

# 74HC4051; 74HCT4051

8-channel analog multiplexer/demultiplexer

Rev. 9 — 26 September 2017

Product data sheet

## 1 General description

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The 74HC4051; 74HCT4051 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  $V_{CC}$ .

## 2 Features and benefits

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- Wide analog input voltage range from -5 V to +5 V
- Complies with JEDEC standard no. 7A
- Low ON resistance:
  - 80  $\Omega$  (typical) at  $V_{CC} - V_{EE} = 4.5$  V
  - 70  $\Omega$  (typical) at  $V_{CC} - V_{EE} = 6.0$  V
  - 60  $\Omega$  (typical) at  $V_{CC} - V_{EE} = 9.0$  V
- Logic level translation: to enable 5 V logic to communicate with  $\pm 5$  V analog signals
- Typical 'break before make' built-in
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
  - CDM JESD22-C101E exceeds 1000 V
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

## 3 Applications

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

## 4 Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC4051D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HCT4051D				
74HC4051DB	-40 °C to +125 °C	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	SOT338-1
74HCT4051DB				
74HC4051PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74HCT4051PW				
74HC4051BQ	-40 °C to +125 °C	DHVQFN16	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm	SOT763-1
74HCT4051BQ				

## 5 Functional diagram





Figure 2. Logic symbol



Figure 3. IEC logic symbol



Figure 4. Schematic diagram (one switch)

6 Pinning information

6.1 Pinning



Figure 5. Pin configuration SO16, and (T)SSOP16



(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<sub>CC</sub>.

Figure 6. Pin configuration DHVQFN16

6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
E	6	enable input (active LOW)
V <sub>EE</sub>	7	supply voltage
GND	8	ground supply voltage
S0, S1, S2	11, 10, 9	select input
Y0, Y1, Y2, Y3, Y4, Y5, Y6, Y7	13, 14, 15, 12, 1, 5, 2, 4	independent input or output
Z	3	common output or input
V <sub>CC</sub>	16	supply voltage

## 7 Function description

Table 3. Function table <sup>[1]</sup>

Input				Channel ON
$\bar{E}$	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

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care.

## 8 Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to  $V_{SS} = 0\text{ V}$  (ground).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage	[1]	-0.5	+11.0	V
$I_{IK}$	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA
$I_{SK}$	switch clamping current	$V_{SW} < -0.5\text{ V}$ or $V_{SW} > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA
$I_{SW}$	switch current	$-0.5\text{ V} < V_{SW} < V_{CC} + 0.5\text{ V}$	-	$\pm 25$	mA
$I_{EE}$	supply current		-	$\pm 20$	mA
$I_{CC}$	supply current		-	50	mA
$I_{GND}$	ground current		-	-50	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	SO16, (T)SSOP16, and DHSVFN16 package [2]	-	500	mW
P	power dissipation	per switch	-	100	mW

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

[2] For SO16 packages: above 70 °C the value of  $P_{tot}$  derates linearly with 8 mW/K.

For SSOP16 and TSSOP16 packages: above 60 °C the value of  $P_{tot}$  derates linearly with 5.5 mW/K.

For DHSVFN16 packages: above 60 °C the value of  $P_{tot}$  derates linearly with 4.5 mW/K.

## 9 Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	74HC4051			74HCT4051			Unit
			Min	Typ	Max	Min	Typ	Max	
$V_{CC}$	supply voltage	see <a href="#">Figure 7</a> and <a href="#">Figure 8</a>							
		$V_{CC} - GND$	2.0	5.0	10.0	4.5	5.0	5.5	V
		$V_{CC} - V_{EE}$	2.0	5.0	10.0	2.0	5.0	10.0	V
$V_I$	input voltage		GND	-	$V_{CC}$	GND	-	$V_{CC}$	V
$V_{SW}$	switch voltage		$V_{EE}$	-	$V_{CC}$	$V_{EE}$	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+25	+125	-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.0\text{ V}$	-	-	625	-	-	-	ns/V
		$V_{CC} = 4.5\text{ V}$	-	1.67	139	-	1.67	139	ns/V
		$V_{CC} = 6.0\text{ V}$	-	-	83	-	-	-	ns/V
		$V_{CC} = 10.0\text{ V}$	-	-	31	-	-	-	ns/V

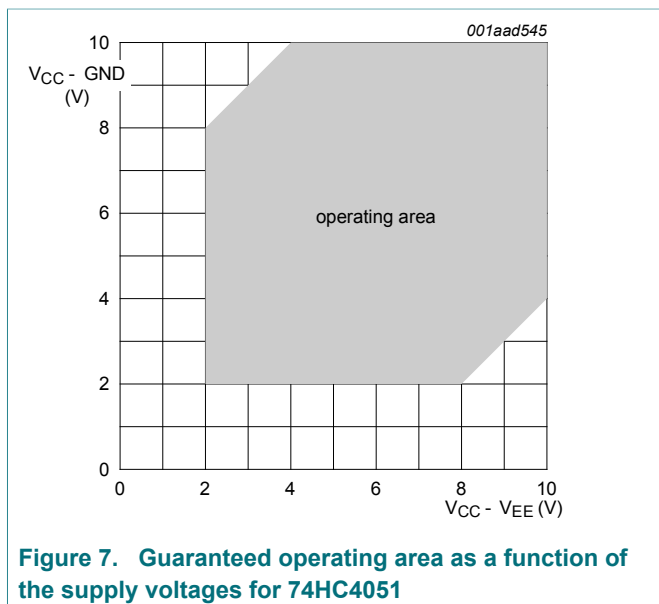


Figure 7. Guaranteed operating area as a function of the supply voltages for 74HC4051

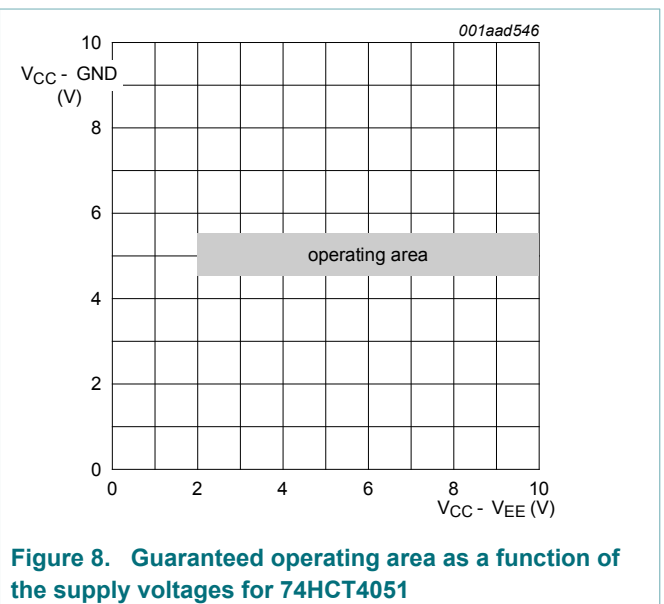


Figure 8. Guaranteed operating area as a function of the supply voltages for 74HCT4051

## 10 Static characteristics

**Table 6.  $R_{ON}$  resistance per switch for 74HC4051 and 74HCT4051**

$V_I = V_{IH}$  or  $V_{IL}$ ; for test circuit see [Figure 9](#).

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

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

For 74HC4051:  $V_{CC} - GND$  or  $V_{CC} - V_{EE} = 2.0\text{ V}$ ,  $4.5\text{ V}$ ,  $6.0\text{ V}$  and  $9.0\text{ V}$ .

For 74HCT4051:  $V_{CC} - GND = 4.5\text{ V}$  and  $5.5\text{ V}$ ,  $V_{CC} - V_{EE} = 2.0\text{ V}$ ,  $4.5\text{ V}$ ,  $6.0\text{ V}$  and  $9.0\text{ V}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b><math>T_{amb} = 25\text{ °C}</math></b>							
$R_{ON(peak)}$	ON resistance (peak)	$V_{is} = V_{CC}$ to $V_{EE}$					
		$V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 100\text{ }\mu\text{A}$ [1]	-	-	-	$\Omega$	
		$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$	-	100	180	$\Omega$	
		$V_{CC} = 6.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$	-	90	160	$\Omega$	
		$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$	-	70	130	$\Omega$	
$R_{ON(rail)}$	ON resistance (rail)	$V_{is} = V_{EE}$					
		$V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 100\text{ }\mu\text{A}$ [1]	-	150	-	$\Omega$	
		$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$	-	80	140	$\Omega$	
		$V_{CC} = 6.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$	-	70	120	$\Omega$	
		$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$	-	60	105	$\Omega$	
		$V_{is} = V_{CC}$					
		$V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 100\text{ }\mu\text{A}$ [1]	-	150	-	$\Omega$	
		$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$	-	90	160	$\Omega$	
		$V_{CC} = 6.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$	-	80	140	$\Omega$	
		$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$ ; $I_{SW} = 1000\text{ }\mu\text{A}$	-	65	120	$\Omega$	
$\Delta R_{ON}$	ON resistance mismatch between channels	$V_{is} = V_{CC}$ to $V_{EE}$					
		$V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ [1]	-	-	-	$\Omega$	
		$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	9	-	$\Omega$	
		$V_{CC} = 6.0\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	8	-	$\Omega$	
		$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$	-	6	-	$\Omega$	

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C</b>						
R <sub>ON(peak)</sub>	ON resistance (peak)	V <sub>is</sub> = V <sub>CC</sub> to V <sub>EE</sub>				
		V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1]	-	-	-	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	225	Ω
		V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	200	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA	-	-	165	Ω
R <sub>ON(rail)</sub>	ON resistance (rail)	V <sub>is</sub> = V <sub>EE</sub>				
		V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1]	-	-	-	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	175	Ω
		V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	150	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA	-	-	130	Ω
		V <sub>is</sub> = V <sub>CC</sub>				
		V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1]	-	-	-	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	200	Ω
		V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	175	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA	-	-	150	Ω
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
R <sub>ON(peak)</sub>	ON resistance (peak)	V <sub>is</sub> = V <sub>CC</sub> to V <sub>EE</sub>				
		V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1]	-	-	-	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	270	Ω
		V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	240	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA	-	-	195	Ω
R <sub>ON(rail)</sub>	ON resistance (rail)	V <sub>is</sub> = V <sub>EE</sub>				
		V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1]	-	-	-	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	210	Ω
		V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	180	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA	-	-	160	Ω
		V <sub>is</sub> = V <sub>CC</sub>				
		V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 100 μA [1]	-	-	-	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	240	Ω
		V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V; I <sub>SW</sub> = 1000 μA	-	-	210	Ω
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V; I <sub>SW</sub> = 1000 μA	-	-	180	Ω

[1] When supply voltages (V<sub>CC</sub> - V<sub>EE</sub>) near 2.0 V the analog switch ON resistance becomes extremely non-linear. When using a supply of 2 V, it is recommended to use these devices only for transmitting digital signals.





Figure 9. Test circuit for measuring  $R_{ON}$



Figure 10. Typical  $R_{ON}$  as a function of input voltage  $V_{is}$

Table 7. Static characteristics for 74HC4051

Voltages are referenced to GND (ground = 0 V).

$V_{is}$  is the input voltage at pins  $Y_n$  or  $Z$ , whichever is assigned as an input.

$V_{os}$  is the output voltage at pins  $Z$  or  $Y_n$ , whichever is assigned as an output.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = 25 \text{ }^\circ\text{C}</math></b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0 \text{ V}$	1.5	1.2	-	V
		$V_{CC} = 4.5 \text{ V}$	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
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0 \text{ V}$	-	0.8	0.5	V
		$V_{CC} = 4.5 \text{ V}$	-	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
$I_I$	input leakage current	$V_{EE} = 0 \text{ V}; V_I = V_{CC} \text{ or GND}$				
		$V_{CC} = 6.0 \text{ V}$	-	-	$\pm 0.1$	$\mu\text{A}$
		$V_{CC} = 10.0 \text{ V}$	-	-	$\pm 0.2$	$\mu\text{A}$
$I_{S(OFF)}$	OFF-state leakage current	$V_{CC} = 10.0 \text{ V}; V_{EE} = 0 \text{ V}; V_I = V_{IH} \text{ or } V_{IL};  V_{SW}  = V_{CC} - V_{EE}$ ; see Figure 11				
		per channel	-	-	$\pm 0.1$	$\mu\text{A}$
		all channels	-	-	$\pm 0.4$	$\mu\text{A}$

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{S(ON)}$	ON-state leakage current	$V_I = V_{IH}$ or $V_{IL}$ ; $ V_{SW}  = V_{CC} - V_{EE}$ ; $V_{CC} = 10.0$ V; $V_{EE} = 0$ V; see <a href="#">Figure 12</a>	-	-	$\pm 0.4$	$\mu$ A
$I_{CC}$	supply current	$V_{EE} = 0$ 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	-	-	8.0	$\mu$ A
		$V_{CC} = 10.0$ V	-	-	16.0	$\mu$ A
$C_I$	input capacitance		-	3.5	-	pF
$C_{SW}$	switch capacitance	independent pins Yn	-	5	-	pF
		common pins Z	-	25	-	pF
<b><math>T_{amb} = -40</math> °C to <math>+85</math> °C</b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0$ V	1.5	-	-	V
		$V_{CC} = 4.5$ V	3.15	-	-	V
		$V_{CC} = 6.0$ V	4.2	-	-	V
		$V_{CC} = 9.0$ V	6.3	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0$ V	-	-	0.5	V
		$V_{CC} = 4.5$ V	-	-	1.35	V
		$V_{CC} = 6.0$ V	-	-	1.8	V
		$V_{CC} = 9.0$ V	-	-	2.7	V
$I_I$	input leakage current	$V_{EE} = 0$ V; $V_I = V_{CC}$ or GND				
		$V_{CC} = 6.0$ V	-	-	$\pm 1.0$	$\mu$ A
		$V_{CC} = 10.0$ V	-	-	$\pm 2.0$	$\mu$ A
$I_{S(OFF)}$	OFF-state leakage current	$V_{CC} = 10.0$ V; $V_{EE} = 0$ V; $V_I = V_{IH}$ or $V_{IL}$ ; $ V_{SW}  = V_{CC} - V_{EE}$ ; see <a href="#">Figure 11</a>				
		per channel	-	-	$\pm 1.0$	$\mu$ A
		all channels	-	-	$\pm 4.0$	$\mu$ A
$I_{S(ON)}$	ON-state leakage current	$V_I = V_{IH}$ or $V_{IL}$ ; $ V_{SW}  = V_{CC} - V_{EE}$ ; $V_{CC} = 10.0$ V; $V_{EE} = 0$ V; see <a href="#">Figure 12</a>	-	-	$\pm 4.0$	$\mu$ A
$I_{CC}$	supply current	$V_{EE} = 0$ 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	$\mu$ A
		$V_{CC} = 10.0$ V	-	-	160.0	$\mu$ A

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	V
		V <sub>CC</sub> = 4.5 V	3.15	-	-	V
		V <sub>CC</sub> = 6.0 V	4.2	-	-	V
		V <sub>CC</sub> = 9.0 V	6.3	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	-	1.8	V
		V <sub>CC</sub> = 9.0 V	-	-	2.7	V
I <sub>I</sub>	input leakage current	V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>CC</sub> or GND				
		V <sub>CC</sub> = 6.0 V	-	-	±1.0	µA
		V <sub>CC</sub> = 10.0 V	-	-	±2.0	µA
I <sub>S(OFF)</sub>	OFF-state leakage current	V <sub>CC</sub> = 10.0 V; V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;  V <sub>SW</sub>   = V <sub>CC</sub> - V <sub>EE</sub> ; see <a href="#">Figure 11</a>				
		per channel	-	-	±1.0	µA
		all channels	-	-	±4.0	µA
I <sub>S(ON)</sub>	ON-state leakage current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;  V <sub>SW</sub>   = V <sub>CC</sub> - V <sub>EE</sub> ; V <sub>CC</sub> = 10.0 V; V <sub>EE</sub> = 0 V; see <a href="#">Figure 12</a>	-	-	±4.0	µA
I <sub>CC</sub>	supply current	V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>is</sub> = V <sub>EE</sub> or V <sub>CC</sub> ; V <sub>os</sub> = V <sub>CC</sub> or V <sub>EE</sub>				
		V <sub>CC</sub> = 6.0 V	-	-	160.0	µA
		V <sub>CC</sub> = 10.0 V	-	-	320.0	µA

**Table 8. Static characteristics for 74HCT4051**

Voltages are referenced to GND (ground = 0 V).

$V_{is}$  is the input voltage at pins Yn or Z, whichever is assigned as an input.

$V_{os}$  is the output voltage at pins Z or Yn, whichever is assigned as an output.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = 25\text{ }^{\circ}\text{C}</math></b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	2.0	1.6	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	1.2	0.8	V
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	-	$\pm 0.1$	$\mu\text{A}$
$I_{S(OFF)}$	OFF-state leakage current	$V_{CC} = 10.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $V_I = V_{IH}$ or $V_{IL}$ ; $ V_{SW}  = V_{CC} - V_{EE}$ ; see <a href="#">Figure 11</a>				
		per channel	-	-	$\pm 0.1$	$\mu\text{A}$
		all channels	-	-	$\pm 0.4$	$\mu\text{A}$
$I_{S(ON)}$	ON-state leakage current	$V_{CC} = 10.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $V_I = V_{IH}$ or $V_{IL}$ ; $ V_{SW}  = V_{CC} - V_{EE}$ ; see <a href="#">Figure 12</a>	-	-	$\pm 0.4$	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $V_{is} = V_{EE}$ or $V_{CC}$ ; $V_{os} = V_{CC}$ or $V_{EE}$				
		$V_{CC} = 5.5\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	-	8.0	$\mu\text{A}$
		$V_{CC} = 5.0\text{ V}$ ; $V_{EE} = -5.0\text{ V}$	-	-	16.0	$\mu\text{A}$
$\Delta I_{CC}$	additional supply current	per input; $V_I = V_{CC} - 2.1\text{ V}$ ; other inputs at $V_{CC}$ or GND; $V_{CC} = 4.5\text{ V to }5.5\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	50	180	$\mu\text{A}$
$C_I$	input capacitance		-	3.5	-	pF
$C_{SW}$	switch capacitance	independent pins Yn	-	5	-	pF
		common pins Z	-	25	-	pF

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.8	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V; V <sub>EE</sub> = 0 V	-	-	±1.0	µA
I <sub>S(OFF)</sub>	OFF-state leakage current	V <sub>CC</sub> = 10.0 V; V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;  V <sub>SW</sub>   = V <sub>CC</sub> - V <sub>EE</sub> ; see <a href="#">Figure 11</a>				
		per channel	-	-	±1.0	µA
		all channels	-	-	±4.0	µA
I <sub>S(ON)</sub>	ON-state leakage current	V <sub>CC</sub> = 10.0 V; V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;  V <sub>SW</sub>   = V <sub>CC</sub> - V <sub>EE</sub> ; see <a href="#">Figure 12</a>	-	-	±4.0	µA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>is</sub> = V <sub>EE</sub> or V <sub>CC</sub> ; V <sub>os</sub> = V <sub>CC</sub> or V <sub>EE</sub>				
		V <sub>CC</sub> = 5.5 V; V <sub>EE</sub> = 0 V	-	-	80.0	µA
		V <sub>CC</sub> = 5.0 V; V <sub>EE</sub> = -5.0 V	-	-	160.0	µA
ΔI <sub>CC</sub>	additional supply current	per input; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V; V <sub>EE</sub> = 0 V	-	-	225	µA
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	0.8	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V; V <sub>EE</sub> = 0 V	-	-	±1.0	µA
I <sub>S(OFF)</sub>	OFF-state leakage current	V <sub>CC</sub> = 10.0 V; V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;  V <sub>SW</sub>   = V <sub>CC</sub> - V <sub>EE</sub> ; see <a href="#">Figure 11</a>				
		per channel	-	-	±1.0	µA
		all channels	-	-	±4.0	µA
I <sub>S(ON)</sub>	ON-state leakage current	V <sub>CC</sub> = 10.0 V; V <sub>EE</sub> = 0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;  V <sub>SW</sub>   = V <sub>CC</sub> - V <sub>EE</sub> ; see <a href="#">Figure 12</a>	-	-	±4.0	µA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>is</sub> = V <sub>EE</sub> or V <sub>CC</sub> ; V <sub>os</sub> = V <sub>CC</sub> or V <sub>EE</sub>				
		V <sub>CC</sub> = 5.5 V; V <sub>EE</sub> = 0 V	-	-	160.0	µA
		V <sub>CC</sub> = 5.0 V; V <sub>EE</sub> = -5.0 V	-	-	320.0	µA
ΔI <sub>CC</sub>	additional supply current	per input; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V; V <sub>EE</sub> = 0 V	-	-	245	µA



$V_{is} = V_{CC}$  and  $V_{os} = V_{EE}$ .

$V_{is} = V_{EE}$  and  $V_{os} = V_{CC}$ .

**Figure 11. Test circuit for measuring OFF-state current**



$V_{is} = V_{CC}$  and  $V_{os} = \text{open-circuit}$ .

$V_{is} = V_{EE}$  and  $V_{os} = \text{open-circuit}$ .

**Figure 12. Test circuit for measuring ON-state current**

## 11 Dynamic characteristics

**Table 9. Dynamic characteristics for 74HC4051**

$GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; for test circuit see [Figure 15](#).

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

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit		
<b>T<sub>amb</sub> = 25 °C</b>								
$t_{pd}$	propagation delay	$V_{is}$ to $V_{os}$ ; $R_L = \infty\ \Omega$ ; see <a href="#">Figure 13</a> [1]						
		$V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	14	60	ns		
		$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	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		
$t_{on}$	turn-on time	$\bar{E}$ to $V_{os}$ ; $R_L = \infty\ \Omega$ ; see <a href="#">Figure 14</a> [2]						
		$V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	72	345	ns		
		$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	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 <a href="#">Figure 14</a> [2]						
		$V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	66	345	ns		
		$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	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		
		$t_{off}$	turn-off time	$\bar{E}$ to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see <a href="#">Figure 14</a> [3]				
				$V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$	-	58	290	ns
$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$	-			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 <a href="#">Figure 14</a> [3]								
$V_{CC} = 2.0\text{ V}$ ; $V_{EE} = 0\text{ V}$	-			61	290	ns		
$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = 0\text{ V}$	-			25	58	ns		
$V_{CC} = 5.0\text{ V}$ ; $V_{EE} = 0\text{ V}$ ; $C_L = 15\text{ pF}$	-			19	-	ns		
$V_{CC} = 6.0\text{ V}$ ; $V_{EE} = 0\text{ V}$	-			18	49	ns		
$V_{CC} = 4.5\text{ V}$ ; $V_{EE} = -4.5\text{ V}$	-			18	42	ns		

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$C_{PD}$	power dissipation capacitance	per switch; $V_I = \text{GND to } V_{CC}$ [4]	-	25	-	pF	
<b><math>T_{amb} = -40\text{ °C to }+85\text{ °C}</math></b>							
$t_{pd}$	propagation delay	$V_{is}$ to $V_{os}$ ; $R_L = \infty\ \Omega$ ; see <a href="#">Figure 13</a> [1]					
		$V_{CC} = 2.0\text{ V}; V_{EE} = 0\text{ V}$	-	-	75	ns	
		$V_{CC} = 4.5\text{ V}; V_{EE} = 0\text{ V}$	-	-	15	ns	
		$V_{CC} = 6.0\text{ V}; V_{EE} = 0\text{ V}$	-	-	13	ns	
		$V_{CC} = 4.5\text{ V}; V_{EE} = -4.5\text{ V}$	-	-	10	ns	
$t_{on}$	turn-on time	$\bar{E}$ to $V_{os}$ ; $R_L = \infty\ \Omega$ ; see <a href="#">Figure 14</a> [2]					
		$V_{CC} = 2.0\text{ V}; V_{EE} = 0\text{ V}$	-	-	430	ns	
		$V_{CC} = 4.5\text{ V}; V_{EE} = 0\text{ V}$	-	-	86	ns	
		$V_{CC} = 6.0\text{ V}; V_{EE} = 0\text{ V}$	-	-	73	ns	
		$V_{CC} = 4.5\text{ V}; V_{EE} = -4.5\text{ V}$	-	-	64	ns	
		Sn to $V_{os}$ ; $R_L = \infty\ \Omega$ ; see <a href="#">Figure 14</a> [2]					
		$V_{CC} = 2.0\text{ V}; V_{EE} = 0\text{ V}$	-	-	430	ns	
		$V_{CC} = 4.5\text{ V}; V_{EE} = 0\text{ V}$	-	-	86	ns	
		$V_{CC} = 6.0\text{ V}; V_{EE} = 0\text{ V}$	-	-	73	ns	
		$V_{CC} = 4.5\text{ V}; V_{EE} = -4.5\text{ V}$	-	-	64	ns	
		$t_{off}$	turn-off time	$\bar{E}$ to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see <a href="#">Figure 14</a> [3]			
$V_{CC} = 2.0\text{ V}; V_{EE} = 0\text{ V}$	-			-	365	ns	
$V_{CC} = 4.5\text{ V}; V_{EE} = 0\text{ V}$	-			-	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	
Sn to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see <a href="#">Figure 14</a> [3]							
$V_{CC} = 2.0\text{ V}; V_{EE} = 0\text{ V}$	-			-	365	ns	
$V_{CC} = 4.5\text{ V}; V_{EE} = 0\text{ V}$	-			-	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	



Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>							
t <sub>pd</sub>	propagation delay	V <sub>is</sub> to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see <a href="#">Figure 13</a> [1]					
		V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V	-	-	90	ns	
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	18	ns	
		V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V	-	-	15	ns	
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	12	ns	
t <sub>on</sub>	turn-on time	$\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see <a href="#">Figure 14</a> [2]					
		V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V	-	-	520	ns	
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	104	ns	
		V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V	-	-	88	ns	
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	77	ns	
		Sn to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see <a href="#">Figure 14</a> [2]					
		V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V	-	-	520	ns	
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	104	ns	
		V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V	-	-	88	ns	
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	77	ns	
t <sub>off</sub>	turn-off time	$\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see <a href="#">Figure 14</a> [3]					
		V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V	-	-	435	ns	
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	87	ns	
		V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V	-	-	74	ns	
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	72	ns	
		Sn to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see <a href="#">Figure 14</a> [3]					
		V <sub>CC</sub> = 2.0 V; V <sub>EE</sub> = 0 V	-	-	435	ns	
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	87	ns	
		V <sub>CC</sub> = 6.0 V; V <sub>EE</sub> = 0 V	-	-	74	ns	
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	72	ns	

[1] t<sub>pd</sub> is the same as t<sub>pHL</sub> and t<sub>pLH</sub>.

[2] t<sub>on</sub> is the same as t<sub>pZH</sub> and t<sub>pZL</sub>.

[3] t<sub>off</sub> is the same as t<sub>pHZ</sub> and t<sub>pLZ</sub>.

[4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

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

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

N = number of inputs switching;

Σ{(C<sub>L</sub> + C<sub>sw</sub>) × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>} = sum of outputs;

C<sub>L</sub> = output load capacitance in pF;

C<sub>sw</sub> = switch capacitance in pF;

V<sub>CC</sub> = supply voltage in V.

**Table 10. Dynamic characteristics for 74HCT4051**

$GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; for test circuit see [Figure 15](#).

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

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b><math>T_{amb} = 25\text{ °C}</math></b>							
$t_{pd}$	propagation delay	$V_{is}$ to $V_{os}$ ; $R_L = \infty\ \Omega$ ; see <a href="#">Figure 13</a> [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	
$t_{on}$	turn-on time	$\bar{E}$ to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see <a href="#">Figure 14</a> [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	
		Sn to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see <a href="#">Figure 14</a> [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	
$t_{off}$	turn-off time	$\bar{E}$ to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see <a href="#">Figure 14</a> [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	
		Sn to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see <a href="#">Figure 14</a> [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	
$C_{PD}$	power dissipation capacitance	per switch; $V_I = GND$ to $V_{CC} - 1.5\text{ V}$ [4]	-	25	-	pF	
<b><math>T_{amb} = -40\text{ °C to }+85\text{ °C}</math></b>							
$t_{pd}$	propagation delay	$V_{is}$ to $V_{os}$ ; $R_L = \infty\ \Omega$ ; see <a href="#">Figure 13</a> [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	
$t_{on}$	turn-on time	$\bar{E}$ to $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see <a href="#">Figure 14</a> [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 $V_{os}$ ; $R_L = 1\text{ k}\Omega$ ; see <a href="#">Figure 14</a> [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	

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t <sub>off</sub>	turn-off time	$\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see <a href="#">Figure 14</a> [3]				
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	56	ns
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	40	ns
		Sn to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see <a href="#">Figure 14</a> [3]				
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	56	ns
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	40	ns
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
t <sub>pd</sub>	propagation delay	V <sub>is</sub> to V <sub>os</sub> ; R <sub>L</sub> = ∞ Ω; see <a href="#">Figure 13</a> [1]				
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	18	ns
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	12	ns
t <sub>on</sub>	turn-on time	$\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see <a href="#">Figure 14</a> [2]				
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	83	ns
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	59	ns
		Sn to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see <a href="#">Figure 14</a> [2]				
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	83	ns
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	59	ns
t <sub>off</sub>	turn-off time	$\bar{E}$ to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see <a href="#">Figure 14</a> [3]				
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	68	ns
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	48	ns
		Sn to V <sub>os</sub> ; R <sub>L</sub> = 1 kΩ; see <a href="#">Figure 14</a> [3]				
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	-	68	ns
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	-	48	ns

[1] t<sub>pd</sub> is the same as t<sub>pHL</sub> and t<sub>pLH</sub>.

[2] t<sub>on</sub> is the same as t<sub>pZH</sub> and t<sub>pZL</sub>.

[3] t<sub>off</sub> is the same as t<sub>pHZ</sub> and t<sub>pLZ</sub>.

[4] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma\{(C_L + C_{sw}) \times V_{CC}^2 \times f_o\}$$

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

N = number of inputs switching;

Σ{(C<sub>L</sub> + C<sub>sw</sub>) × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>} = sum of outputs;

C<sub>L</sub> = output load capacitance in pF;

C<sub>sw</sub> = switch capacitance in pF;

V<sub>CC</sub> = supply voltage in V.



**Figure 13. Input ( $V_{is}$ ) to output ( $V_{os}$ ) propagation delays**



For 74HC4051:  $V_M = 0.5 \times V_{CC}$ .

For 74HCT4051:  $V_M = 1.3 \text{ V}$ .

**Figure 14. Turn-on and turn-off times**



**Table 11. Test data**

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

[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:  $V_I = 3$  V

11.1 Additional dynamic characteristics

Table 12. Additional dynamic characteristics

Recommended conditions and typical values; GND = 0 V; T<sub>amb</sub> = 25 °C; C<sub>L</sub> = 50 pF.

V<sub>is</sub> is the input voltage at pins nYn or nZ, whichever is assigned as an input.

V<sub>os</sub> is the output voltage at pins nYn or nZ, whichever is assigned as an output.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
d <sub>sin</sub>	sine-wave distortion	f <sub>i</sub> = 1 kHz; R <sub>L</sub> = 10 kΩ; see <a href="#">Figure 16</a>					
		V <sub>is</sub> = 4.0 V (p-p); V <sub>CC</sub> = 2.25 V; V <sub>EE</sub> = -2.25 V	-	0.04	-	%	
		V <sub>is</sub> = 8.0 V (p-p); V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	0.02	-	%	
		f <sub>i</sub> = 10 kHz; R <sub>L</sub> = 10 kΩ; see <a href="#">Figure 16</a>					
		V <sub>is</sub> = 4.0 V (p-p); V <sub>CC</sub> = 2.25 V; V <sub>EE</sub> = -2.25 V	-	0.12	-	%	
		V <sub>is</sub> = 8.0 V (p-p); V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	0.06	-	%	
α <sub>iso</sub>	isolation (OFF-state)	R <sub>L</sub> = 600 Ω; f <sub>i</sub> = 1 MHz; see <a href="#">Figure 17</a>					
		V <sub>CC</sub> = 2.25 V; V <sub>EE</sub> = -2.25 V	[1]	-	-50	-	dB
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	[1]	-	-50	-	dB
V <sub>ct</sub>	crosstalk voltage	peak-to-peak value; between control and any switch; R <sub>L</sub> = 600 Ω; f <sub>i</sub> = 1 MHz; E or Sn square wave between V <sub>CC</sub> and GND; t <sub>r</sub> = t <sub>f</sub> = 6 ns; see <a href="#">Figure 18</a>					
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = 0 V	-	110	-	mV	
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	-	220	-	mV	
f <sub>i(-3dB)</sub>	-3 dB frequency response	R <sub>L</sub> = 50 Ω; see <a href="#">Figure 19</a>					
		V <sub>CC</sub> = 2.25 V; V <sub>EE</sub> = -2.25 V	[2]	-	170	-	MHz
		V <sub>CC</sub> = 4.5 V; V <sub>EE</sub> = -4.5 V	[2]	-	180	-	MHz

[1] Adjust input voltage V<sub>is</sub> to 0 dBm level (0 dBm = 1 mW into 600 Ω).

[2] Adjust input voltage V<sub>is</sub> to 0 dBm level at V<sub>os</sub> for 1 MHz (0 dBm = 1 mW into 50 Ω).



Figure 16. Test circuit for measuring sine-wave distortion



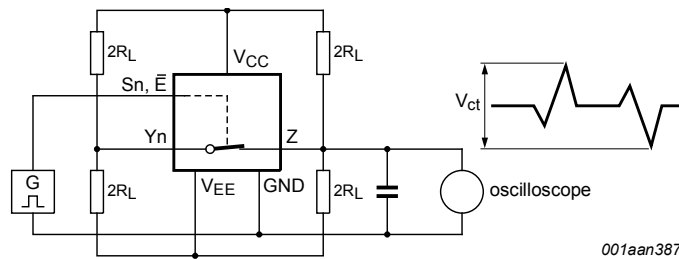
$V_{CC} = 4.5\text{ V}$ ;  $GND = 0\text{ V}$ ;  $V_{EE} = -4.5\text{ V}$ ;  $R_L = 600\ \Omega$ ;  $R_S = 1\text{ k}\Omega$ .

a. Test circuit



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

**Figure 17. Test circuit for measuring isolation (OFF-state)**



**Figure 18. 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

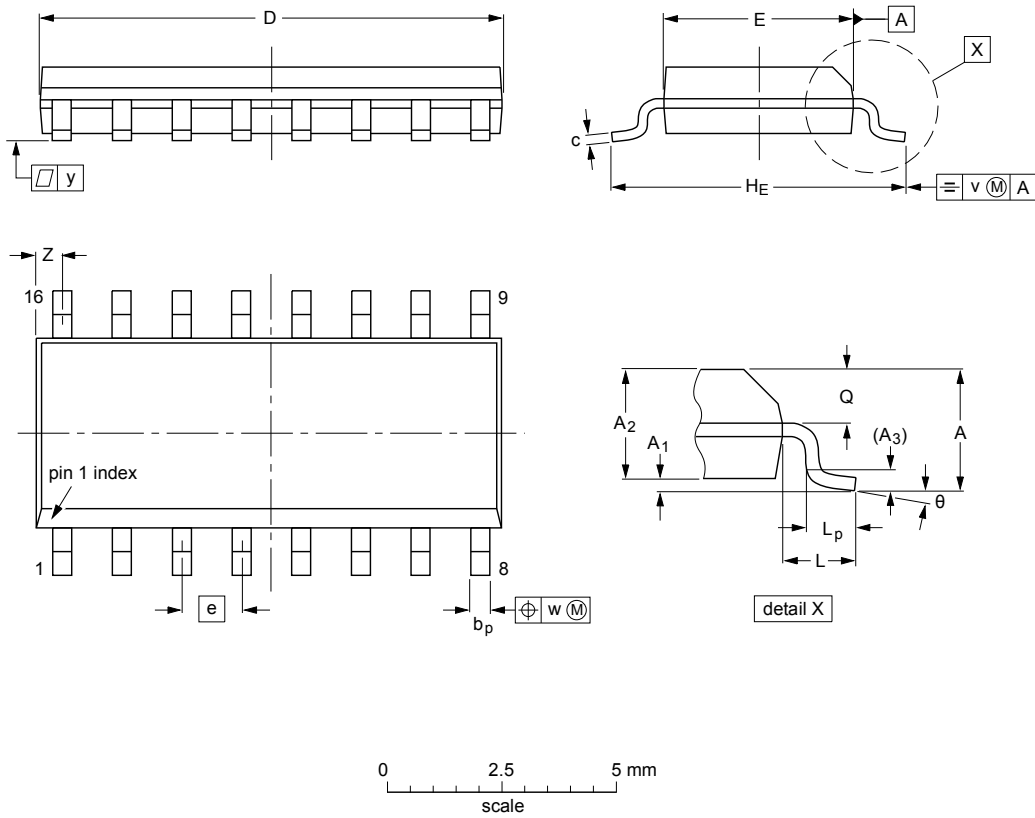
**Figure 19. Test circuit for frequency response**



12 Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

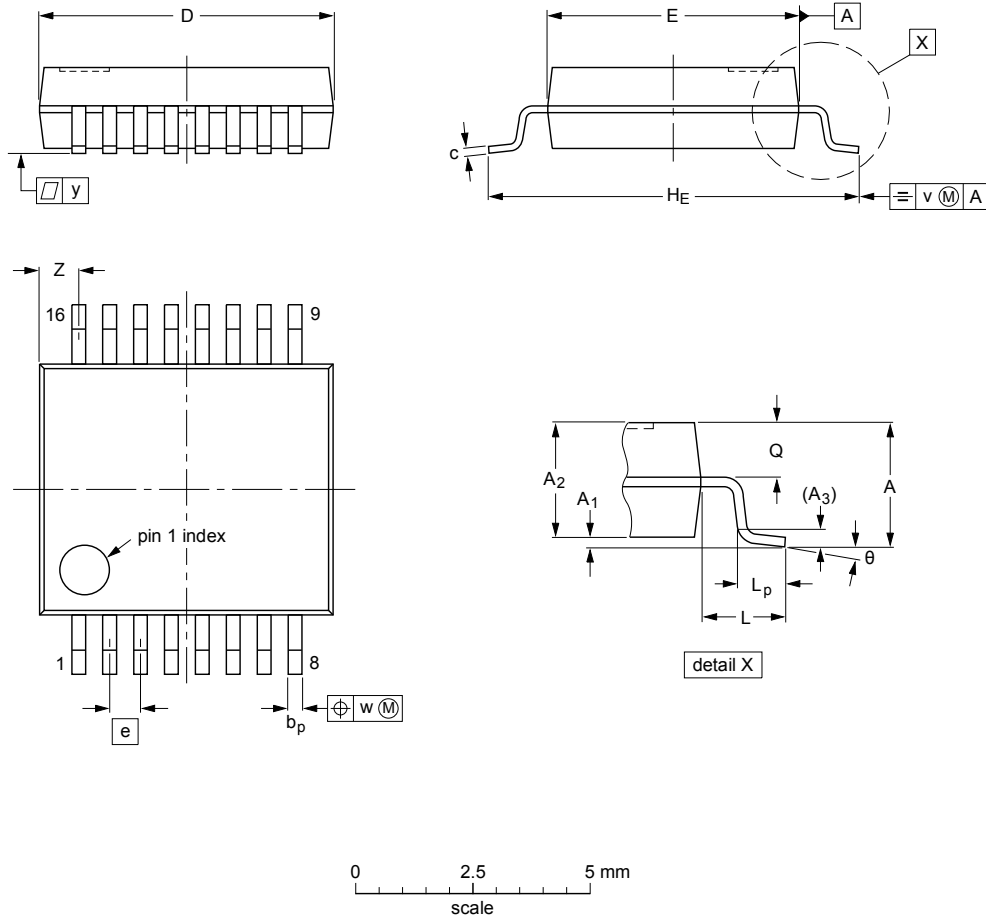
1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA		
SOT109-1	076E07	MS-012			99-12-27 03-02-19

Figure 20. Package outline SOT109-1 (SO16)

SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm

SOT338-1



**DIMENSIONS (mm are the original dimensions)**

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	1.00 0.55	8° 0°

**Note**

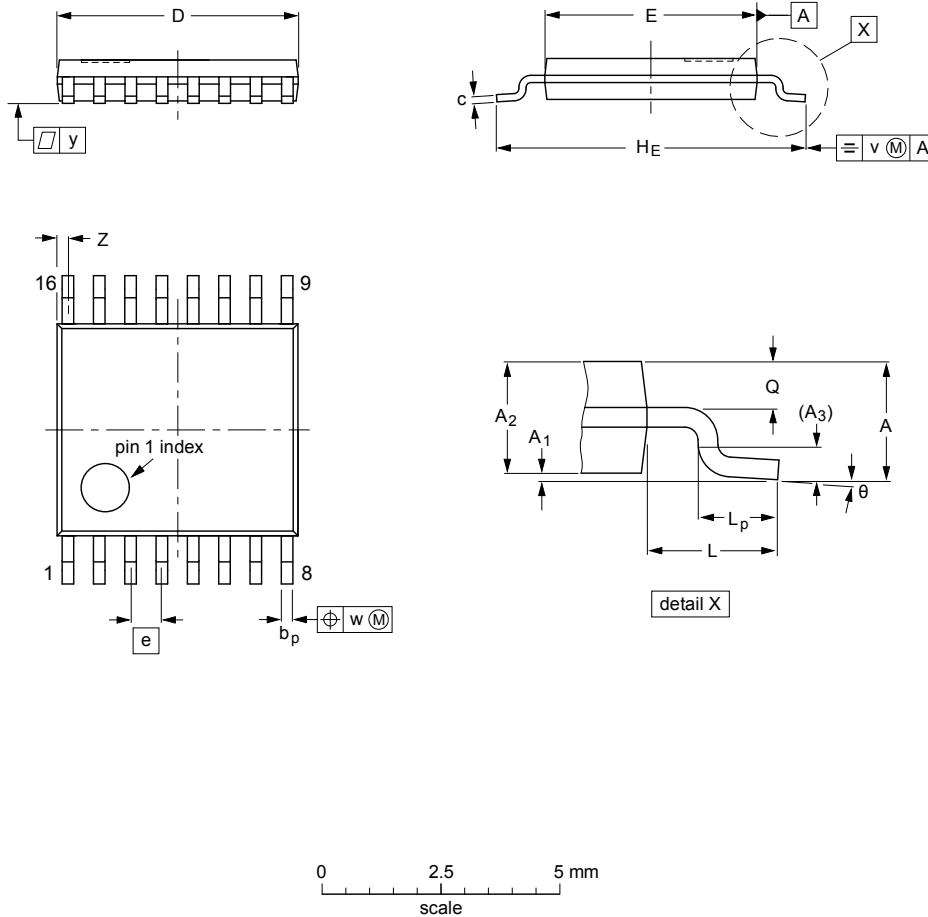
1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT338-1		MO-150				99-12-27 03-02-19

Figure 21. Package outline SOT338-1 (SSOP16)

TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1



**DIMENSIONS (mm are the original dimensions)**

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(2)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.40 0.06	8° 0°

**Notes**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT403-1		MO-153				99-12-27 03-02-18

Figure 22. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm

SOT763-1



Figure 23. Package outline SOT763-1 (DHVQFN16)

## 13 Abbreviations

Table 13. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

## 14 Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT4051 v.9	20170926	Product data sheet	-	74HC_HCT4051 v.8
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>			
74HC_HCT4051 v.8	20160205	Product data sheet	-	74HC_HCT4051 v.7
Modifications:	<ul style="list-style-type: none"> <li>Type numbers 74HC4051N and 74HCT4051N (SOT38-4) removed.</li> </ul>			
74HC_HCT4051 v.7	20120719	Product data sheet	-	74HC_HCT4051 v.6
Modifications:	<ul style="list-style-type: none"> <li>CDM added to features.</li> </ul>			
74HC_HCT4051 v.6	20111213	Product data sheet	-	74HC_HCT4051 v.5
Modifications:	<ul style="list-style-type: none"> <li>Legal pages updated.</li> </ul>			
74HC_HCT4051 v.5	20110513	Product data sheet	-	74HC_HCT4051 v.4
74HC_HCT4051 v.4	20110117	Product data sheet	-	74HC_HCT4051 v.3
74HC_HCT4051 v.3	20051219	Product specification	-	74HC_HCT4051_CNV_2

## 15 Legal information

### 15.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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