

# 74HC4051; 74HCT4051

## 8-channel analog multiplexer/demultiplexer

Rev. 6 — 13 December 2011

Product data sheet

### 1. General description

The 74HC4051; 74HCT4051 is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). The device is specified in compliance with JEDEC standard no. 7A.

The 74HC4051; 74HCT4051 is an 8-channel analog multiplexer/demultiplexer with three digital select inputs (S0 to S2), an active-LOW enable input ( $\bar{E}$ ), eight independent inputs/outputs (Y0 to Y7) and a common input/output (Z). With  $\bar{E}$  LOW, one of the eight switches is selected (low impedance ON-state) by S0 to S2. With  $\bar{E}$  HIGH, all switches are in the high-impedance OFF-state, independent of S0 to S2.

$V_{CC}$  and GND are the supply voltage pins for the digital control inputs (S0 to S2, and  $\bar{E}$ ). The  $V_{CC}$  to GND ranges are 2.0 V to 10.0 V for 74HC4051 and 4.5 V to 5.5 V for 74HCT4051. The analog inputs/outputs (Y0 to Y7, and Z) can swing between  $V_{CC}$  as a positive limit and  $V_{EE}$  as a negative limit.  $V_{CC} - V_{EE}$  may not exceed 10.0 V.

For operation as a digital multiplexer/demultiplexer,  $V_{EE}$  is connected to GND (typically ground).

### 2. Features and benefits

- Wide analog input voltage range from  $-5$  V to  $+5$  V
- 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
- Multiple package options
- Specified from  $-40$  °C to  $+85$  °C and  $-40$  °C to  $+125$  °C

### 3. Applications

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



## 4. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC4051N	−40 °C to +125 °C	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
74HCT4051N				
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 × 3.5 × 0.85 mm	SOT763-1
74HCT4051BQ				

## 5. Functional diagram

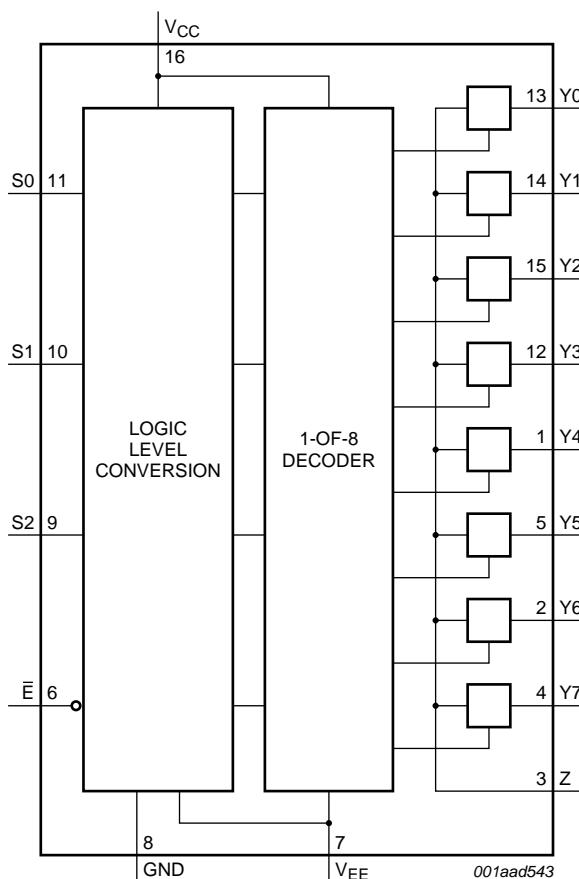


Fig 1. Functional diagram

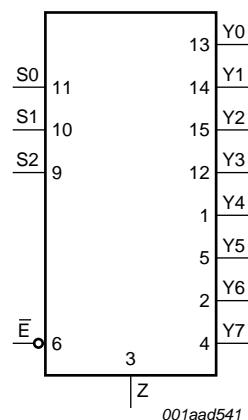


Fig 2. Logic symbol

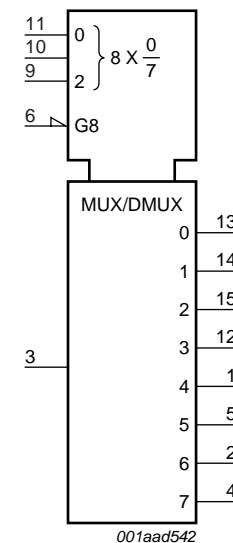


Fig 3. IEC logic symbol

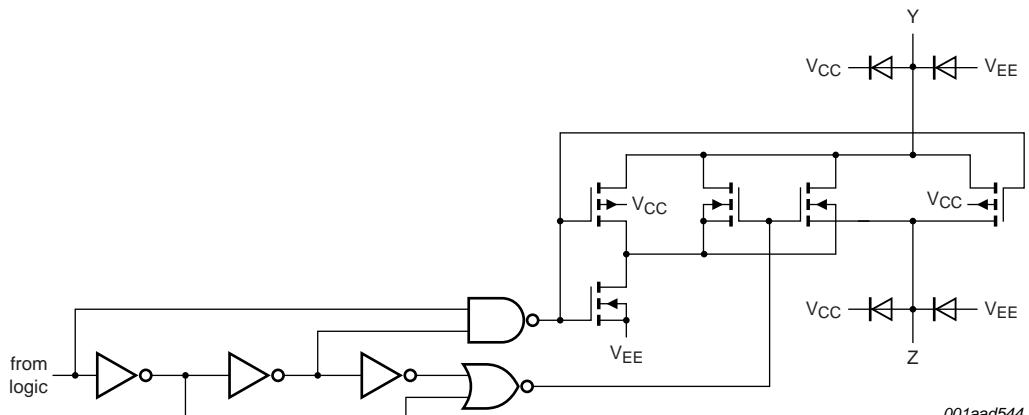


Fig 4. Schematic diagram (one switch)

## 6. Pinning information

### 6.1 Pinning

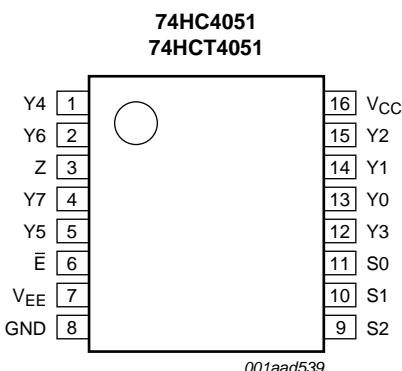


Fig 5. Pin configuration DIP16, SO16, and (T)SSOP16

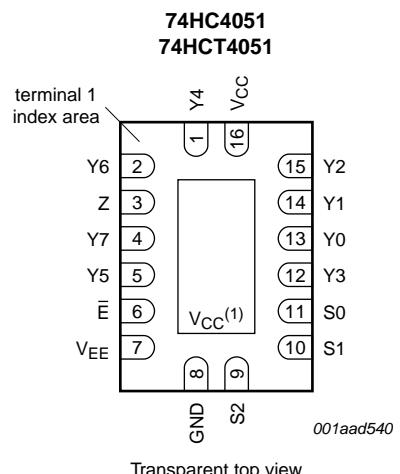


Fig 6. Pin configuration DHVQFN16

(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>.

### 6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$\bar{E}$	6	enable input (active LOW)
$V_{EE}$	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
$V_{CC}$	16	supply voltage

## 7. Functional description

### 7.1 Function table

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

Input				Channel ON
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  $V_{SS} = 0$  V (ground).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		<sup>[1]</sup> -0.5	+11.0	V
$I_{IK}$	input clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	-	$\pm 20$	mA
$I_{SK}$	switch clamping current	$V_{SW} < -0.5$ V or $V_{SW} > V_{CC} + 0.5$ V	-	$\pm 20$	mA
$I_{SW}$	switch current	$-0.5$ V < $V_{SW} < V_{CC} + 0.5$ 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	DIP16 package	<sup>[2]</sup> -	750	mW
		SO16, (T)SSOP16, and DHVQFN16 package	<sup>[3]</sup> -	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  $Y_n$ , 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  $V_{EE}$ .

[2] For DIP16 packages: above 70 °C the value of  $P_{tot}$  derates linearly with 12 mW/K.

[3] 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 DHVQFN16 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	$V_{CC} = 2.0$ V	-	-	625	-	-	-	ns/V
		$V_{CC} = 4.5$ V	-	1.67	139	-	1.67	139	ns/V
		$V_{CC} = 6.0$ V	-	-	83	-	-	-	ns/V
		$V_{CC} = 10.0$ V	-	-	31	-	-	-	ns/V

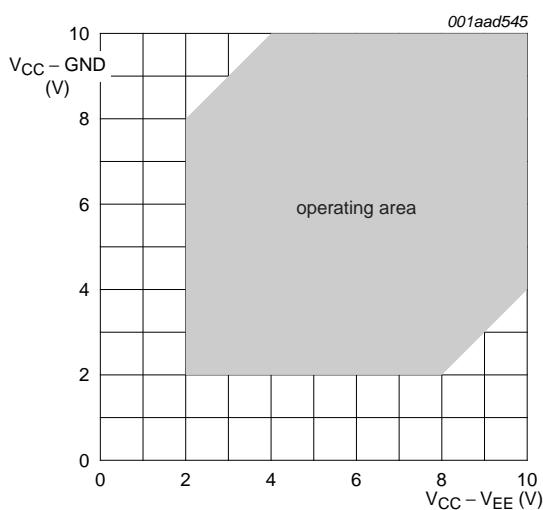


Fig 7. Guaranteed operating area as a function of the supply voltages for 74HC4051

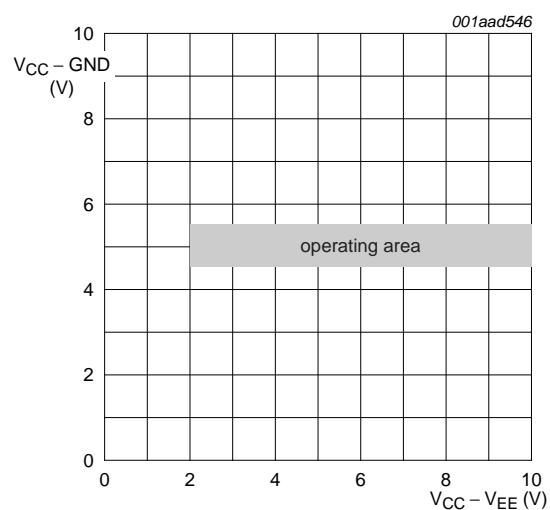


Fig 8. Guaranteed operating area as a function of the supply voltages for 74HCT4051

## 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  $Y_n$  or  $Z$  terminal, whichever is assigned as an input.

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

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

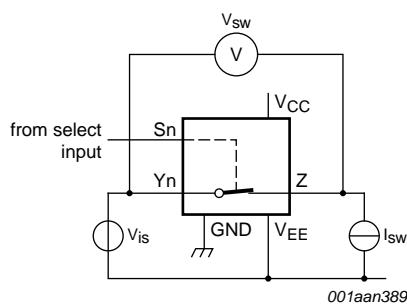
For 74HCT4051:  $V_{CC} - GND = 4.5$  V and 5.5 V,  $V_{CC} - V_{EE} = 2.0$  V, 4.5 V, 6.0 V and 9.0 V.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = 25</math> °C</b>						
$R_{ON(peak)}$	ON resistance (peak)	$V_{IS} = V_{CC}$ to $V_{EE}$ $V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_{SW} = 100$ $\mu$ A $V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A $V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A $V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_{SW} = 1000$ $\mu$ A	[1]	-	-	$\Omega$
$R_{ON(rail)}$	ON resistance (rail)	$V_{IS} = V_{EE}$ $V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_{SW} = 100$ $\mu$ A $V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A $V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A $V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_{SW} = 1000$ $\mu$ A	[1]	150	-	$\Omega$
$R_{ON(rail)}$		$V_{IS} = V_{CC}$ $V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_{SW} = 100$ $\mu$ A $V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A $V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A $V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_{SW} = 1000$ $\mu$ A	[1]	150	-	$\Omega$
$\Delta R_{ON}$	ON resistance mismatch between channels	$V_{IS} = V_{CC}$ to $V_{EE}$ $V_{CC} = 2.0$ V; $V_{EE} = 0$ V $V_{CC} = 4.5$ V; $V_{EE} = 0$ V $V_{CC} = 6.0$ V; $V_{EE} = 0$ V $V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V	[1]	-	-	$\Omega$
				9	-	$\Omega$
				8	-	$\Omega$
				6	-	$\Omega$
<b><math>T_{amb} = -40</math> °C to +85 °C</b>						
$R_{ON(peak)}$	ON resistance (peak)	$V_{IS} = V_{CC}$ to $V_{EE}$ $V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_{SW} = 100$ $\mu$ A $V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A $V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A $V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_{SW} = 1000$ $\mu$ A	[1]	-	-	$\Omega$
				-	225	$\Omega$
				-	200	$\Omega$
				-	165	$\Omega$

**Table 6.  $R_{ON}$  resistance per switch for 74HC4051 and 74HCT4051 ...continued** $V_I = V_{IH}$  or  $V_{IL}$ ; for test circuit see [Figure 9](#). $V_{is}$  is the input voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an input. $V_{os}$  is the output voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an output.For 74HC4051:  $V_{CC} - GND$  or  $V_{CC} - V_{EE} = 2.0$  V, 4.5 V, 6.0 V and 9.0 V.For 74HCT4051:  $V_{CC} - GND = 4.5$  V and 5.5 V,  $V_{CC} - V_{EE} = 2.0$  V, 4.5 V, 6.0 V and 9.0 V.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{ON(rail)}$	ON resistance (rail)	$V_{is} = V_{EE}$				
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_{SW} = 100$ $\mu$ A	[1]	-	-	$\Omega$
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A	-	-	175	$\Omega$
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A	-	-	150	$\Omega$
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_{SW} = 1000$ $\mu$ A	-	-	130	$\Omega$
		$V_{is} = V_{CC}$				
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_{SW} = 100$ $\mu$ A	[1]	-	-	$\Omega$
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A	-	-	200	$\Omega$
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A	-	-	175	$\Omega$
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_{SW} = 1000$ $\mu$ A	-	-	150	$\Omega$
<b><math>T_{amb} = -40</math> °C to +125 °C</b>						
$R_{ON(peak)}$	ON resistance (peak)	$V_{is} = V_{CC}$ to $V_{EE}$				
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_{SW} = 100$ $\mu$ A	[1]	-	-	$\Omega$
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A	-	-	270	$\Omega$
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A	-	-	240	$\Omega$
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_{SW} = 1000$ $\mu$ A	-	-	195	$\Omega$
$R_{ON(rail)}$	ON resistance (rail)	$V_{is} = V_{EE}$				
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_{SW} = 100$ $\mu$ A	[1]	-	-	$\Omega$
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A	-	-	210	$\Omega$
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A	-	-	180	$\Omega$
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_{SW} = 1000$ $\mu$ A	-	-	160	$\Omega$
		$V_{is} = V_{CC}$				
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_{SW} = 100$ $\mu$ A	[1]	-	-	$\Omega$
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A	-	-	240	$\Omega$
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_{SW} = 1000$ $\mu$ A	-	-	210	$\Omega$
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_{SW} = 1000$ $\mu$ A	-	-	180	$\Omega$

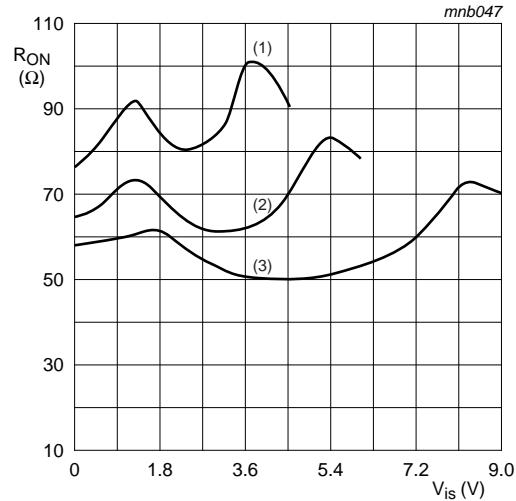
[1] When supply voltages ( $V_{CC} - V_{EE}$ ) near 2.0 V the analog switch ON resistance becomes extremely non-linear. When using a supply of 2 V, it is recommended to use these devices only for transmitting digital signals.



$V_{is} = 0 \text{ V to } (V_{cc} - V_{ee})$ .

$$R_{ON} = \frac{V_{sw}}{I_{sw}}$$

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



$V_{is} = 0 \text{ V to } (V_{cc} - V_{ee})$ .

- (1)  $V_{cc} = 4.5 \text{ V}$
- (2)  $V_{cc} = 6 \text{ V}$
- (3)  $V_{cc} = 9 \text{ V}$

Fig 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
$T_{amb} = 25 \text{ }^{\circ}\text{C}$						
$V_{IH}$	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 <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	$V_I = V_{IH} \text{ or } V_{IL};  V_{sw}  = V_{cc} - V_{ee}; V_{cc} = 10.0 \text{ V}; V_{ee} = 0 \text{ V}$ ; see <a href="#">Figure 12</a>	-	-	$\pm 0.4$	$\mu\text{A}$

Table 7. Static characteristics for 74HC4051 ...continued

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
$I_{CC}$	supply current	$V_{EE} = 0 \text{ V}$ ; $V_I = V_{CC}$ or GND; $V_{IS} = V_{EE}$ or $V_{CC}$ ;				
		$V_{OS} = V_{CC}$ or $V_{EE}$				
		$V_{CC} = 6.0 \text{ V}$	-	-	8.0	$\mu\text{A}$
$C_I$	input capacitance	$V_{CC} = 10.0 \text{ V}$	-	-	16.0	$\mu\text{A}$
			-	3.5	-	$\text{pF}$
$C_{SW}$	switch capacitance	independent pins $Y_n$	-	5	-	$\text{pF}$
		common pins $Z$	-	25	-	$\text{pF}$
<b><math>T_{amb} = -40 \text{ }^{\circ}\text{C to } +85 \text{ }^{\circ}\text{C}</math></b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0 \text{ V}$	1.5	-	-	$\text{V}$
		$V_{CC} = 4.5 \text{ V}$	3.15	-	-	$\text{V}$
		$V_{CC} = 6.0 \text{ V}$	4.2	-	-	$\text{V}$
		$V_{CC} = 9.0 \text{ V}$	6.3	-	-	$\text{V}$
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0 \text{ V}$	-	-	0.5	$\text{V}$
		$V_{CC} = 4.5 \text{ V}$	-	-	1.35	$\text{V}$
		$V_{CC} = 6.0 \text{ V}$	-	-	1.8	$\text{V}$
		$V_{CC} = 9.0 \text{ V}$	-	-	2.7	$\text{V}$
$I_I$	input leakage current	$V_{EE} = 0 \text{ V}$ ; $V_I = V_{CC}$ or GND				
		$V_{CC} = 6.0 \text{ V}$	-	-	$\pm 1.0$	$\mu\text{A}$
		$V_{CC} = 10.0 \text{ V}$	-	-	$\pm 2.0$	$\mu\text{A}$
$I_{S(OFF)}$	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	-	-	$\pm 1.0$	$\mu\text{A}$
$I_{S(ON)}$	ON-state leakage current	$V_I = V_{IH}$ or $V_{IL}$ ; $ V_{SW}  = V_{CC} - V_{EE}$ ;				
		$V_{CC} = 10.0 \text{ V}$ ; $V_{EE} = 0 \text{ V}$ ; see <a href="#">Figure 12</a>	-	-	$\pm 4.0$	$\mu\text{A}$
$I_{CC}$	supply current	$V_{EE} = 0 \text{ V}$ ; $V_I = V_{CC}$ or GND; $V_{IS} = V_{EE}$ or $V_{CC}$ ;				
		$V_{OS} = V_{CC}$ or $V_{EE}$				
		$V_{CC} = 6.0 \text{ V}$	-	-	80.0	$\mu\text{A}$
		$V_{CC} = 10.0 \text{ V}$	-	-	160.0	$\mu\text{A}$
<b><math>T_{amb} = -40 \text{ }^{\circ}\text{C to } +125 \text{ }^{\circ}\text{C}</math></b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.0 \text{ V}$	1.5	-	-	$\text{V}$
		$V_{CC} = 4.5 \text{ V}$	3.15	-	-	$\text{V}$
		$V_{CC} = 6.0 \text{ V}$	4.2	-	-	$\text{V}$
		$V_{CC} = 9.0 \text{ V}$	6.3	-	-	$\text{V}$
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.0 \text{ V}$	-	-	0.5	$\text{V}$
		$V_{CC} = 4.5 \text{ V}$	-	-	1.35	$\text{V}$
		$V_{CC} = 6.0 \text{ V}$	-	-	1.8	$\text{V}$
		$V_{CC} = 9.0 \text{ V}$	-	-	2.7	$\text{V}$

**Table 7. Static characteristics for 74HC4051 ...continued***Voltages are referenced to GND (ground = 0 V).**V<sub>is</sub> is the input voltage at pins Y<sub>n</sub> or Z, whichever is assigned as an input.**V<sub>os</sub> is the output voltage at pins Z or Y<sub>n</sub>, whichever is assigned as an output.*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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<sub>is</sub> is the input voltage at pins Y<sub>n</sub> or Z, whichever is assigned as an input.**V<sub>os</sub> is the output voltage at pins Z or Y<sub>n</sub>, whichever is assigned as an output.*

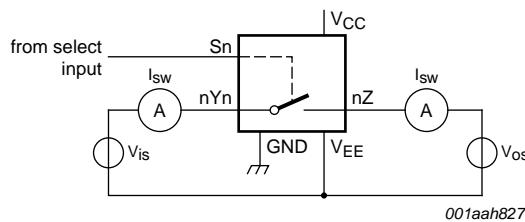
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T <sub>amb</sub> = 25 °C						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	1.2	0.8	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V; V <sub>EE</sub> = 0 V	-	-	±0.1	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	-	-	±0.1	μA
		all channels	-	-	±0.4	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>	-	-	±0.4	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	-	-	8.0	μA
		V <sub>CC</sub> = 5.0 V; V <sub>EE</sub> = –5.0 V	-	-	16.0	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	-	50	180	μA
C <sub>I</sub>	input capacitance		-	3.5	-	pF
C <sub>SW</sub>	switch capacitance	independent pins Y <sub>n</sub>	-	5	-	pF
		common pins Z	-	25	-	pF

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

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.

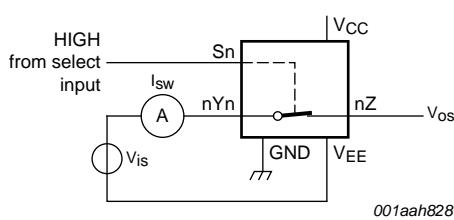
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = -40^{\circ}\text{C}</math> to <math>+85^{\circ}\text{C}</math></b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 4.5 \text{ V}$ to $5.5 \text{ V}$	2.0	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 4.5 \text{ V}$ to $5.5 \text{ V}$	-	-	0.8	V
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$ ; $V_{EE} = 0 \text{ V}$	-	-	$\pm 1.0$	$\mu\text{A}$
$I_{S(OFF)}$	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	-	-	$\pm 1.0$	$\mu\text{A}$
		all channels	-	-	$\pm 4.0$	$\mu\text{A}$
$I_{S(ON)}$	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>	-	-	$\pm 4.0$	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $V_{is} = V_{EE}$ or $V_{CC}$ ; $V_{os} = V_{CC}$ or $V_{EE}$				
		$V_{CC} = 5.5 \text{ V}$ ; $V_{EE} = 0 \text{ V}$	-	-	80.0	$\mu\text{A}$
		$V_{CC} = 5.0 \text{ V}$ ; $V_{EE} = -5.0 \text{ V}$	-	-	160.0	$\mu\text{A}$
$\Delta I_{CC}$	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 $5.5 \text{ V}$ ; $V_{EE} = 0 \text{ V}$	-	-	225	$\mu\text{A}$
<b><math>T_{amb} = -40^{\circ}\text{C}</math> to <math>+125^{\circ}\text{C}</math></b>						
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 4.5 \text{ V}$ to $5.5 \text{ V}$	2.0	-	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 4.5 \text{ V}$ to $5.5 \text{ V}$	-	-	0.8	V
$I_I$	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$ ; $V_{EE} = 0 \text{ V}$	-	-	$\pm 1.0$	$\mu\text{A}$
$I_{S(OFF)}$	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	-	-	$\pm 1.0$	$\mu\text{A}$
		all channels	-	-	$\pm 4.0$	$\mu\text{A}$
$I_{S(ON)}$	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>	-	-	$\pm 4.0$	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $V_{is} = V_{EE}$ or $V_{CC}$ ; $V_{os} = V_{CC}$ or $V_{EE}$				
		$V_{CC} = 5.5 \text{ V}$ ; $V_{EE} = 0 \text{ V}$	-	-	160.0	$\mu\text{A}$
		$V_{CC} = 5.0 \text{ V}$ ; $V_{EE} = -5.0 \text{ V}$	-	-	320.0	$\mu\text{A}$
$\Delta I_{CC}$	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 $5.5 \text{ V}$ ; $V_{EE} = 0 \text{ V}$	-	-	245	$\mu\text{A}$



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

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

Fig 11. Test circuit for measuring OFF-state current



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

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

Fig 12. Test circuit for measuring ON-state current

## 11. Dynamic characteristics

Table 9. Dynamic characteristics for 74HC4051

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

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

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = 25</math> °C</b>						
$t_{pd}$	propagation delay	$V_{is}$ to $V_{os}$ ; $R_L = \infty$ Ω; see <a href="#">Figure 13</a>		[1]		
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V	-	14	60	ns
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V	-	5	12	ns
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V	-	4	10	ns
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V	-	4	8	ns

**Table 9. Dynamic characteristics for 74HC4051 ...continued** $GND = 0 \text{ V}$ ;  $t_r = t_f = 6 \text{ ns}$ ;  $C_L = 50 \text{ pF}$ ; for test circuit see [Figure 15](#). $V_{is}$  is the input voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an input. $V_{os}$  is the output voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an output.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$t_{on}$	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
		$S_n$ 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
$t_{off}$	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
		$S_n$ 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
$C_{PD}$	power dissipation capacitance	per switch; $V_I = \text{GND}$ to $V_{CC}$	[4]	-	25	-	pF
<b><math>T_{amb} = -40 \text{ }^{\circ}\text{C}</math> to <math>+85 \text{ }^{\circ}\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

**Table 9. Dynamic characteristics for 74HC4051 ...continued** $GND = 0 \text{ V}$ ;  $t_r = t_f = 6 \text{ ns}$ ;  $C_L = 50 \text{ pF}$ ; for test circuit see [Figure 15](#). $V_{is}$  is the input voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an input. $V_{os}$  is the output voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an output.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$t_{on}$	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
		$S_n$ 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
		$S_n$ 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
<b><math>T_{amb} = -40 \text{ }^{\circ}\text{C to } +125 \text{ }^{\circ}\text{C}</math></b>							
$t_{pd}$	propagation delay	$V_{is}$ to $V_{os}$ ; $R_L = \infty \Omega$ ; see <a href="#">Figure 13</a>	[1]				
		$V_{CC} = 2.0 \text{ V}$ ; $V_{EE} = 0 \text{ V}$		-	-	90	ns
		$V_{CC} = 4.5 \text{ V}$ ; $V_{EE} = 0 \text{ V}$		-	-	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
$t_{on}$	turn-on time	$\bar{E}$ to $V_{os}$ ; $R_L = \infty \Omega$ ; see <a href="#">Figure 14</a>	[2]				
		$V_{CC} = 2.0 \text{ V}$ ; $V_{EE} = 0 \text{ V}$		-	-	520	ns
		$V_{CC} = 4.5 \text{ V}$ ; $V_{EE} = 0 \text{ V}$		-	-	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 <a href="#">Figure 14</a>		[2]			
		$V_{CC} = 2.0 \text{ V}$ ; $V_{EE} = 0 \text{ V}$		-	-	520	ns
		$V_{CC} = 4.5 \text{ V}$ ; $V_{EE} = 0 \text{ V}$		-	-	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

**Table 9. Dynamic characteristics for 74HC4051 ...continued***GND = 0 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  $Y_n$  or  $Z$  terminal, whichever is assigned as an input.* *$V_{OS}$  is the output voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an output.*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{off}$	turn-off time	$\bar{E}$ to $V_{OS}$ ; $R_L = 1 \text{ k}\Omega$ ; see <a href="#">Figure 14</a>	[3]			
		$V_{CC} = 2.0 \text{ V}; V_{EE} = 0 \text{ V}$	-	-	435	ns
		$V_{CC} = 4.5 \text{ V}; V_{EE} = 0 \text{ V}$	-	-	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 <a href="#">Figure 14</a>	[3]			
		$V_{CC} = 2.0 \text{ V}; V_{EE} = 0 \text{ V}$	-	-	435	ns
		$V_{CC} = 4.5 \text{ V}; V_{EE} = 0 \text{ V}$	-	-	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

[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  $\mu\text{W}$ ).

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

 $f_i$  = input frequency in MHz; $f_o$  = output frequency in MHz;

N = number of inputs switching;

 $\Sigma \{ (C_L + C_{sw}) \times V_{CC}^2 \times f_o \}$  = sum of outputs; $C_L$  = output load capacitance in pF; $C_{sw}$  = switch capacitance in pF; $V_{CC}$  = supply voltage in V.**Table 10. Dynamic characteristics for 74HCT4051***GND = 0 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  $Y_n$  or  $Z$  terminal, whichever is assigned as an input.* *$V_{OS}$  is the output voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an output.*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = 25 \text{ }^{\circ}\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
		$S_n$ 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

**Table 10. Dynamic characteristics for 74HCT4051 ...continued** $GND = 0 \text{ V}$ ;  $t_r = t_f = 6 \text{ ns}$ ;  $C_L = 50 \text{ pF}$ ; for test circuit see [Figure 15](#). $V_{is}$  is the input voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an input. $V_{os}$  is the output voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an output.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{off}$	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
		$S_n$ 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; $V_I = \text{GND to } V_{CC} - 1.5 \text{ V}$	[4]	-	25	-
<b><math>T_{amb} = -40 \text{ }^{\circ}\text{C to } +85 \text{ }^{\circ}\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
		$S_n$ 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
$t_{off}$	turn-off time	$\bar{E}$ to $V_{os}$ ; $R_L = 1 \text{ k}\Omega$ ; see <a href="#">Figure 14</a>	[3]			
		$V_{CC} = 4.5 \text{ V}; V_{EE} = 0 \text{ V}$	-	-	56	ns
		$V_{CC} = 4.5 \text{ V}; V_{EE} = -4.5 \text{ V}$	-	-	40	ns
		$S_n$ to $V_{os}$ ; $R_L = 1 \text{ k}\Omega$ ; see <a href="#">Figure 14</a>	[3]			
		$V_{CC} = 4.5 \text{ V}; V_{EE} = 0 \text{ V}$	-	-	56	ns
		$V_{CC} = 4.5 \text{ V}; V_{EE} = -4.5 \text{ V}$	-	-	40	ns
<b><math>T_{amb} = -40 \text{ }^{\circ}\text{C to } +125 \text{ }^{\circ}\text{C}</math></b>						
$t_{pd}$	propagation delay	$V_{is}$ to $V_{os}$ ; $R_L = \infty \Omega$ ; see <a href="#">Figure 13</a>	[1]			
		$V_{CC} = 4.5 \text{ V}; V_{EE} = 0 \text{ V}$	-	-	18	ns
		$V_{CC} = 4.5 \text{ V}; V_{EE} = -4.5 \text{ V}$	-	-	12	ns
$t_{on}$	turn-on time	$\bar{E}$ to $V_{os}$ ; $R_L = 1 \text{ k}\Omega$ ; see <a href="#">Figure 14</a>	[2]			
		$V_{CC} = 4.5 \text{ V}; V_{EE} = 0 \text{ V}$	-	-	83	ns
		$V_{CC} = 4.5 \text{ V}; V_{EE} = -4.5 \text{ V}$	-	-	59	ns
		$S_n$ to $V_{os}$ ; $R_L = 1 \text{ k}\Omega$ ; see <a href="#">Figure 14</a>	[2]			
		$V_{CC} = 4.5 \text{ V}; V_{EE} = 0 \text{ V}$	-	-	83	ns
		$V_{CC} = 4.5 \text{ V}; V_{EE} = -4.5 \text{ V}$	-	-	59	ns

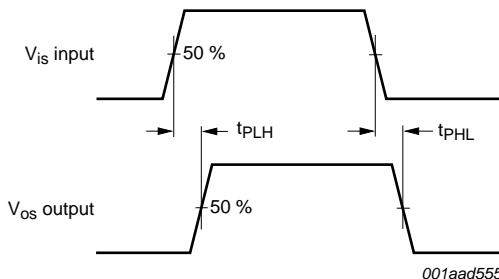
Table 10. Dynamic characteristics for 74HCT4051 ...continued

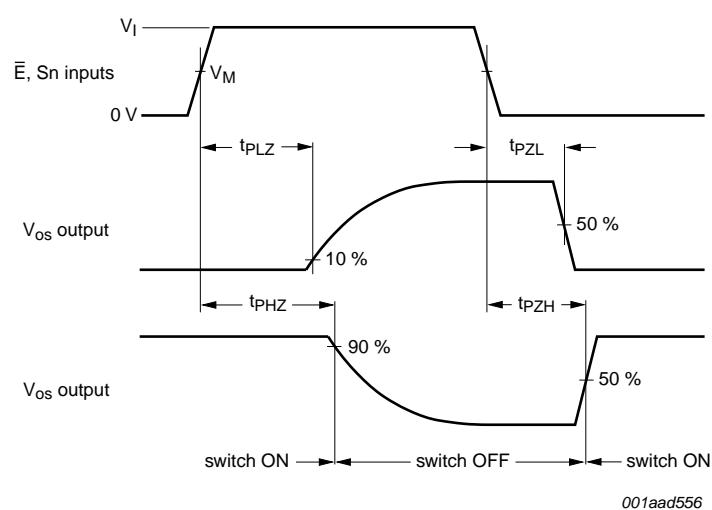
GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF; for test circuit see [Figure 15](#). $V_{is}$  is the input voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an input. $V_{os}$  is the output voltage at a  $Y_n$  or  $Z$  terminal, whichever is assigned as an output.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{off}$	turn-off time	$\bar{E}$ to $V_{os}$ ; $R_L = 1$ k $\Omega$ ; see <a href="#">Figure 14</a>	[3]			
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V	-	-	68	ns
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V	-	-	48	ns
		$S_n$ to $V_{os}$ ; $R_L = 1$ k $\Omega$ ; see <a href="#">Figure 14</a>	[3]			
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V	-	-	68	ns
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V	-	-	48	ns

[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  $\mu$ W). $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum \{ (C_L + C_{sw}) \times V_{CC}^2 \times f_o \}$  where: $f_i$  = input frequency in MHz; $f_o$  = output frequency in MHz;

N = number of inputs switching;

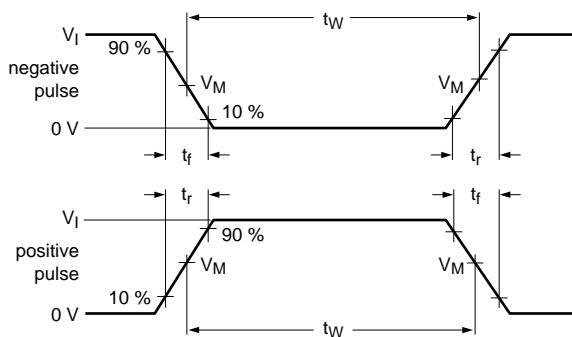
 $\sum \{ (C_L + C_{sw}) \times V_{CC}^2 \times f_o \}$  = sum of outputs; $C_L$  = output load capacitance in pF; $C_{sw}$  = switch capacitance in pF; $V_{CC}$  = supply voltage in V.Fig 13. Input ( $V_{is}$ ) to output ( $V_{os}$ ) propagation delays



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

For 74HCT4051:  $V_M = 1.3$  V.

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



Definitions for test circuit; see [Table 11](#):

$R_T$  = 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.

**Fig 15. Test circuit for measuring AC performance**

Table 11. Test data

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

[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:

- a) For 74HC4051:  $V_I = V_{CC}$
- b) For 74HCT4051:  $V_I = 3$  V

## 12. Additional dynamic characteristics

Table 12. Additional dynamic characteristics

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

$V_{IS}$  is the input voltage at pins  $nYn$  or  $nZ$ , whichever is assigned as an input.

$V_{OS}$  is the output voltage at pins  $nYn$  or  $nZ$ , whichever is assigned as an output.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$d_{sin}$	sine-wave distortion	$f_i = 1$ kHz; $R_L = 10$ k $\Omega$ ; see <a href="#">Figure 16</a>					
		$V_{IS} = 4.0$ 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; $R_L = 10$ k $\Omega$ ; see <a href="#">Figure 16</a>					
		$V_{IS} = 4.0$ 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	-	%	
$\alpha_{iso}$	isolation (OFF-state)	$R_L = 600$ $\Omega$ ; $f_i = 1$ MHz; see <a href="#">Figure 17</a>					
		$V_{CC} = 2.25$ V; $V_{EE} = -2.25$ V	[1]	-	-50	-	dB
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V	[1]	-	-50	-	dB
$V_{ct}$	crosstalk voltage	peak-to-peak value; between control and any switch; $R_L = 600$ $\Omega$ ; $f_i = 1$ MHz; $\bar{E}$ or Sn square wave between $V_{CC}$ and GND; $t_r = t_f = 6$ ns; see <a href="#">Figure 18</a>					
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V	-	110	-	mV	
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V	-	220	-	mV	
$f_{(-3dB)}$	-3 dB frequency response	$R_L = 50$ $\Omega$ ; see <a href="#">Figure 19</a>					
		$V_{CC} = 2.25$ V; $V_{EE} = -2.25$ V	[2]	-	170	-	MHz
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V	[2]	-	180	-	MHz

[1] Adjust input voltage  $V_{IS}$  to 0 dBm level (0 dBm = 1 mW into 600  $\Omega$ ).

[2] Adjust input voltage  $V_{IS}$  to 0 dBm level at  $V_{OS}$  for 1 MHz (0 dBm = 1 mW into 50  $\Omega$ ).

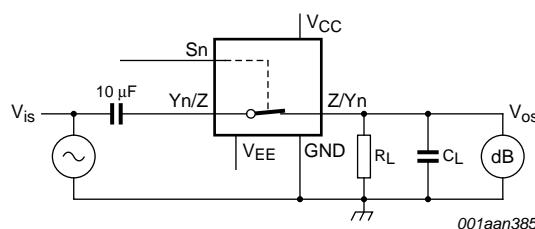
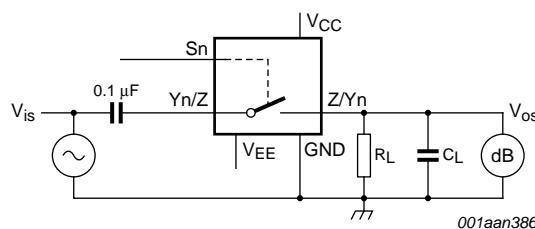
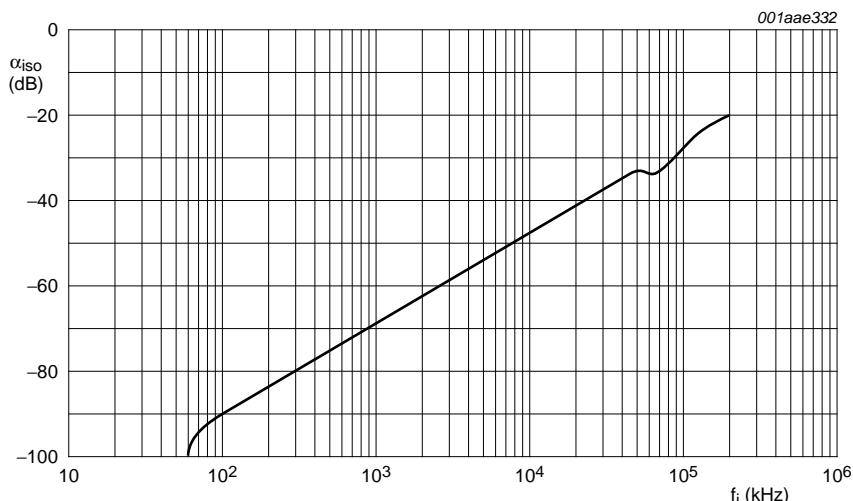


Fig 16. Test circuit for measuring sine-wave distortion



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

a. Test circuit



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

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

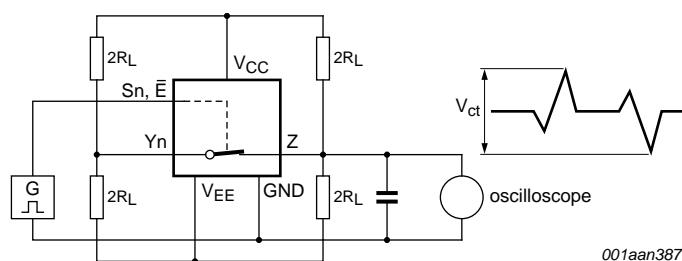
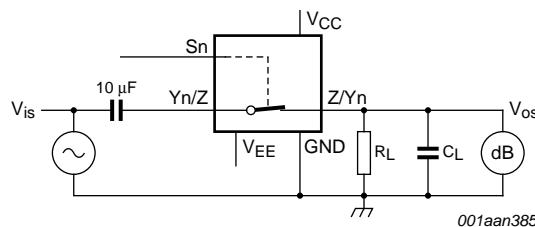
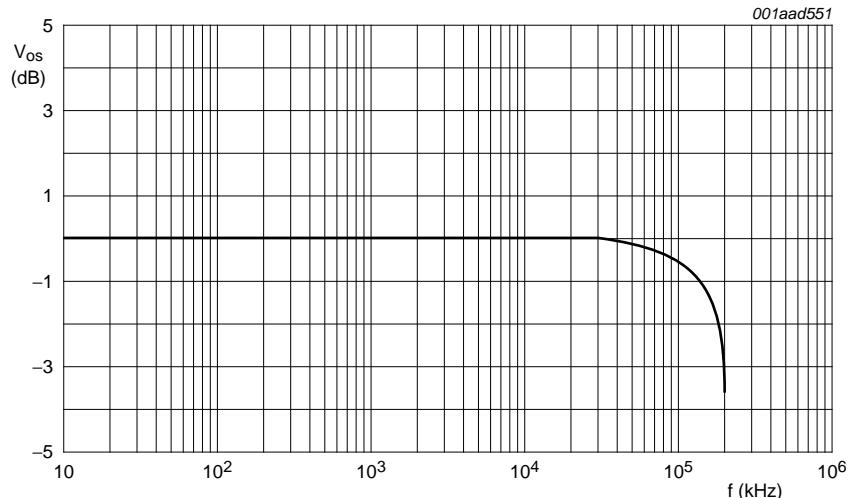


Fig 18. Test circuit for measuring crosstalk between control input and any switch



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

a. Test circuit



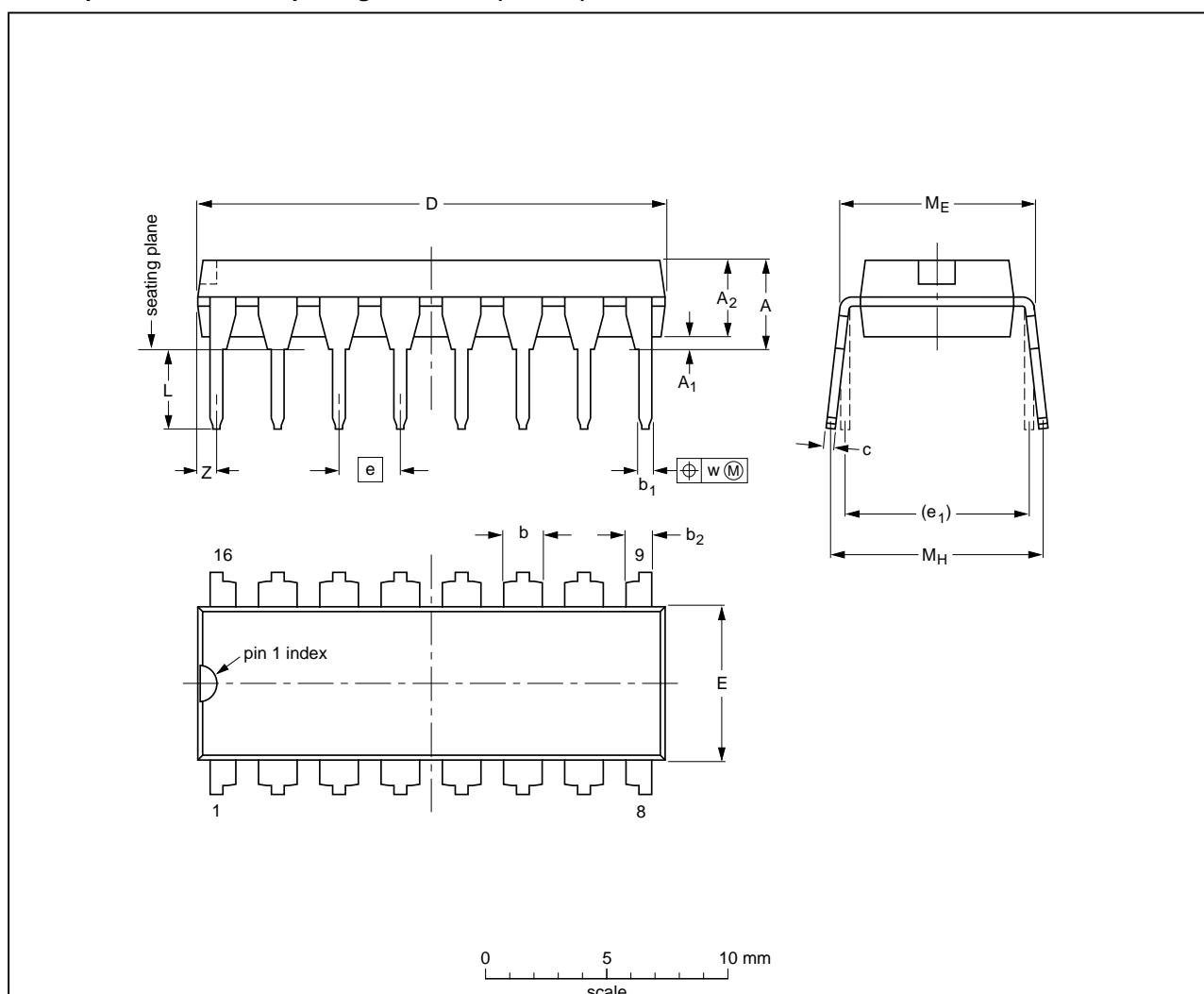
b. Typical frequency response

Fig 19. Test circuit for frequency response

## 13. Package outline

DIP16: plastic dual in-line package; 16 leads (300 mil)

SOT38-4



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

UNIT	A max.	A <sub>1</sub> min.	A <sub>2</sub> max.	b	b <sub>1</sub>	b <sub>2</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	e <sub>1</sub>	L	M <sub>E</sub>	M <sub>H</sub>	w	Z <sup>(1)</sup> max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.02	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	0.1	0.3	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.03

## Note

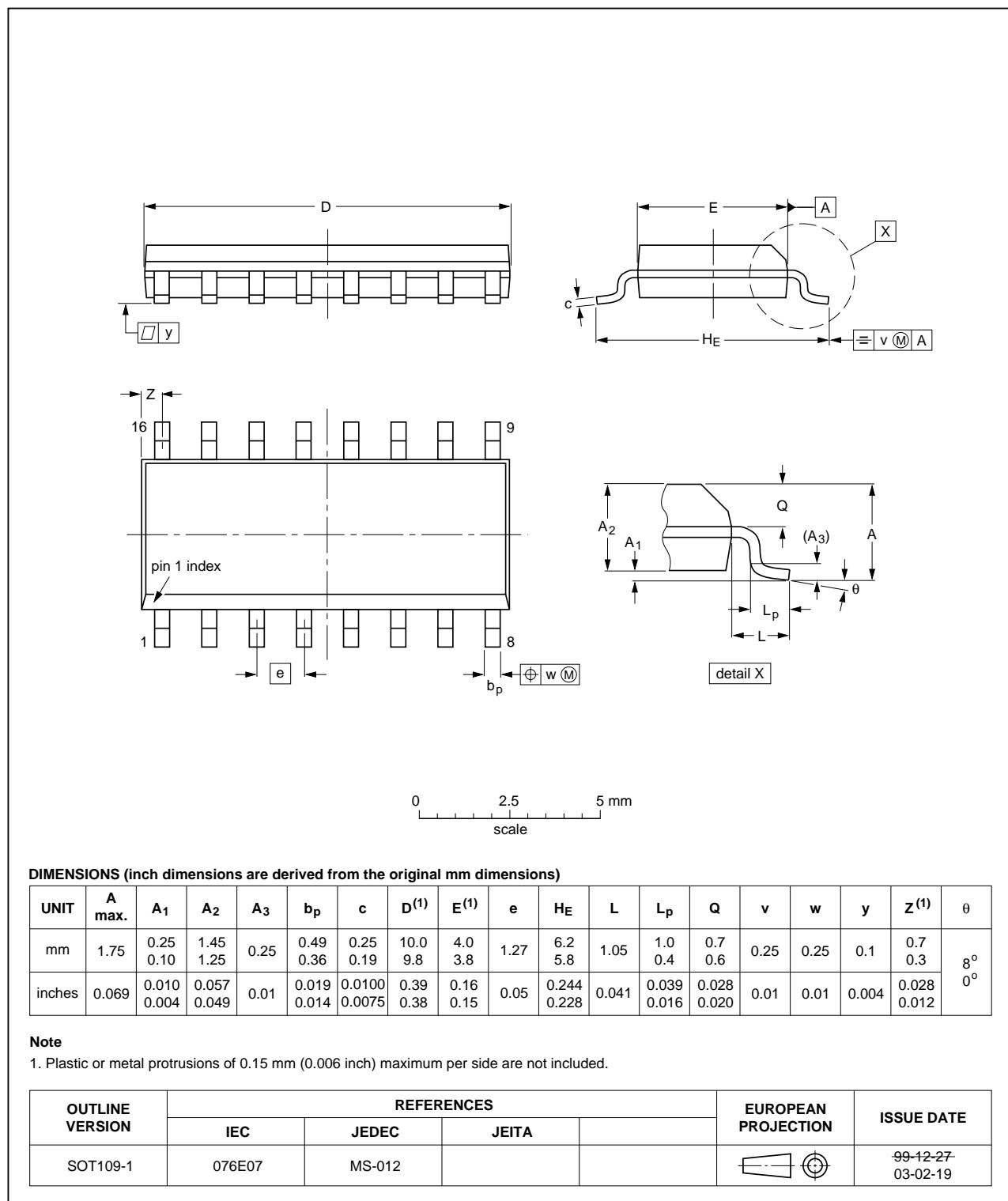
1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT38-4						95-01-14 03-02-13

Fig 20. Package outline SOT38-4 (DIP16)

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 0.10	0.25 0.36	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 0.004	0.010 0.049	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

Fig 21. Package outline SOT109-1 (SO16)

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

SOT338-1

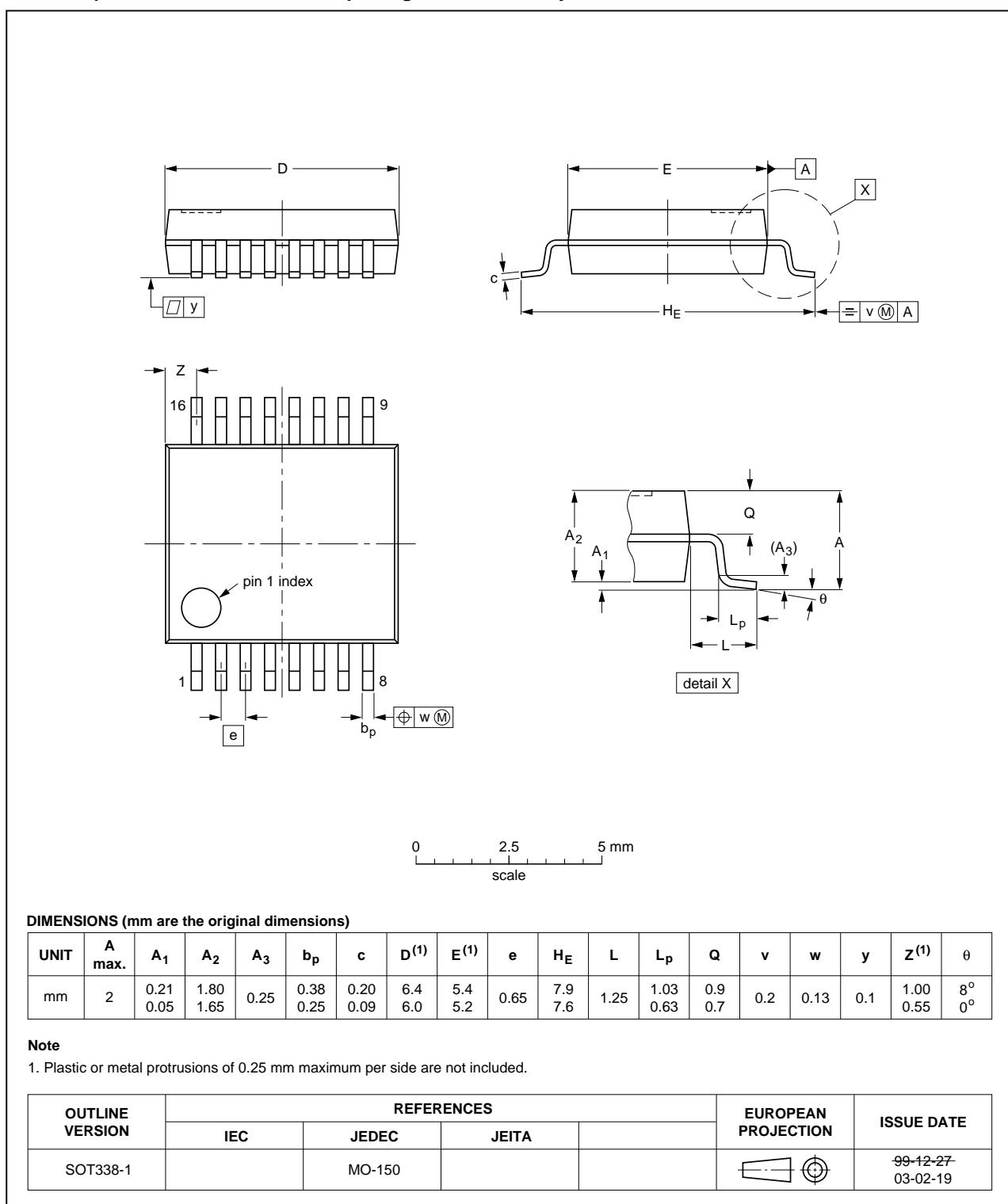


Fig 22. Package outline SOT338-1 (SSOP16)

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

SOT403-1

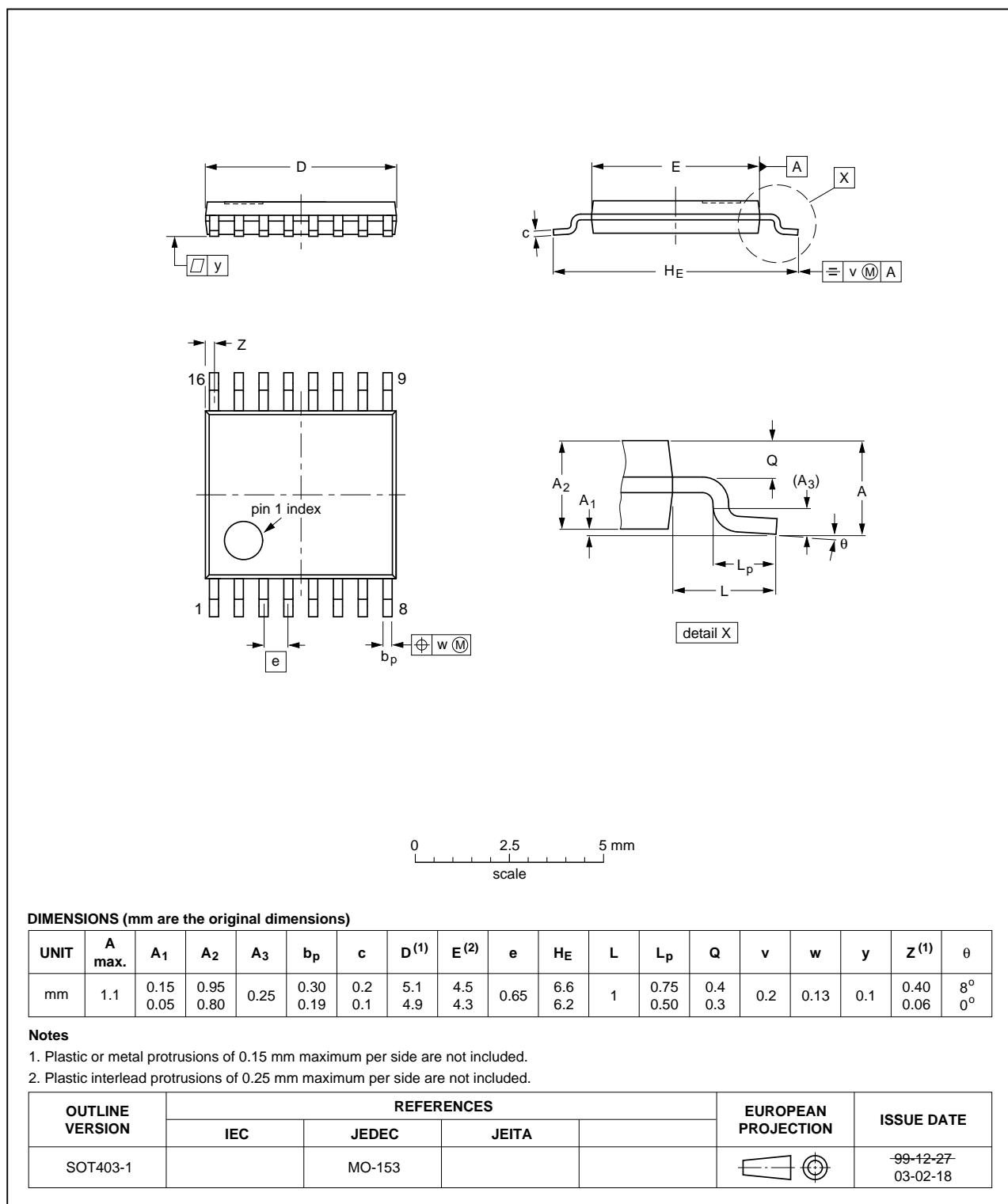


Fig 23. Package outline SOT403-1 (TSSOP16)

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

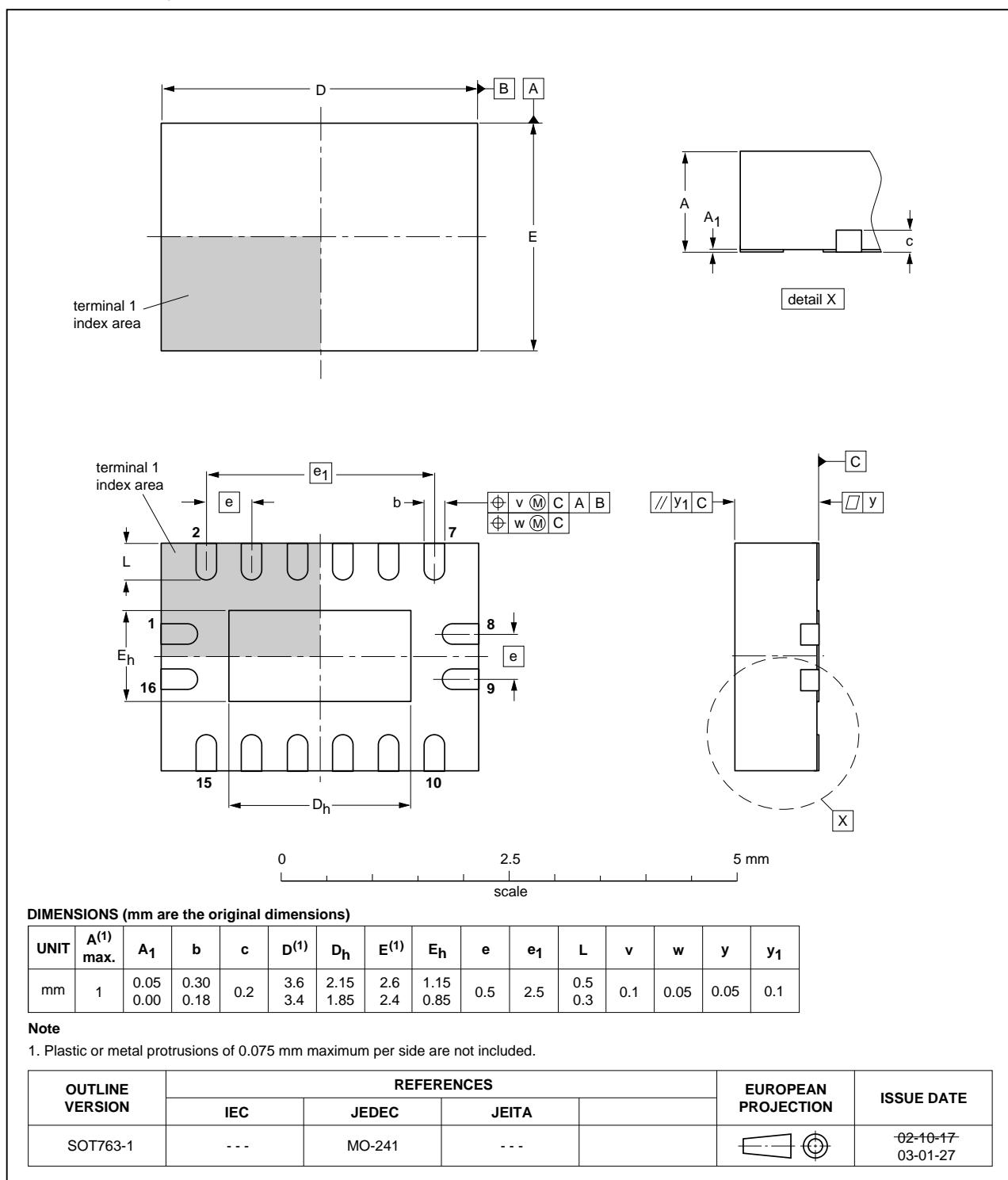


Fig 24. Package outline SOT763-1 (DHVQFN16)

## 14. Abbreviations

**Table 13. Abbreviations**

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

## 15. Revision history

**Table 14. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT4051 v.6	20111213	Product data sheet	-	74HC_HCT4051 v.5
Modifications:		• Legal pages updated.		
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

## 16. Legal information

### 16.1 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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