0$ V; $V_{EE} = 0$ V	-	-	73	ns
			$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V	-	-	64	ns
		S_n to V_{os} ; $R_L = \infty \Omega$; see Figure 10 ^[2]	$V_{CC} = 4.5$ V; $V_{EE} = 0$ V	-	-	86	ns
			$V_{CC} = 6.0$ V; $V_{EE} = 0$ V	-	-	73	ns
			$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V	-	-	64	ns
turn-off time	t_{off}	\bar{E} to V_{os} ; $R_L = 1$ k Ω ; see Figure 10 ^[3]	$V_{CC} = 4.5$ V; $V_{EE} = 0$ V	-	-	73	ns
			$V_{CC} = 6.0$ V; $V_{EE} = 0$ V	-	-	62	ns

			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	-	53	ns
		Sn to V_{os} ; $R_L = 1\text{ k}\Omega$; see Figure 10 ^[3]	$V_{CC} = 4.5\text{ V};$ $V_{EE} = 0\text{ V}$	-	-	73	ns
			$V_{CC} = 6.0\text{ V};$ $V_{EE} = 0\text{ V}$	-	-	62	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	-	53	ns
74HCT4051							
propagation delay	t_{pd}	V_{is} to V_{os} ; $R_L = \infty\ \Omega$; see Figure 9 ^[1]	$V_{CC} = 4.5\text{ V};$ $V_{EE} = 0\text{ V}$	-	-	15	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	-	10	ns
turn-on time	t_{on}	\bar{E} to V_{os} ; $R_L = \infty\ \Omega$; see Figure 10 ^[2]	$V_{CC} = 4.5\text{ V};$ $V_{EE} = 0\text{ V}$	-	-	69	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	-	49	ns
		Sn to V_{os} ; $R_L = \infty\ \Omega$; see Figure 10 ^[2]	$V_{CC} = 4.5\text{ V};$ $V_{EE} = 0\text{ V}$	-	-	69	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	-	49	ns
turn-off time	t_{off}	\bar{E} to V_{os} ; $R_L = 1\text{ k}\Omega$; see Figure 10 ^[3]	$V_{CC} = 4.5\text{ V};$ $V_{EE} = 0\text{ V}$	-	-	56	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	-	40	ns
		Sn to V_{os} ; $R_L = 1\text{ k}\Omega$; see Figure 10 ^[3]	$V_{CC} = 4.5\text{ V};$ $V_{EE} = 0\text{ V}$	-	-	56	ns
			$V_{CC} = 4.5\text{ V};$ $V_{EE} = -4.5\text{ V}$	-	-	40	ns

Note:

[1] t_{pd} is the same as t_{PHL} and t_{PLH} .

[2] t_{on} is the same as t_{PZH} and t_{PZL} .

[3] t_{off} is the same as t_{PHZ} and t_{PLZ} .

[4] For test circuit see Figure 11.

[5] V_{is} is the input voltage at a Yn or Z terminal, whichever is assigned as an input.

[6] V_{os} is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

3.3.6、AC Characteristics 3

 ($T_{amb} = -40^{\circ}\text{C} \sim +125^{\circ}\text{C}$; $\text{GND} = 0\text{ V}$; $t_r = t_f = 6\text{ ns}$; $C_L = 50\text{ pF}$; unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
74HC4051							
propagation delay	t_{pd}	V_{is} to V_{os} ; $R_L = \infty \Omega$; see Figure 9 ^[1]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	18	ns
			$V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	15	ns
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	-	12	ns
turn-on time	t_{on}	\bar{E} to V_{os} ; $R_L = \infty \Omega$; see Figure 10 ^[2]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	104	ns
			$V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	88	ns
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	-	77	ns
		S_n to V_{os} ; $R_L = \infty \Omega$; see Figure 10 ^[2]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	104	ns
			$V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	88	ns
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	-	77	ns
turn-off time	t_{off}	\bar{E} to V_{os} ; $R_L = 1\text{ k}\Omega$; see Figure 10 ^[3]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	87	ns
			$V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	74	ns
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	-	72	ns
		S_n to V_{os} ; $R_L = 1\text{ k}\Omega$; see Figure 10 ^[3]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	87	ns
			$V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	74	ns
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	-	72	ns
74HCT4051							
propagation delay	t_{pd}	V_{is} to V_{os} ; $R_L = \infty \Omega$; see Figure 9 ^[1]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	18	ns
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	-	12	ns
turn-on time	t_{on}	\bar{E} to V_{os} ; $R_L = \infty \Omega$; see Figure 10 ^[2]	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	83	ns
			$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	-	59	ns

		Sn to V _{os} ; R _L = ∞ Ω; see Figure 10 ^[2]	V _{CC} = 4.5 V; V _{EE} = 0 V	-	-	83	ns
			V _{CC} = 4.5 V; V _{EE} = -4.5 V	-	-	59	ns
turn-off time	t _{off}	\bar{E} to V _{os} ; R _L = 1 kΩ; see Figure 10 ^[3]	V _{CC} = 4.5 V; V _{EE} = 0 V	-	-	68	ns
			V _{CC} = 4.5 V; V _{EE} = -4.5 V	-	-	48	ns
		Sn to V _{os} ; R _L = 1 kΩ; see Figure 10 ^[3]	V _{CC} = 4.5 V; V _{EE} = 0 V	-	-	68	ns
			V _{CC} = 4.5 V; V _{EE} = -4.5 V	-	-	48	ns

Note:

[1] t_{pd} is the same as t_{PHL} and t_{PLH}.

[2] t_{on} is the same as t_{PZH} and t_{PZL}.

[3] t_{off} is the same as t_{PHZ} and t_{PLZ}.

[4] For test circuit see Figure 11.

[5] V_{is} is the input voltage at a Yn or Z terminal, whichever is assigned as an input.

[6] V_{os} is the output voltage at a Yn or Z terminal, whichever is assigned as an output.

3.3.7、AC Characteristics 4

(T_{amb} = 25°C; GND = 0V; C_L = 50pF; recommended conditions and typical values.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
sine-wave distortion	d _{sin}	f _i = 1 kHz; R _L = 10 kΩ; see Figure 12	V _{is} = 4.0 V (p-p); V _{CC} = 2.25 V; V _{EE} = -2.25 V	-	0.04	-	%
			V _{is} = 8.0 V (p-p); V _{CC} = 4.5 V; V _{EE} = -4.5 V	-	0.02	-	%
		f _i = 10 kHz; R _L = 10 kΩ; see Figure 12	V _{is} = 4.0 V (p-p); V _{CC} = 2.25 V; V _{EE} = -2.25 V	-	0.12	-	%
			V _{is} = 8.0 V (p-p); V _{CC} = 4.5 V; V _{EE} = -4.5 V	-	0.06	-	%
isolation (OFF-state)	α _{iso}	R _L = 600 Ω; f _i = 1 MHz; see Figure 13	V _{CC} = 2.25 V; V _{EE} = -2.25 V ^[1]	-	-50	-	dB
			V _{CC} = 4.5 V; V _{EE} = -4.5 V ^[1]	-	-50	-	dB
crosstalk voltage	V _{ct}	peak-to-peak value; between control and	V _{CC} = 4.5 V; V _{EE} = 0 V	-	110	-	mV

		any switch; $R_L = 600 \Omega$; $f_i = 1 \text{ MHz}$; \bar{E} or S_n square wave between V_{CC} and GND; $t_r = t_f = 6 \text{ ns}$; see Figure 14	$V_{CC} = 4.5 \text{ V}$; $V_{EE} = -4.5 \text{ V}$	-	220	-	mV
-3dB frequency response	$f_{(-3\text{dB})}$	$R_L = 50 \Omega$; see Figure 15	$V_{CC} = 2.25 \text{ V}$; ^[2] $V_{EE} = -2.25 \text{ V}$	-	170	-	MHz
			$V_{CC} = 4.5 \text{ V}$; ^[2] $V_{EE} = -4.5 \text{ V}$	-	180	-	MHz

Note:

[1] Adjust input voltage V_{is} to 0 dBm level (0 dBm = 1 mW into 600 Ω).

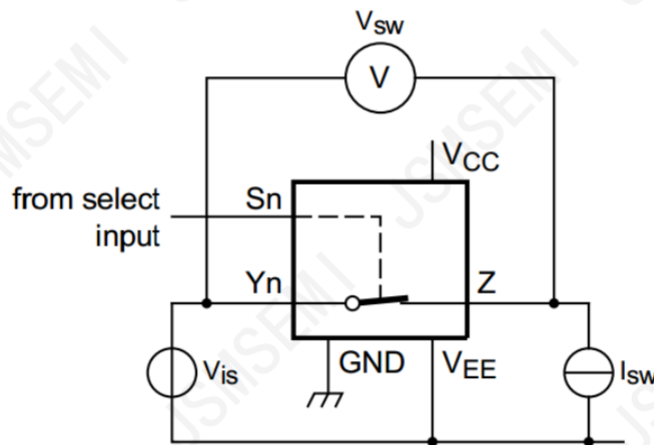
[2] Adjust input voltage V_{is} to 0 dBm level at V_{os} for 1 MHz (0 dBm = 1 mW into 50 Ω).

[3] V_{is} is the input voltage at a Y_n or Z terminal, whichever is assigned as an input.

[4] V_{os} is the output voltage at a Y_n or Z terminal, whichever is assigned as an output.

4、Testing Circuit

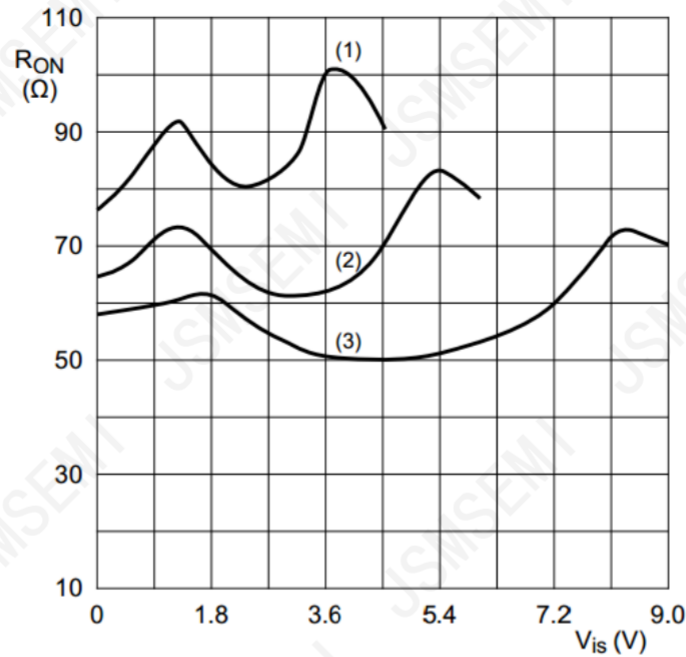
4.1、DC Testing Circuit 1



$$V_{is} = 0\text{V to } (V_{CC} - V_{EE})$$

$$R_{ON} = V_{sw}/I_{sw}$$

Figure 5. Test circuit for measuring R_{ON}



$V_{is} = 0V$ to $(V_{CC} - V_{EE})$

(1) $V_{CC} = 4.5V$

(2) $V_{CC} = 6V$

(3) $V_{CC} = 9V$

Figure 6. Typical R_{ON} as a function of input voltage V_{is}

4.2、DC Testing Circuit 2

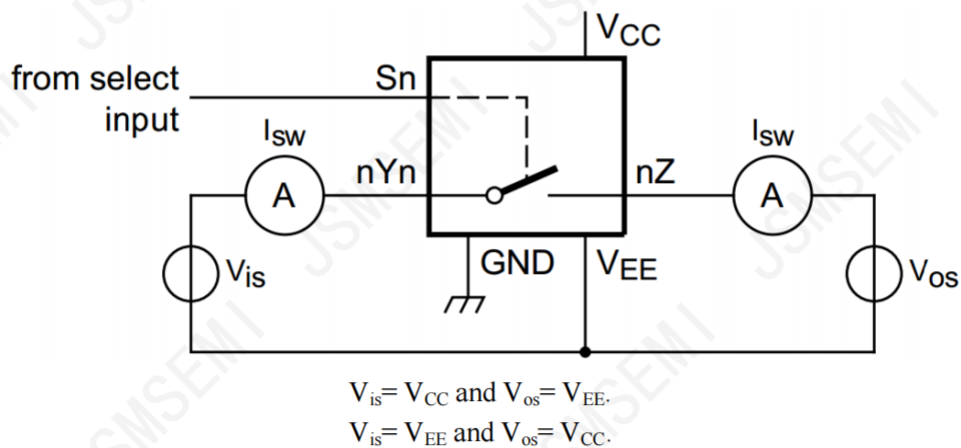


Figure 7. Test circuit for measuring OFF-state current

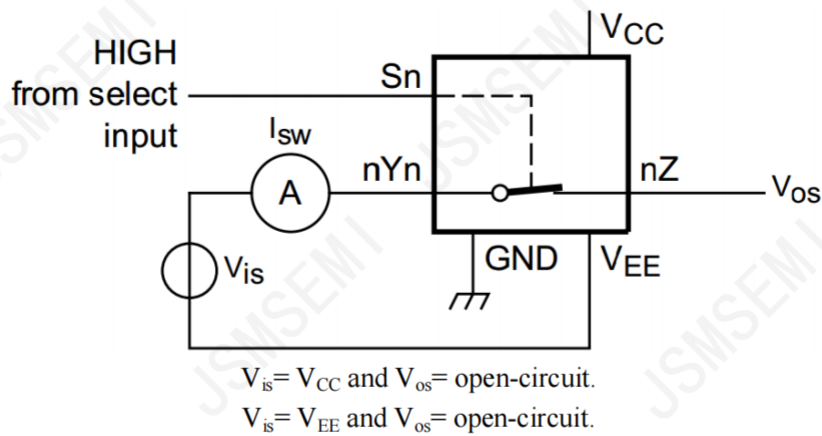


Figure 8. Test circuit for measuring ON-state current

4.3. AC Testing Waveforms

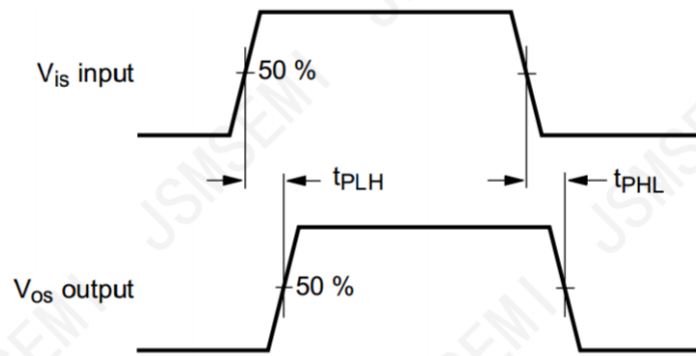


Figure 9. Input (V_{is}) to output (V_{os}) propagation delays

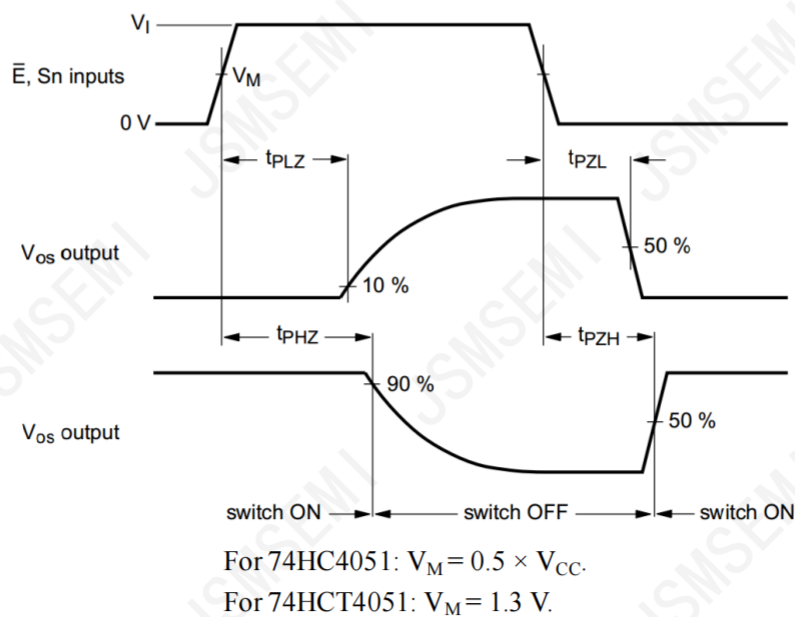


Figure 10. Turn-on and turn-off times

4.4、AC Testing Circuit 1

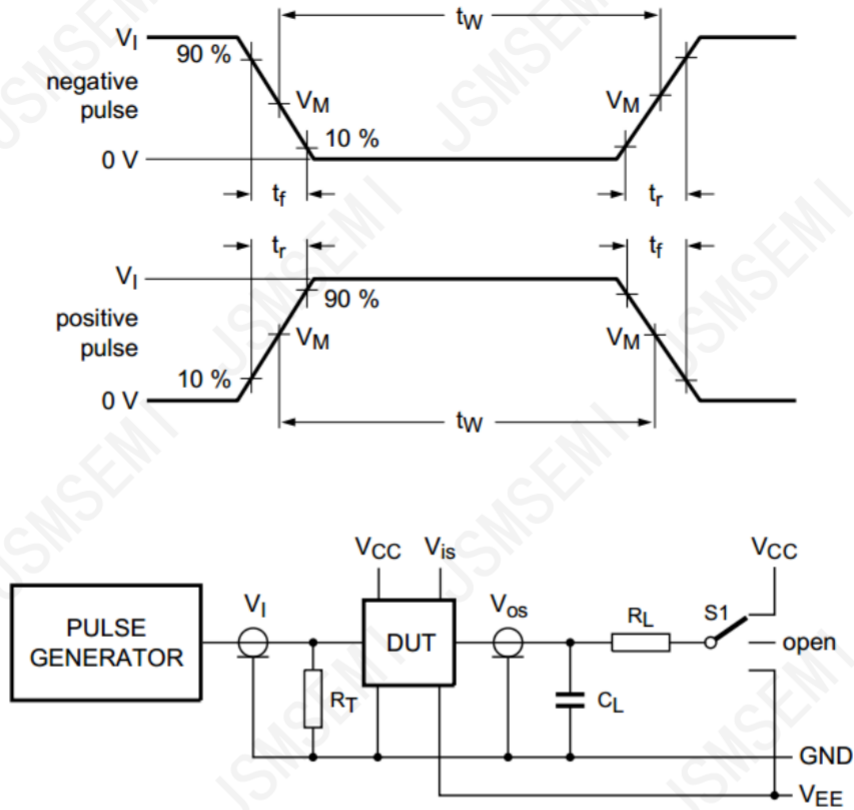


Figure 11. Test circuit for measuring switching times

Definitions for test circuit:

R_T = termination resistance should be equal to the output impedance Z_O of the pulse generator.

C_L = load capacitance including jig and probe capacitance.

R_L = load resistance.

S1 = Test selection switch.

4.5、Test Data

Test	Input				Load		S1 position
	V_I	V_{is}	t_r, t_f		C_L	R_L	
			at f_{max}	other ^[1]			
t_{PHL}, t_{PLH}	[2]	pulse	< 2ns	6ns	50pF	1k Ω	open
t_{PZH}, t_{PHZ}	[2]	V_{CC}	< 2ns	6ns	50pF	1k Ω	V_{EE}
t_{PZL}, t_{PLZ}	[2]	V_{EE}	< 2ns	6ns	50pF	1k Ω	V_{CC}

Note:

[1] $t_r = t_f = 6$ ns; when measuring f_{max} , there is no constraint to t_r and t_f with 50 % duty factor.

[2] V_I values:

For 74HC4051: $V_I = V_{CC}$.

For 74HCT4051: $V_I = 3V$.

4.6、AC Testing Circuit 2

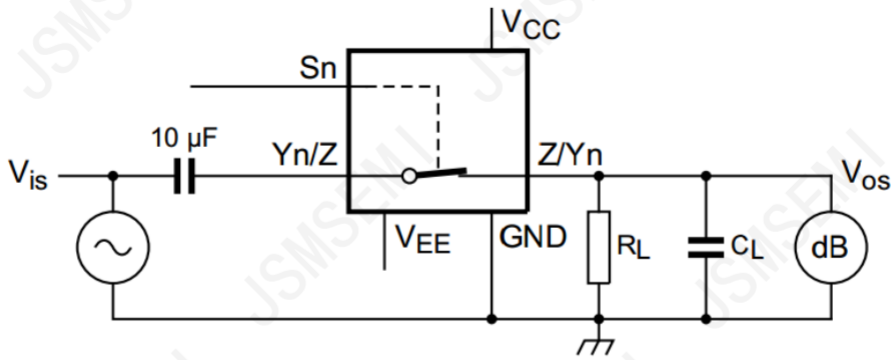
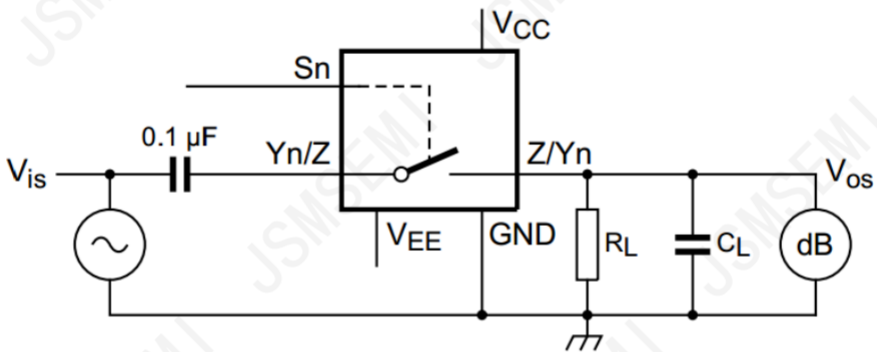
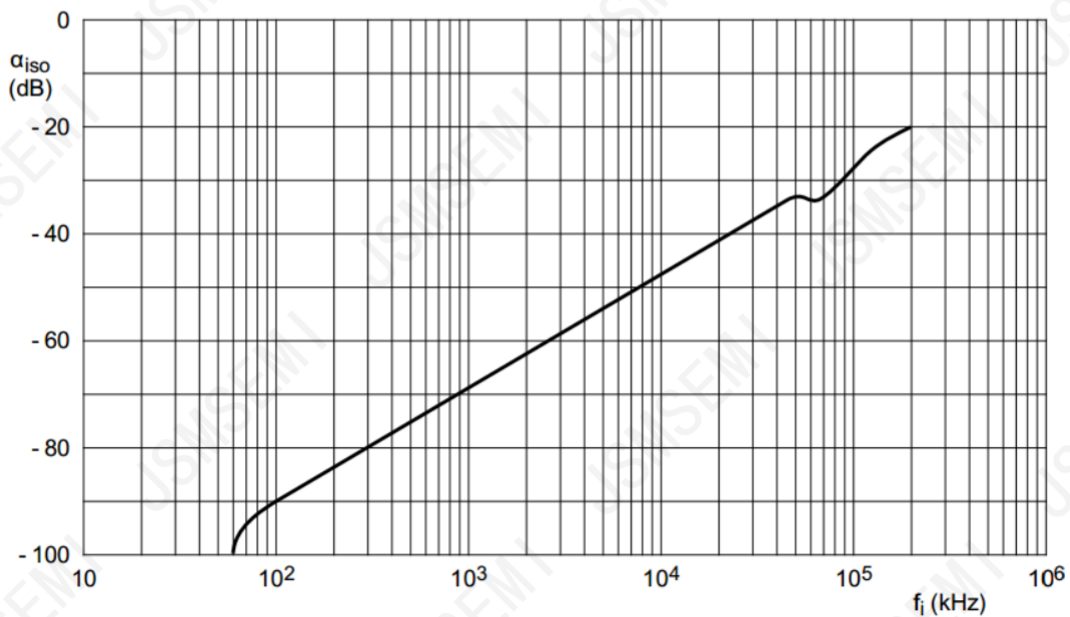


Figure 12. Test circuit for measuring sine-wave distortion



$V_{CC} = 4.5 \text{ V}$; $GND = 0 \text{ V}$; $V_{EE} = -4.5 \text{ V}$; $R_L = 600 \Omega$; $R_S = 1 \text{ k}\Omega$.

a. Test circuit



b. Isolation (OFF-state) as a function of frequency

Figure 13. Test circuit for measuring isolation (OFF-state)

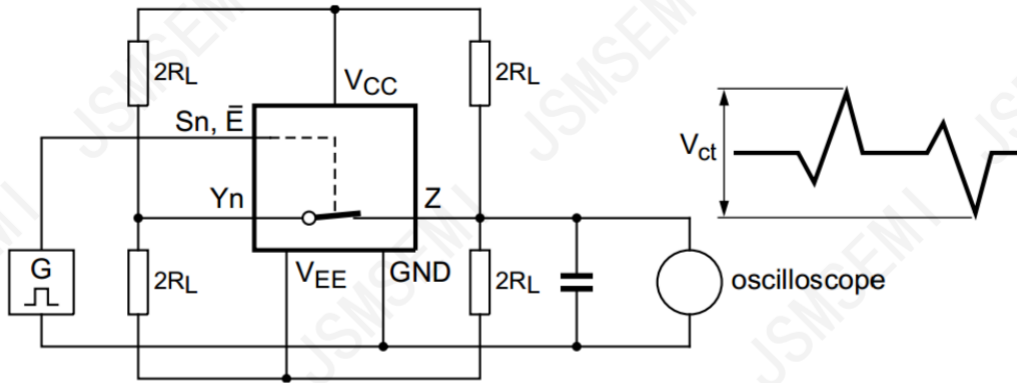
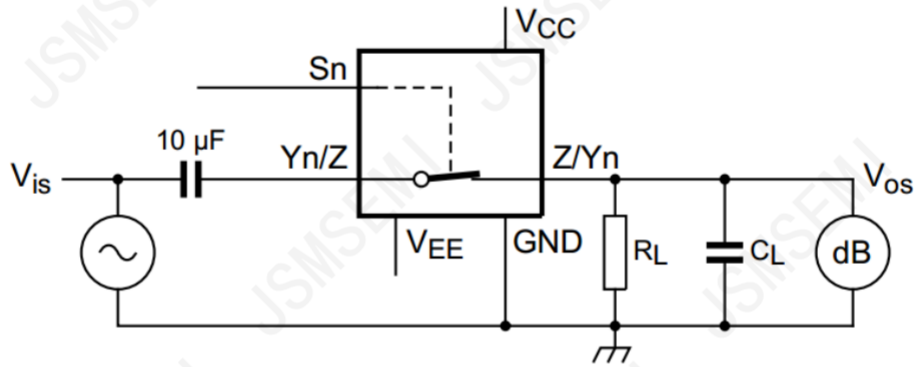
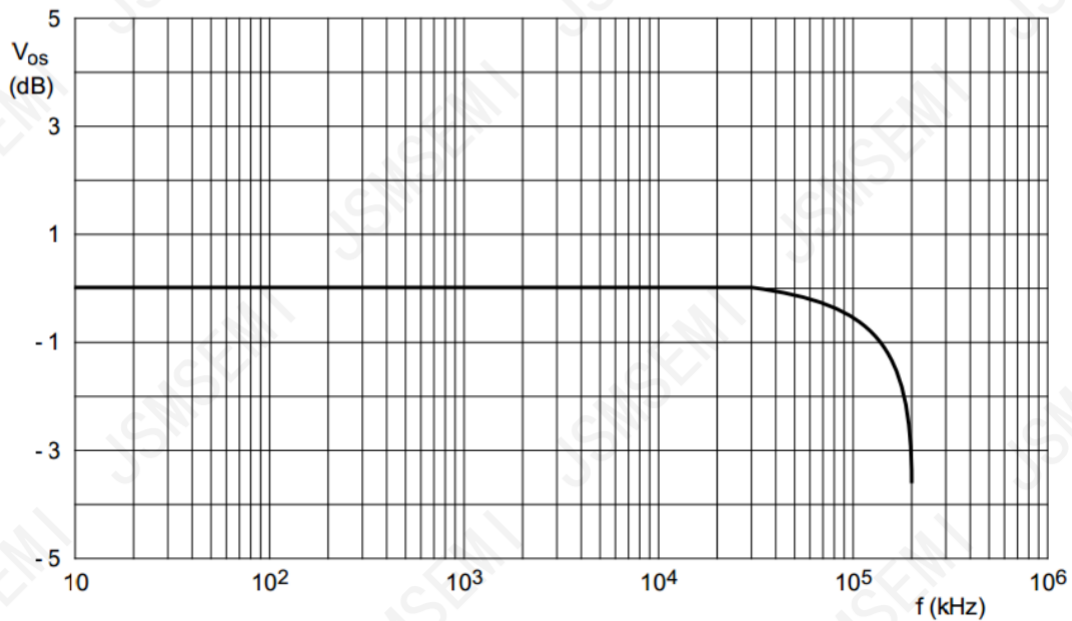


Figure 14. Test circuit for measuring crosstalk between control input and any switch



$V_{CC} = 4.5\text{ V}$; $GND = 0\text{ V}$; $V_{EE} = -4.5\text{ V}$; $R_L = 50\ \Omega$; $R_S = 1\text{ k}\Omega$

a. Test circuit

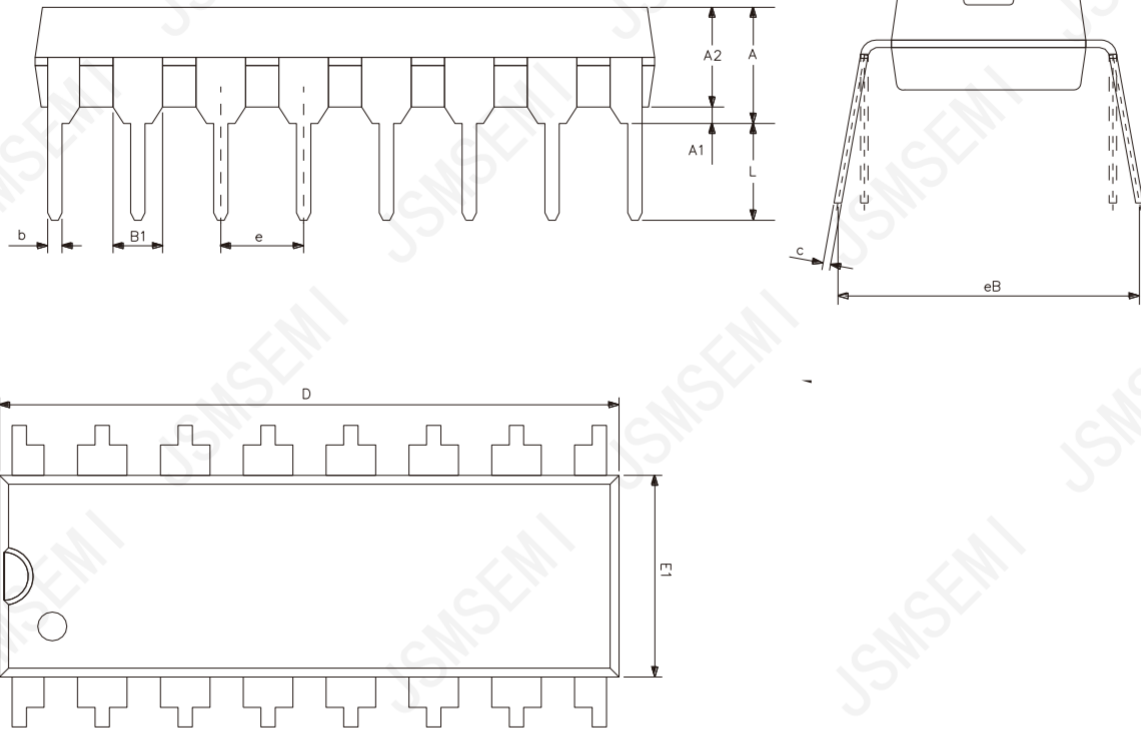


b. Typical frequency response

Figure 15. Test circuit for frequency response

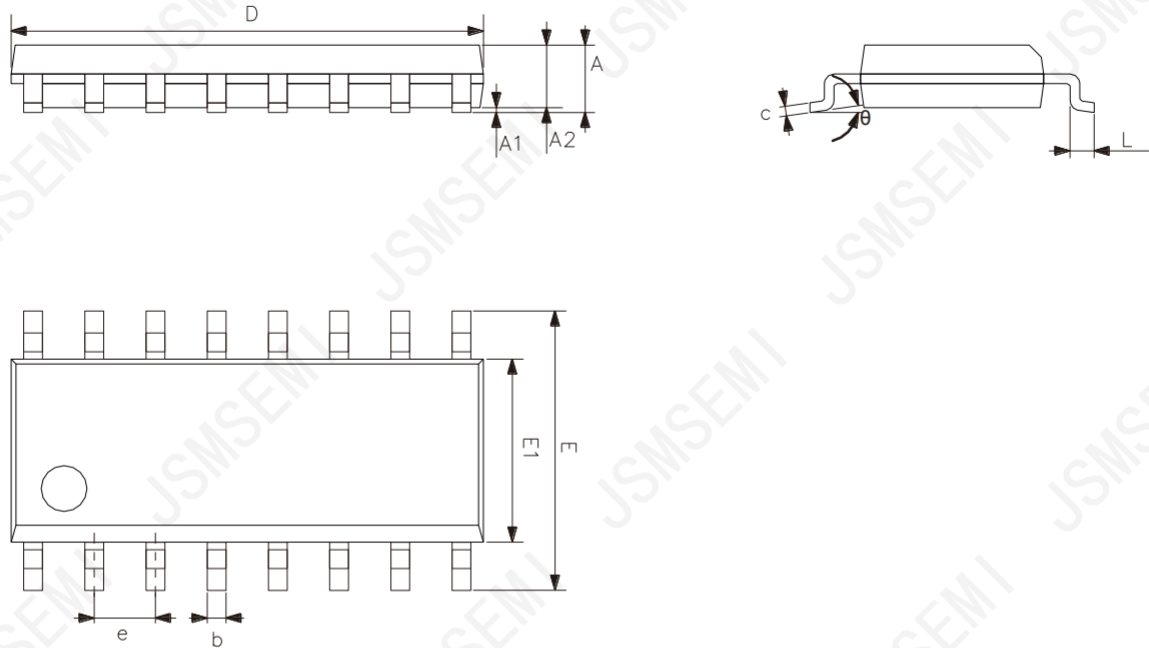
5、 Package Information

5.1、 DIP16



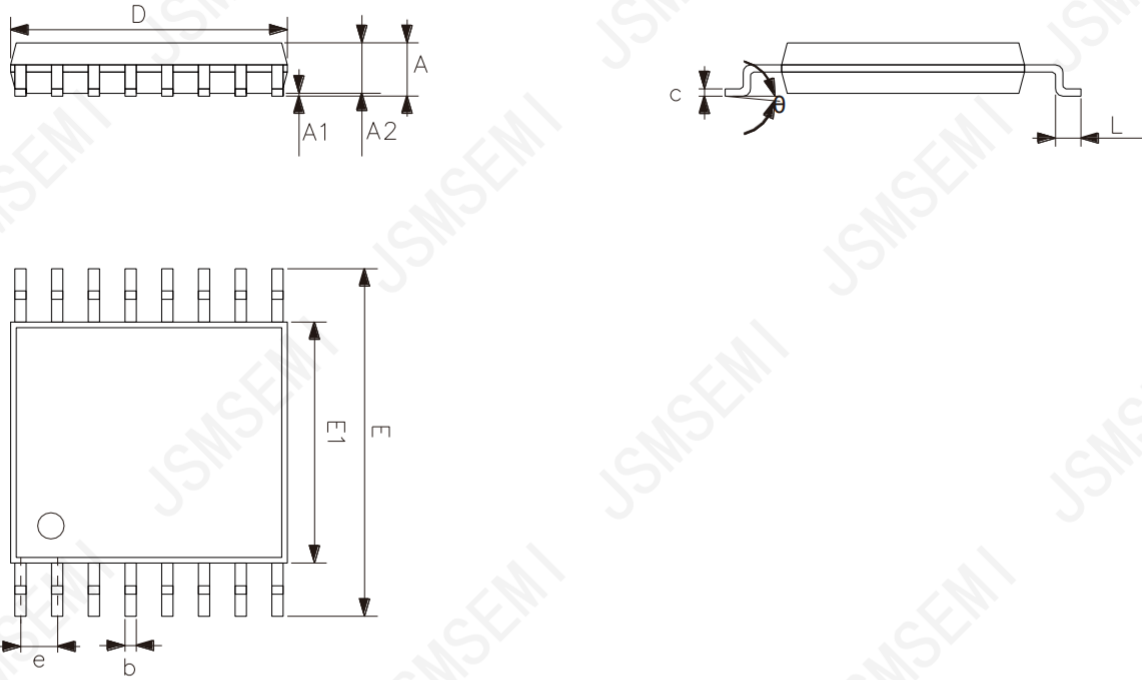
Symbol	Dimensions (mm)	
	Min.	Max.
A2	3.20	3.60
A1	0.51	-
A	3.60	5.33
L	3.00	3.60
b	0.36	0.56
B1	1.52	
D	18.80	19.94
E1	6.20	6.60
e	2.54	
c	0.20	0.36
eB	7.62	9.30

5.2、SOP16



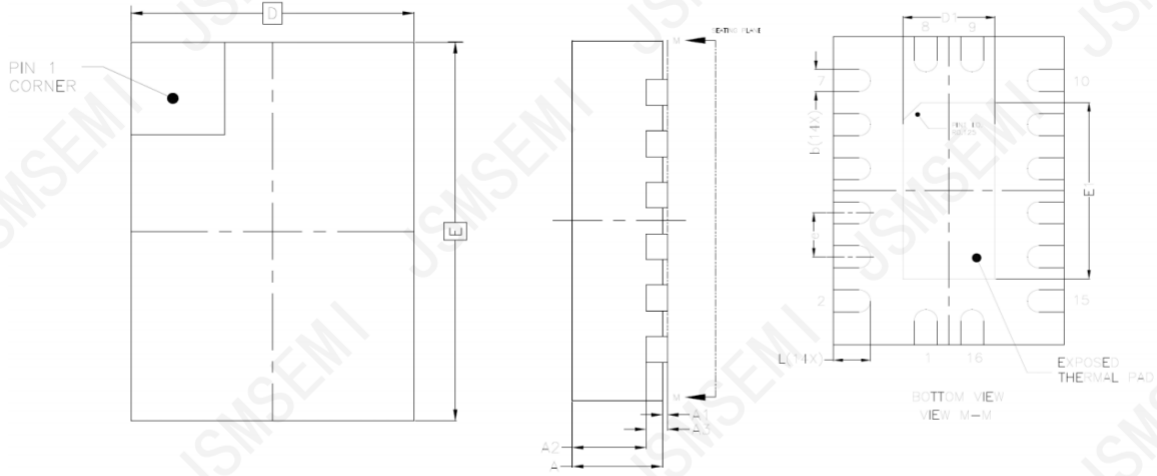
Symbol	Dimensions (mm)	
	Min.	Max.
A	1.35	1.80
A1	0.10	0.25
A2	1.25	1.55
b	0.33	0.51
c	0.19	0.25
D	9.50	10.10
E	5.80	6.30
E1	3.70	4.10
e	1.27	
L	0.35	0.89
θ	0°	8°

5.3、TSSOP16



Symbol	Dimensions (mm)	
	Min.	Max.
A	-	1.20
A1	0.05	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	4.90	5.10
E1	4.30	4.50
E	6.20	6.60
e	0.65	
L	0.45	0.75
θ	0°	8°

5.4、DHVQFN16



Symbol	Dimensions (mm)	
	Min.	Max.
A	0.80	1.00
A1	0.00	0.05
A2	0.60	0.70
A3	0.20	
D	2.40	2.60
E	3.40	3.60
e	0.50	
b	0.18	0.30
L	0.30	0.50
D1	0.85	1.15
E1	1.85	2.15

6、 Statements And Notes

6.1、 The name and content of Hazardous substances or Elements in the product

Part name	Hazardous substances or Elements									
	Lead and lead compounds	Mercury and mercury compounds	Cadmium and cadmium compounds	Hexavalent chromium compounds	Polybrominated biphenyls	Polybrominated biphenyl ethers	Dibutyl phthalate	Butylbenzyl phthalate	Di-2-ethylhexyl phthalate	Diisobutyl phthalate
Lead frame	○	○	○	○	○	○	○	○	○	○
Plastic resin	○	○	○	○	○	○	○	○	○	○
Chip	○	○	○	○	○	○	○	○	○	○
The lead	○	○	○	○	○	○	○	○	○	○
Plastic sheet installed	○	○	○	○	○	○	○	○	○	○
explanation	○: Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard. ×: Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements.									

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