

74HC4051; 74HCT4051

8-channel analog multiplexer/demultiplexer

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

- Wide analog input voltage range: ± 5 V
- Low ON-state resistance:
 - ◆ 80 Ω (typical) at $V_{CC} - V_{EE} = 4.5$ V
 - ◆ 70 Ω (typical) at $V_{CC} - V_{EE} = 6.0$ V
 - ◆ 60 Ω (typical) at $V_{CC} - V_{EE} = 9.0$ V
- Logic level translation:
 - ◆ To enable 5 V logic to communicate with ± 5 V analog signals
- Typical 'break before make' built in

3. Applications

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

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4. Quick reference data

Table 1: Quick reference data

 $V_{EE} = GND = 0\text{ V}$; $T_{amb} = 25\text{ °C}$; $t_r = t_f = 6\text{ ns}$.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Type 74HC4051						
t_{PZH}, t_{PZL}	turn-ON time	$C_L = 15\text{ pF}$; $R_L = 1\text{ k}\Omega$; $V_{CC} = 5\text{ V}$				
	\bar{E} to V_{os}		-	22	-	ns
	Sn to V_{os}		-	20	-	ns
t_{PHZ}, t_{PLZ}	turn-OFF time	$C_L = 15\text{ pF}$; $R_L = 1\text{ k}\Omega$; $V_{CC} = 5\text{ V}$				
	\bar{E} to V_{os}		-	18	-	ns
	Sn to V_{os}		-	19	-	ns
C_i	input capacitance		-	3.5	-	pF
C_{PD}	power dissipation capacitance (per switch)		[1][2]	25	-	pF
C_S	switch capacitance					
	independent input/output Yn		-	5	-	pF
	common input/output Z		-	25	-	pF
Type 74HCT4051						
t_{PZH}, t_{PZL}	turn-ON time	$C_L = 15\text{ pF}$; $R_L = 1\text{ k}\Omega$; $V_{CC} = 5\text{ V}$				
	\bar{E} to V_{os}		-	22	-	ns
	Sn to V_{os}		-	24	-	ns
t_{PHZ}, t_{PLZ}	turn-OFF time	$C_L = 15\text{ pF}$; $R_L = 1\text{ k}\Omega$; $V_{CC} = 5\text{ V}$				
	\bar{E} to V_{os}		-	16	-	ns
	Sn to V_{os}		-	20	-	ns
C_i	input capacitance		-	3.5	-	pF
C_{PD}	power dissipation capacitance (per switch)		[1][3]	25	-	pF
C_S	switch capacitance					
	independent input/output Yn		-	5	-	pF
	common input/output Z		-	25	-	pF

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

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

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

C_L = output load capacitance in pF;

C_S = switch capacitance in pF;

V_{CC} = supply voltage in V.

[2] For 74HC4051 the condition is $V_I = GND$ to V_{CC} .

[3] For 74HCT4051 the condition is $V_I = GND$ to $V_{CC} - 1.5\text{ V}$.

5. Ordering information

Table 2: Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
Type 74HC4051				
74HC4051N	-40 °C to +125 °C	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
74HC4051D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HC4051DB	-40 °C to +125 °C	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	SOT338-1
74HC4051PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
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
Type 74HCT4051				
74HCT4051N	-40 °C to +125 °C	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
74HCT4051D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HCT4051DB	-40 °C to +125 °C	SSOP16	plastic shrink small outline package; 16 leads; body width 5.3 mm	SOT338-1
74HCT4051PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74HCT4051BQ	-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

8. Functional description

8.1 Function table

Table 4: Function table [1]

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	-

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

9. Limiting values

Table 5: Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		[1] -0.5	+11.0	V
I_{IK}	input clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	-	± 20	mA
I_{SK}	switch clamping current	$V_S < -0.5$ V or $V_S > V_{CC} + 0.5$ V	-	± 20	mA
I_S	switch current	$V_S = -0.5$ V to $(V_{CC} + 0.5$ V)	-	± 25	mA
I_{EE}	negative supply current		-	± 20	mA
I_{CC}	quiescent supply current		-	50	mA
I_{GND}	ground supply current		-	-50	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40$ °C to +125 °C			
	DIP16 package		[2] -	750	mW
	SO16, (T)SSOP16, and DHVQFN16 package		[3] -	500	mW
P_S	power dissipation per switch		-	100	mW

- [1] To avoid drawing V_{CC} current out of terminal Z, when switch current flows in 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 . 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} .

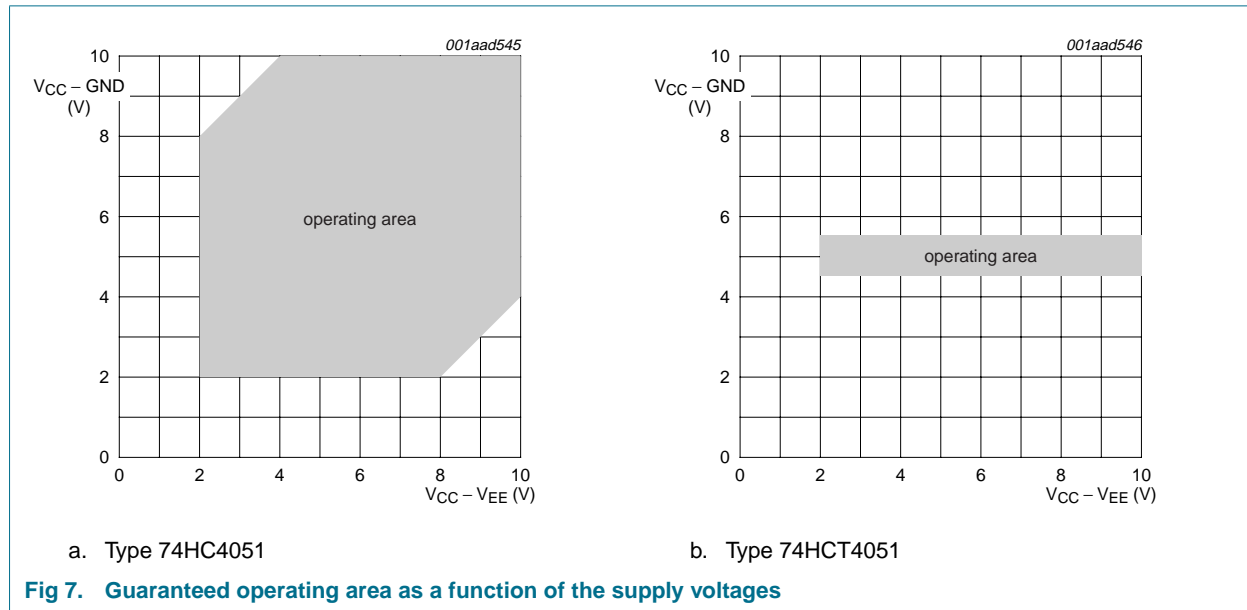
- [2] For DIP16 packages, above 70 °C, P_{tot} derates linearly with 12 mW/K.

[3] For SO16, (T)SSOP16, and DHVQFN16 packages, above 70 °C, P_{tot} derates linearly with 8 mW/K.

10. Recommended operating conditions

Table 6: Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Type 74HC4051						
ΔV_{CC}	supply voltage difference	see Figure 7				
	$V_{CC} - GND$		2.0	5.0	10.0	V
	$V_{CC} - V_{EE}$		2.0	5.0	10.0	V
V_I	input voltage		GND	-	V_{CC}	V
V_S	switch voltage		V_{EE}	-	V_{CC}	V
T_{amb}	ambient temperature		-40	-	+125	°C
t_r, t_f	input rise and fall times	$V_{CC} = 2.0\text{ V}$	-	6.0	1000	ns
		$V_{CC} = 4.5\text{ V}$	-	6.0	500	ns
		$V_{CC} = 6.0\text{ V}$	-	6.0	400	ns
		$V_{CC} = 10.0\text{ V}$	-	6.0	250	ns
Type 74HCT4051						
ΔV_{CC}	supply voltage difference	see Figure 7				
	$V_{CC} - GND$		4.5	5.0	5.5	V
	$V_{CC} - V_{EE}$		2.0	5.0	10.0	V
V_I	input voltage		GND	-	V_{CC}	V
V_S	switch voltage		V_{EE}	-	V_{CC}	V
T_{amb}	ambient temperature		-40	-	+125	°C
t_r, t_f	input rise and fall times	$V_{CC} = 2.0\text{ V}$	-	6.0	500	ns
		$V_{CC} = 4.5\text{ V}$	-	6.0	500	ns
		$V_{CC} = 6.0\text{ V}$	-	6.0	500	ns
		$V_{CC} = 10.0\text{ V}$	-	6.0	500	ns



11. Static characteristics

Table 7: R_{ON} resistance per switch for types 74HC4051 and 74HCT4051

$V_I = V_{IH}$ or V_{IL} ; for test circuit see [Figure 8](#).

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 V .

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$T_{amb} = 25\text{ }^\circ\text{C}$							
$R_{ON(peak)}$	ON-state resistance (peak)	$V_{is} = V_{CC}$ to V_{EE}					
		$V_{CC} = 2.0\text{ V}; V_{EE} = 0\text{ V}; I_S = 100\text{ }\mu\text{A}$	[1]	-	-	Ω	
		$V_{CC} = 4.5\text{ V}; V_{EE} = 0\text{ V}; I_S = 1000\text{ }\mu\text{A}$	-	100	180	Ω	
		$V_{CC} = 6.0\text{ V}; V_{EE} = 0\text{ V}; I_S = 1000\text{ }\mu\text{A}$	-	90	160	Ω	
$R_{ON(rail)}$	ON-state resistance (rail)	$V_{is} = V_{EE}$					
		$V_{CC} = 2.0\text{ V}; V_{EE} = 0\text{ V}; I_S = 100\text{ }\mu\text{A}$	[1]	-	150	Ω	
		$V_{CC} = 4.5\text{ V}; V_{EE} = 0\text{ V}; I_S = 1000\text{ }\mu\text{A}$	-	80	140	Ω	
		$V_{CC} = 6.0\text{ V}; V_{EE} = 0\text{ V}; I_S = 1000\text{ }\mu\text{A}$	-	70	120	Ω	
		$V_{CC} = 4.5\text{ V}; V_{EE} = -4.5\text{ V}; I_S = 1000\text{ }\mu\text{A}$	-	70	130	Ω	
		$V_{is} = V_{CC}$					
		$V_{CC} = 2.0\text{ V}; V_{EE} = 0\text{ V}; I_S = 100\text{ }\mu\text{A}$	[1]	-	150	Ω	
		$V_{CC} = 4.5\text{ V}; V_{EE} = 0\text{ V}; I_S = 1000\text{ }\mu\text{A}$	-	90	160	Ω	
$V_{CC} = 6.0\text{ V}; V_{EE} = 0\text{ V}; I_S = 1000\text{ }\mu\text{A}$	-	80	140	Ω			
$V_{CC} = 4.5\text{ V}; V_{EE} = -4.5\text{ V}; I_S = 1000\text{ }\mu\text{A}$	-	65	120	Ω			

Table 7: R_{ON} resistance per switch for types 74HC4051 and 74HCT4051 ...continued

$V_I = V_{IH}$ or V_{IL} ; for test circuit see Figure 8.

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 $V_{CC} - V_{EE} = 2.0$ 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	
$\Delta R_{ON(max)}$	maximum ON-state resistance variation between any two channels	$V_{is} = V_{CC}$ to V_{EE}					
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V	[1]	-	-	Ω	
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V		-	9	-	Ω
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V		-	8	-	Ω
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V		-	6	-	Ω
$T_{amb} = -40$ °C to $+85$ °C							
$R_{ON(peak)}$	ON-state resistance (peak)	$V_{is} = V_{CC}$ to V_{EE}					
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_S = 100$ μ A	[1]	-	-	Ω	
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	225	Ω
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	200	Ω
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_S = 1000$ μ A		-	-	165	Ω
$R_{ON(rail)}$	ON-state resistance (rail)	$V_{is} = V_{EE}$					
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_S = 100$ μ A	[1]	-	-	Ω	
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	175	Ω
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	150	Ω
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_S = 1000$ μ A		-	-	130	Ω
		$V_{is} = V_{CC}$					
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_S = 100$ μ A	[1]	-	-	Ω	
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	200	Ω
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	175	Ω
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_S = 1000$ μ A		-	-	150	Ω
$T_{amb} = -40$ °C to $+125$ °C							
$R_{ON(peak)}$	ON-state resistance (peak)	$V_{is} = V_{CC}$ to V_{EE}					
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_S = 100$ μ A	[1]	-	-	Ω	
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	270	Ω
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	240	Ω
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_S = 1000$ μ A		-	-	195	Ω
$R_{ON(rail)}$	ON-state resistance (rail)	$V_{is} = V_{EE}$					
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_S = 100$ μ A	[1]	-	-	Ω	
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	210	Ω
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	180	Ω
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_S = 1000$ μ A		-	-	160	Ω
		$V_{is} = V_{CC}$					
		$V_{CC} = 2.0$ V; $V_{EE} = 0$ V; $I_S = 100$ μ A	[1]	-	-	Ω	
		$V_{CC} = 4.5$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	240	Ω
		$V_{CC} = 6.0$ V; $V_{EE} = 0$ V; $I_S = 1000$ μ A		-	-	210	Ω
		$V_{CC} = 4.5$ V; $V_{EE} = -4.5$ V; $I_S = 1000$ μ A		-	-	180	Ω

[1] At supply voltages ($V_{CC} - V_{EE}$) approaching 2.0 V the analog switch ON-state resistance becomes extremely non-linear. Therefore it is recommended that these devices be used to transmit digital signals only, when using these supply voltages.

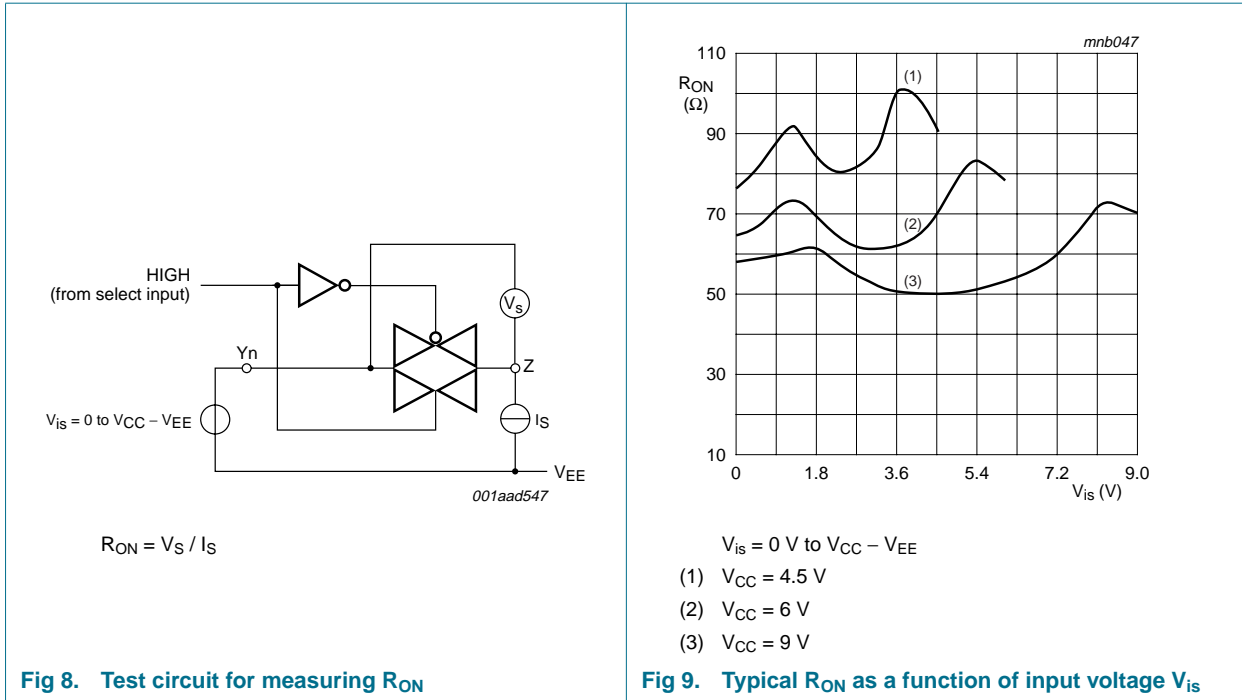


Table 8: Static characteristics type 74HC4051

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

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
$T_{amb} = 25\text{ }^\circ\text{C}$						
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_{LI}	input leakage current	$V_{EE} = 0\text{ V}; V_I = V_{CC}$ or GND				
		$V_{CC} = 6.0\text{ V}$	-	-	± 0.1	μA
		$V_{CC} = 10.0\text{ V}$	-	-	± 0.2	μA
$I_{S(OFF)}$	switch OFF-state current	$V_{CC} = 10.0\text{ V}; V_I = V_{IH}$ or $V_{IL}; V_{EE} = 0\text{ V}; V_S = V_{CC} - V_{EE}$; see Figure 10				
		per channel	-	-	± 0.1	μA
		all channels	-	-	± 0.4	μA

Table 8: Static characteristics type 74HC4051 ...continued

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

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
$I_{S(ON)}$	switch ON-state current	$V_{CC} = 10.0\text{ V}$; $V_I = V_{IH}$ or V_{IL} ; $V_{EE} = 0\text{ V}$; $ V_S = V_{CC} - V_{EE}$; see Figure 11	-	-	± 0.4	μA
I_{CC}	quiescent 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	μA
		$V_{CC} = 10.0\text{ V}$	-	-	16.0	μA
C_i	input capacitance		-	3.5	-	pF
$T_{amb} = -40\text{ }^\circ\text{C to } +85\text{ }^\circ\text{C}$						
V_{IH}	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	-	-	V
		$V_{CC} = 4.5\text{ V}$	3.15	-	-	V
		$V_{CC} = 6.0\text{ V}$	4.2	-	-	V
		$V_{CC} = 9.0\text{ V}$	6.3	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	-	0.5	V
		$V_{CC} = 4.5\text{ V}$	-	-	1.35	V
		$V_{CC} = 6.0\text{ V}$	-	-	1.8	V
		$V_{CC} = 9.0\text{ V}$	-	-	2.7	V
I_{LI}	input leakage current	$V_{EE} = 0\text{ V}$; $V_I = V_{CC}$ or GND				
		$V_{CC} = 6.0\text{ V}$	-	-	± 1.0	μA
		$V_{CC} = 10.0\text{ V}$	-	-	± 2.0	μA
$I_{S(OFF)}$	switch OFF-state current	$V_{CC} = 10.0\text{ V}$; $V_I = V_{IH}$ or V_{IL} ; $V_{EE} = 0\text{ V}$; $ V_S = V_{CC} - V_{EE}$; see Figure 10				
		per channel	-	-	± 1.0	μA
		all channels	-	-	± 4.0	μA
$I_{S(ON)}$	switch ON-state current	$V_{CC} = 10.0\text{ V}$; $V_I = V_{IH}$ or V_{IL} ; $V_{EE} = 0\text{ V}$; $ V_S = V_{CC} - V_{EE}$; see Figure 11	-	-	± 4.0	μA
I_{CC}	quiescent 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	μA
		$V_{CC} = 10.0\text{ V}$	-	-	160.0	μA
$T_{amb} = -40\text{ }^\circ\text{C to } +125\text{ }^\circ\text{C}$						
V_{IH}	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	-	-	V
		$V_{CC} = 4.5\text{ V}$	3.15	-	-	V
		$V_{CC} = 6.0\text{ V}$	4.2	-	-	V
		$V_{CC} = 9.0\text{ V}$	6.3	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	-	0.5	V
		$V_{CC} = 4.5\text{ V}$	-	-	1.35	V
		$V_{CC} = 6.0\text{ V}$	-	-	1.8	V
		$V_{CC} = 9.0\text{ V}$	-	-	2.7	V

Table 8: Static characteristics type 74HC4051 ...continued

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

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
I_{LI}	input leakage current	$V_{EE} = 0\text{ V}; V_I = V_{CC}\text{ or GND}$				
		$V_{CC} = 6.0\text{ V}$	-	-	± 1.0	μA
		$V_{CC} = 10.0\text{ V}$	-	-	± 2.0	μA
$I_{S(OFF)}$	switch OFF-state current	$V_{CC} = 10.0\text{ V}; V_I = V_{IH}\text{ or }V_{IL}; V_{EE} = 0\text{ V}; V_S = V_{CC} - V_{EE};$ see Figure 10				
		per channel	-	-	± 1.0	μA
		all channels	-	-	± 4.0	μA
$I_{S(ON)}$	switch ON-state current	$V_{CC} = 10.0\text{ V}; V_I = V_{IH}\text{ or }V_{IL}; V_{EE} = 0\text{ V}; V_S = V_{CC} - V_{EE};$ see Figure 11	-	-	± 4.0	μA
I_{CC}	quiescent supply current	$V_{EE} = 0\text{ V}; V_I = V_{CC}\text{ or GND}; V_{is} = V_{EE}\text{ or }V_{CC}; V_{os} = V_{CC}\text{ or }V_{EE}$				
		$V_{CC} = 6.0\text{ V}$	-	-	160.0	μA
		$V_{CC} = 10.0\text{ V}$	-	-	320.0	μA

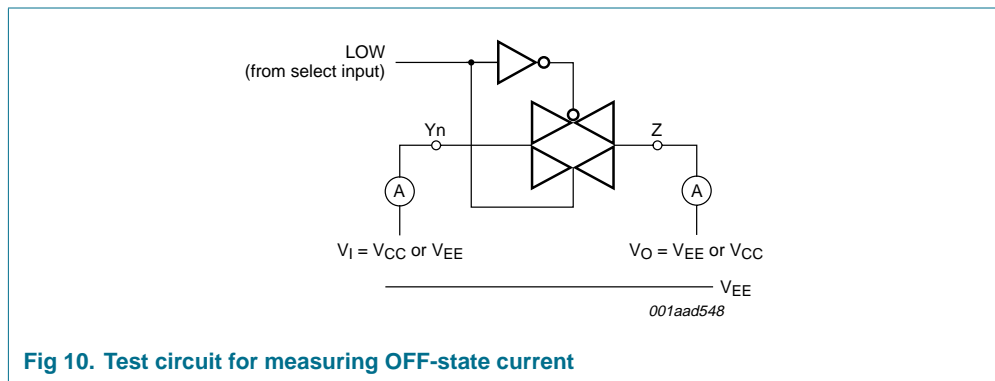


Fig 10. Test circuit for measuring OFF-state current

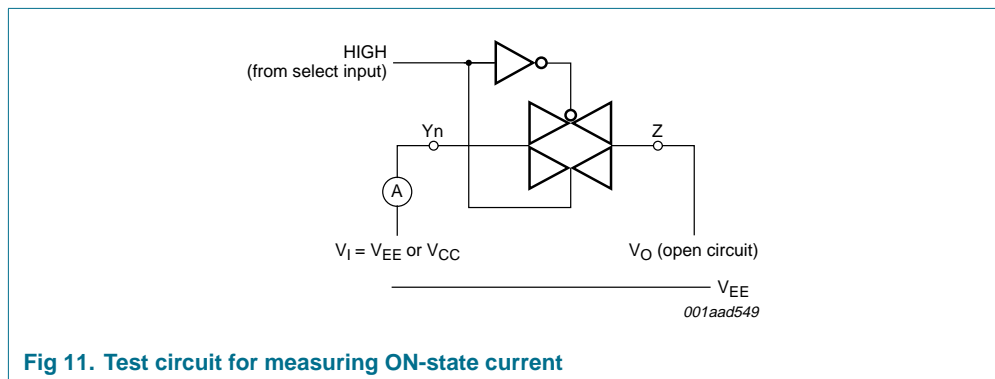


Fig 11. Test circuit for measuring ON-state current

Table 9: Static characteristics type 74HCT4051 ...continued

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

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
$I_{S(OFF)}$	switch OFF-state current	$V_{CC} = 10.0\text{ V}$; $V_I = V_{IH}$ or V_{IL} ; $V_{EE} = 0\text{ V}$; $ V_S = V_{CC} - V_{EE}$; see Figure 10				
		per channel	-	-	± 1.0	μA
		all channels	-	-	± 4.0	μA
$I_{S(ON)}$	switch ON-state current	$V_{CC} = 10.0\text{ V}$; $V_I = V_{IH}$ or V_{IL} ; $V_{EE} = 0\text{ V}$; $ V_S = V_{CC} - V_{EE}$; see Figure 11	-	-	± 4.0	μA
I_{CC}	quiescent supply current	$V_I = V_{CC}$ or GND; $V_{is} = V_{EE}$ or V_{CC} ; $V_{os} = V_{CC}$ or V_{EE}				
		$V_{EE} = 0\text{ V}$; $V_{CC} = 5.5\text{ V}$	-	-	160.0	μA
		$V_{EE} = -5.0\text{ V}$; $V_{CC} = 5.0\text{ V}$	-	-	320.0	μA
ΔI_{CC}	additional quiescent supply current per input pin	$V_{CC} = 4.5\text{ V to } 5.5\text{ V}$; $V_{EE} = 0\text{ V}$; $V_I = V_{CC} - 2.1\text{ V}$; other inputs at V_{CC} or GND				
		Sn input	-	-	245	μA
		\bar{E} input	-	-	245	μA

12. Dynamic characteristics

Table 10: Dynamic characteristics type 74HC4051

$GND = 0\text{ V}$; $t_r = t_f = 6\text{ ns}$; $C_L = 50\text{ pF}$ unless specified otherwise; for test circuit see [Figure 14](#).

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
$T_{amb} = 25\text{ }^\circ\text{C}$						
t_{PHL} , t_{PLH}	propagation delay V_{is} to V_{os}	$R_L = \infty\ \Omega$; see Figure 12				
		$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	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_{PZH} , t_{PZL}	turn-ON time \bar{E} to V_{os} Sn to V_{os}	$R_L = 1\text{ k}\Omega$; see Figure 13				
		$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	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
		$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	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

Table 10: Dynamic characteristics type 74HC4051 ...continued

$GND = 0\text{ V}$; $t_r = t_f = 6\text{ ns}$; $C_L = 50\text{ pF}$ unless specified otherwise; for test circuit see [Figure 14](#).

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
t_{PHZ} , t_{PLZ}	turn-OFF time \bar{E} to V_{os}	$R_L = 1\text{ k}\Omega$; see Figure 13				
		$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	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}	$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	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
C_{PD}	power dissipation capacitance (per switch)		[1] [2]	25	-	pF
$T_{amb} = -40\text{ }^\circ\text{C to }+85\text{ }^\circ\text{C}$						
t_{PHL} , t_{PLH}	propagation delay V_{is} to V_{os}	$R_L = \infty\ \Omega$; see Figure 12				
		$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	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_{PZH} , t_{PZL}	turn-ON time \bar{E} to V_{os}	$R_L = 1\text{ k}\Omega$; see Figure 13				
		$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	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}	$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	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_{PHZ} , t_{PLZ}	turn-OFF time \bar{E} to V_{os}	$R_L = 1\text{ k}\Omega$; see Figure 13				
		$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	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}	$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	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

Table 10: Dynamic characteristics type 74HC4051 ...continued

$GND = 0\text{ V}$; $t_r = t_f = 6\text{ ns}$; $C_L = 50\text{ pF}$ unless specified otherwise; for test circuit see [Figure 14](#).

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
$T_{amb} = -40\text{ °C to }+125\text{ °C}$						
t_{PHL} , t_{PLH}	propagation delay V_{is} to V_{os}	$R_L = \infty\ \Omega$; see Figure 12				
		$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	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_{PZH} , t_{PZL}	turn-ON time	$R_L = 1\text{ k}\Omega$; see Figure 13				
	\bar{E} to V_{os}	$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	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
	Sn to V_{os}	$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	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
t_{PHZ} , t_{PLZ}	turn-OFF time	$R_L = 1\text{ k}\Omega$; see Figure 13				
	\bar{E} to V_{os}	$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	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
	Sn to V_{os}	$V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$	-	-	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] C_{PD} is used to determine the dynamic power dissipation (P_D in μW):

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

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

C_L = output load capacitance in pF;

C_S = switch capacitance in pF;

V_{CC} = supply voltage in V.

[2] For 74HC4051 the condition is $V_i = GND$ to V_{CC} .

14. Additional dynamic characteristics

Table 14: Additional dynamic characteristics

Recommended conditions and typical values; $GND = 0\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

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	
d_{sin}	sine-wave distortion	$R_L = 10\text{ k}\Omega$; $C_L = 50\text{ pF}$; see Figure 15					
		$f_i = 1\text{ kHz}$					
		$V_{CC} = 2.25\text{ V}$; $V_{EE} = -2.25\text{ V}$; $V_{is(p-p)} = 4.0\text{ V}$	-	0.04	-	%	
		$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$; $V_{is(p-p)} = 8.0\text{ V}$	-	0.02	-	%	
		$f_i = 10\text{ kHz}$					
		$V_{CC} = 2.25\text{ V}$; $V_{EE} = -2.25\text{ V}$; $V_{is(p-p)} = 4.0\text{ V}$	-	0.12	-	%	
$\alpha_{(ft)OFF}$	switch OFF-state signal feed-through suppression	$R_L = 600\text{ }\Omega$; $C_L = 50\text{ pF}$; see Figure 16				[1]	
		$V_{CC} = 2.25\text{ V}$; $V_{EE} = -2.25\text{ V}$	-	-50	-	dB	
		$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	-50	-	dB	
$V_{ct(p-p)}$	crosstalk voltage (peak-to-peak value)	$R_L = 600\text{ }\Omega$; $C_L = 50\text{ pF}$; $f_i = 1\text{ MHz}$; \bar{E} or Sn square-wave between V_{CC} and GND; $t_r = t_f = 6\text{ ns}$; see Figure 17					
		between \bar{E} or Sn and Yn or Z	$V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$	-	110	-	mV
		$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	220	-	mV	
$f_{h(-3dB)}$	-3 dB high frequency	$R_L = 50\text{ }\Omega$; $C_L = 10\text{ pF}$; see Figure 18				[2]	
		$V_{CC} = 2.25\text{ V}$; $V_{EE} = -2.25\text{ V}$	-	170	-	MHz	
		$V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$	-	180	-	MHz	
C_S	switch capacitance						
		independent input/output Yn	-	5	-	pF	
		common input/output Z	-	25	-	pF	

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

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

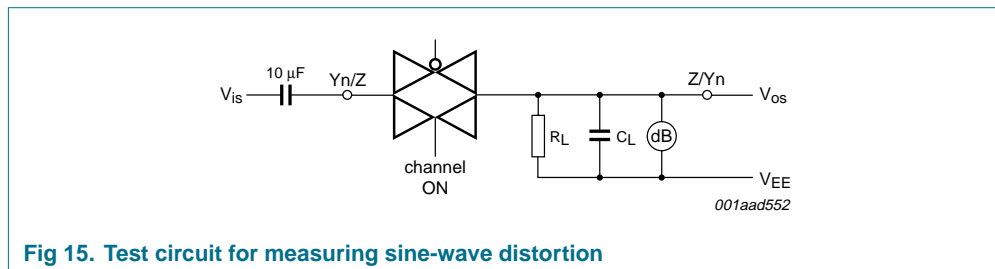
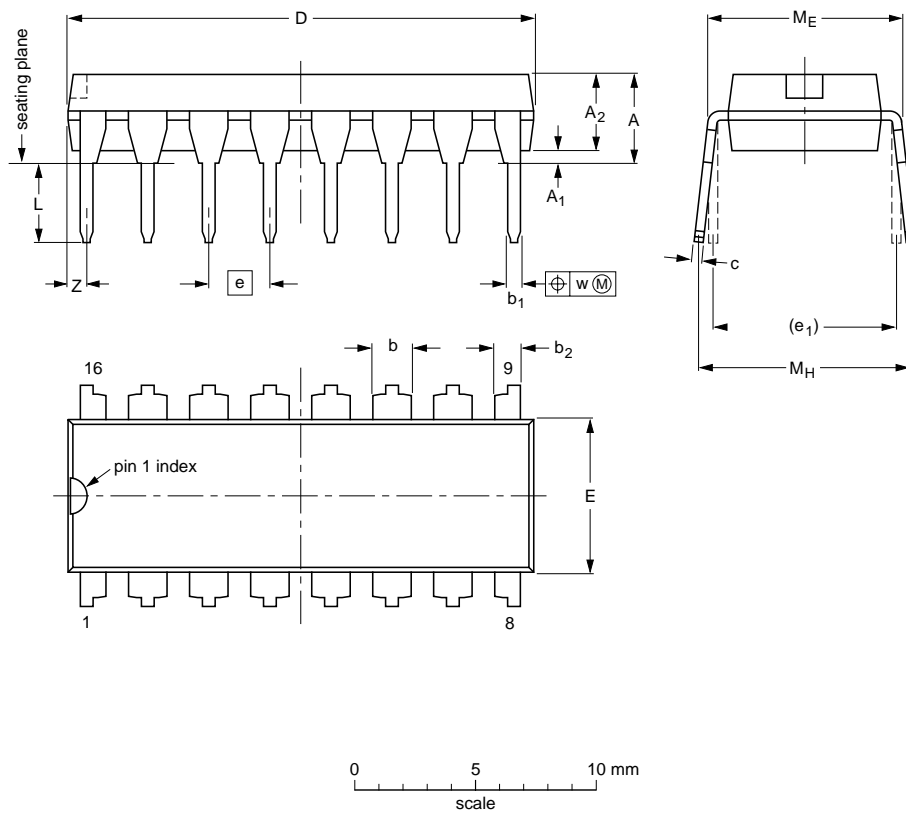


Fig 15. Test circuit for measuring sine-wave distortion

15. 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 ₁ min.	A ₂ max.	b	b ₁	b ₂	c	D ⁽¹⁾	E ⁽¹⁾	e	e ₁	L	M _E	M _H	w	Z ⁽¹⁾ 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

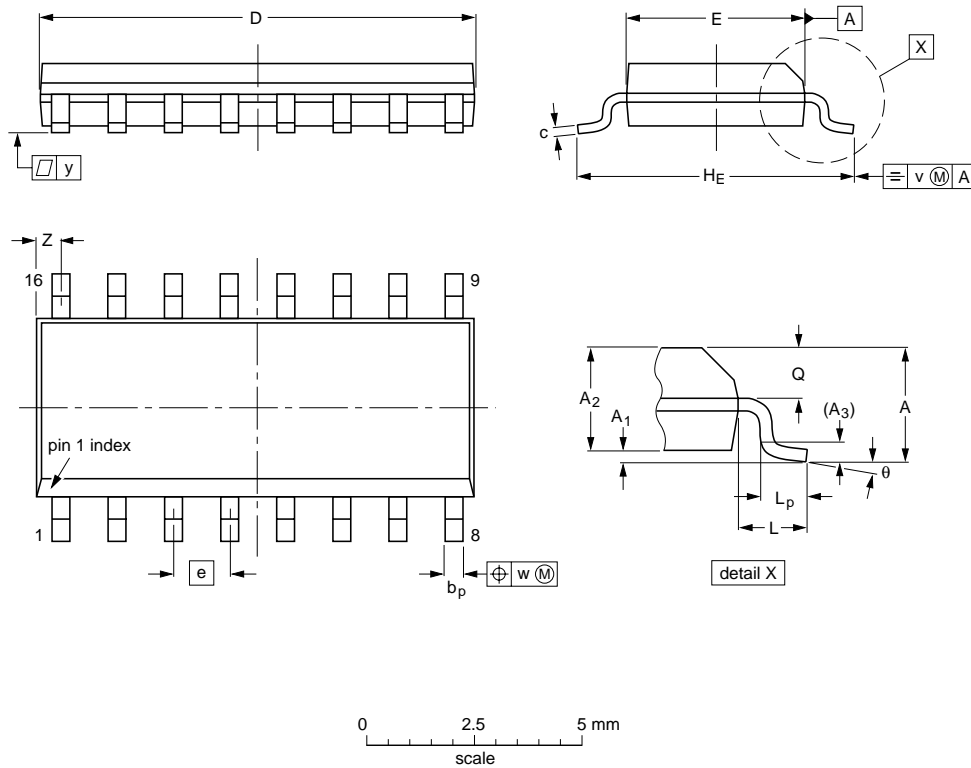
1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION
	IEC	JEDEC	JEITA	
SOT38-4				

Fig 19. 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 ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	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
	IEC	JEDEC	JEITA	
SOT109-1	076E07	MS-012		

Fig 20. Package outline SOT109-1 (SO16)