

74HC4051; 74HCT4051

8-channel analog multiplexer/demultiplexer

Rev. 9 — 26 September 2017

Product data sheet

1 General description

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

- Wide analog input voltage range from -5 V to +5 V
- Complies with JEDEC standard no. 7A
- Low ON resistance:
 - 80 Ω (typical) at $V_{CC} - V_{EE} = 4.5$ V
 - 70 Ω (typical) at $V_{CC} - V_{EE} = 6.0$ V
 - 60 Ω (typical) at $V_{CC} - V_{EE} = 9.0$ V
- Logic level translation: to enable 5 V logic to communicate with ± 5 V analog signals
- Typical 'break before make' built-in
- 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

- 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

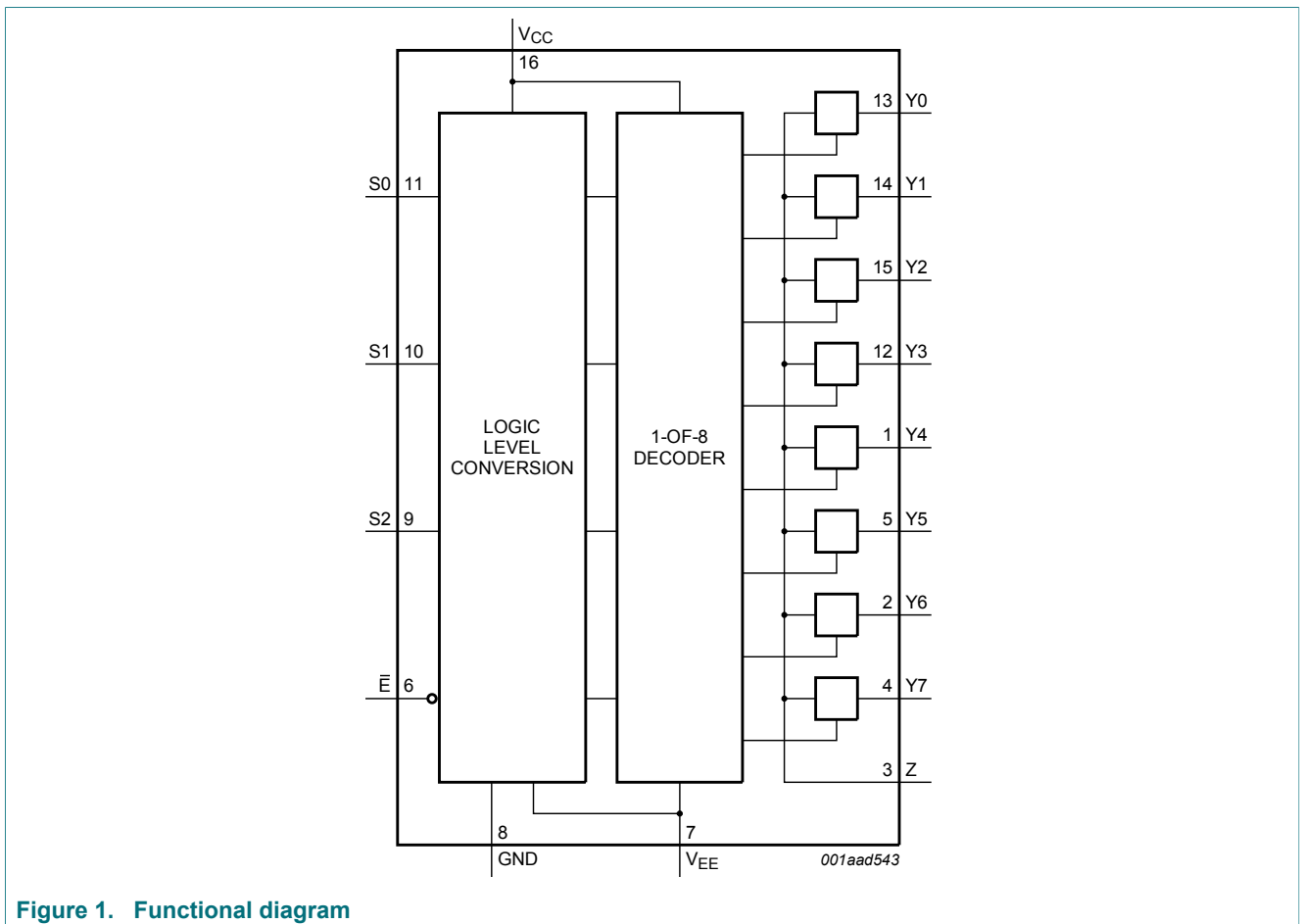


Figure 1. Functional diagram



Figure 2. Logic symbol



Figure 3. IEC logic symbol



Figure 4. Schematic diagram (one switch)

6 Pinning information

6.1 Pinning

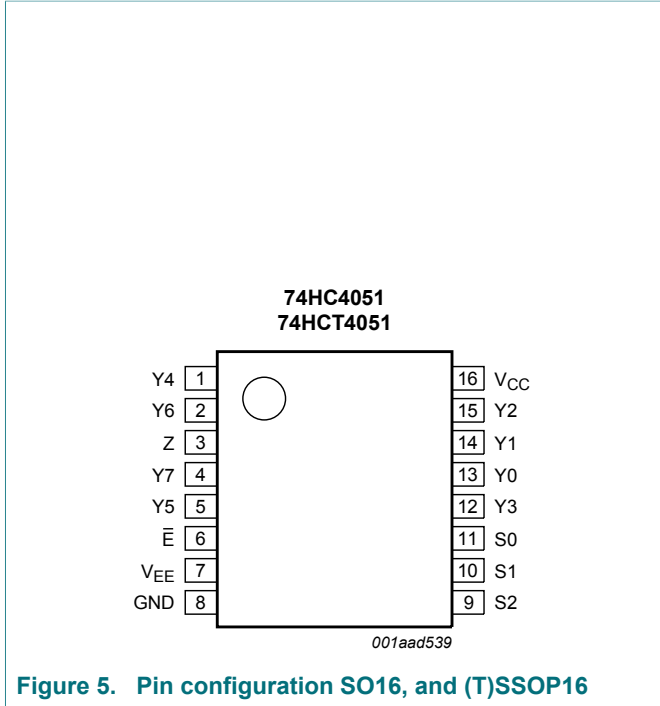
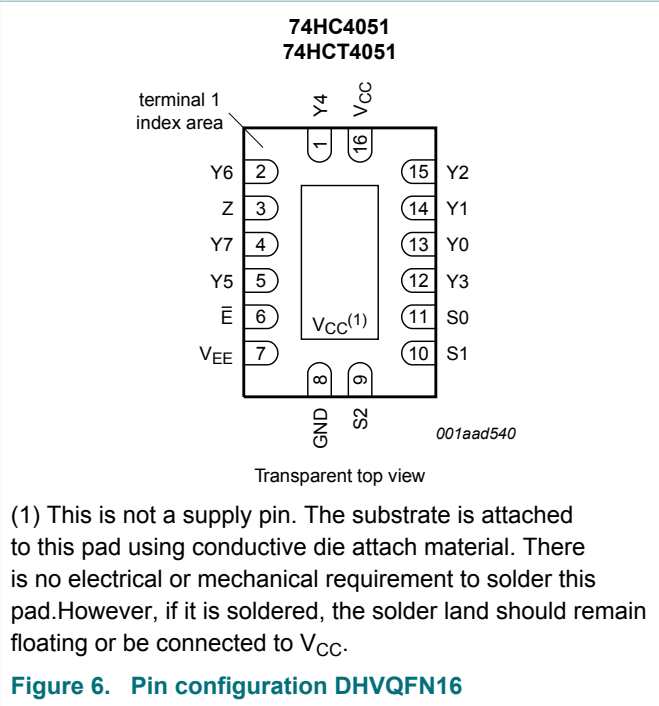


Figure 5. Pin configuration SO16, and (T)SSOP16



(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_{CC}.

Figure 6. Pin configuration DHVQFN16

6.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|--------------------------------|----------------------------|-----------------------------|
| 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 Function description

Table 3. 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 | 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 $V_I > V_{CC} + 0.5\text{ V}$ | - | ± 20 | mA |
| I_{SK} | switch clamping current | $V_{SW} < -0.5\text{ V}$ or $V_{SW} > V_{CC} + 0.5\text{ V}$ | - | ± 20 | mA |
| I_{SW} | switch current | $-0.5\text{ V} < V_{SW} < V_{CC} + 0.5\text{ V}$ | - | ± 25 | mA |
| I_{EE} | supply current | | - | ± 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 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 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 Figure 7 and Figure 8 | | | | | | | |
| | | 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 |
| Δt/ΔV | 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 |



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 V , 6.0 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 V , 6.0 V and 9.0 V .

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|--|---|---|-----|-----|-----|----------|--|
| $T_{amb} = 25\text{ °C}$ | | | | | | | |
| $R_{ON(peak)}$ | 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] | - | - | - | Ω | |
| | | $V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$; $I_{SW} = 1000\text{ }\mu\text{A}$ | - | 100 | 180 | Ω | |
| | | $V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$; $I_{SW} = 1000\text{ }\mu\text{A}$ | - | 90 | 160 | Ω | |
| | | $V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$; $I_{SW} = 1000\text{ }\mu\text{A}$ | - | 70 | 130 | Ω | |
| $R_{ON(rail)}$ | 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 | - | Ω | |
| | | $V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$; $I_{SW} = 1000\text{ }\mu\text{A}$ | - | 80 | 140 | Ω | |
| | | $V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$; $I_{SW} = 1000\text{ }\mu\text{A}$ | - | 70 | 120 | Ω | |
| | | $V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$; $I_{SW} = 1000\text{ }\mu\text{A}$ | - | 60 | 105 | Ω | |
| | | $V_{is} = V_{CC}$ | | | | | |
| | | $V_{CC} = 2.0\text{ V}$; $V_{EE} = 0\text{ V}$; $I_{SW} = 100\text{ }\mu\text{A}$ [1] | - | 150 | - | Ω | |
| | | $V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$; $I_{SW} = 1000\text{ }\mu\text{A}$ | - | 90 | 160 | Ω | |
| | | $V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$; $I_{SW} = 1000\text{ }\mu\text{A}$ | - | 80 | 140 | Ω | |
| | | $V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$; $I_{SW} = 1000\text{ }\mu\text{A}$ | - | 65 | 120 | Ω | |
| ΔR_{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] | - | - | - | Ω | |
| | | $V_{CC} = 4.5\text{ V}$; $V_{EE} = 0\text{ V}$ | - | 9 | - | Ω | |
| | | $V_{CC} = 6.0\text{ V}$; $V_{EE} = 0\text{ V}$ | - | 8 | - | Ω | |
| | | $V_{CC} = 4.5\text{ V}$; $V_{EE} = -4.5\text{ V}$ | - | 6 | - | Ω | |

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

[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.

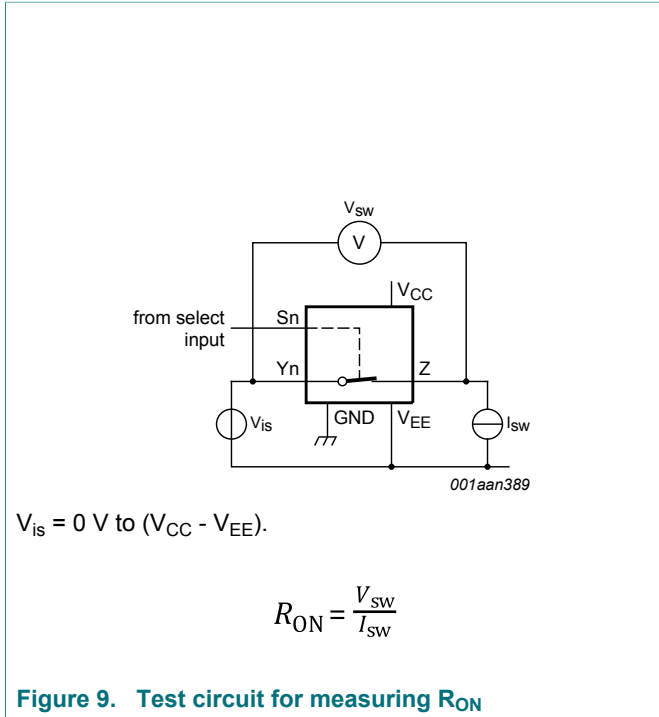


Figure 9. Test circuit for measuring R_{ON}

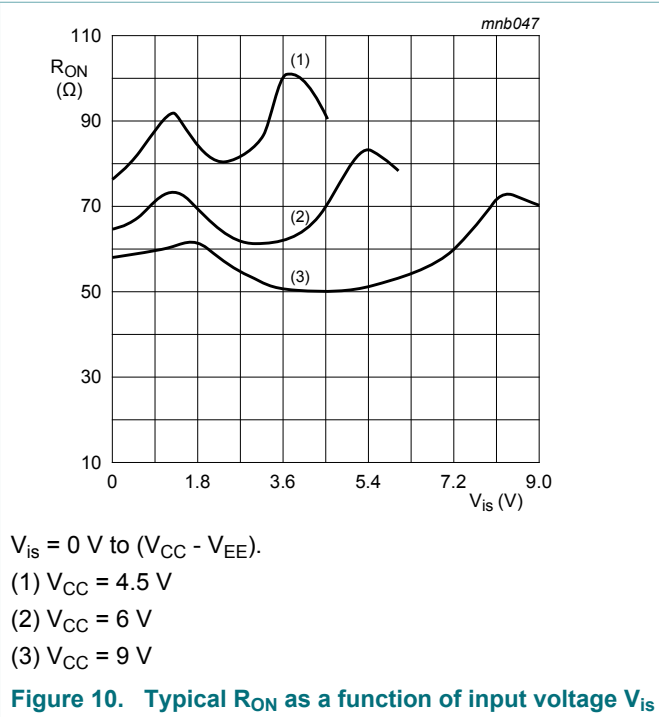


Figure 10. Typical R_{ON} as a function of input voltage V_{is}

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 |
|---|---------------------------|--|------|-----|-----------|---------------|
| $T_{amb} = 25 \text{ }^\circ\text{C}$ | | | | | | |
| 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 | $V_{EE} = 0 \text{ V}; V_I = V_{CC} \text{ or GND}$ | | | | |
| | | $V_{CC} = 6.0 \text{ V}$ | - | - | ± 0.1 | μA |
| | | $V_{CC} = 10.0 \text{ V}$ | - | - | ± 0.2 | μA |
| $I_{S(OFF)}$ | 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 | - | - | ± 0.1 | μA |
| | | all channels | - | - | ± 0.4 | μA |

| 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}$; $V_{CC} = 10.0\text{ V}$; $V_{EE} = 0\text{ V}$; see Figure 12 | - | - | ± 0.4 | μA |
| 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 | μA |
| | | $V_{CC} = 10.0\text{ V}$ | - | - | 16.0 | μA |
| C_I | input capacitance | | - | 3.5 | - | pF |
| C_{SW} | switch capacitance | independent pins Yn | - | 5 | - | pF |
| | | common pins Z | - | 25 | - | 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_I | 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 |
| $I_{S(OFF)}$ | 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 Figure 11 | | | | |
| | | per channel | - | - | ± 1.0 | μA |
| | | all channels | - | - | ± 4.0 | μA |
| $I_{S(ON)}$ | 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 Figure 12 | - | - | ± 4.0 | μA |
| 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 | μA |
| | | $V_{CC} = 10.0\text{ V}$ | - | - | 160.0 | μA |

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--|---------------------------|--|------|-----|-------|------|
| T_{amb} = -40 °C to +125 °C | | | | | | |
| 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 | - | - | ±1.0 | µA |
| | | V _{CC} = 10.0 V | - | - | ±2.0 | µA |
| 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 Figure 11 | | | | |
| | | per channel | - | - | ±1.0 | µA |
| | | all channels | - | - | ±4.0 | µA |
| 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 Figure 12 | - | - | ±4.0 | µA |
| 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 | - | - | 160.0 | µA |
| | | V _{CC} = 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 |
|--------------------------------|---------------------------|--|-----|-----|------|------|
| T_{amb} = 25 °C | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 4.5 V to 5.5 V | 2.0 | 1.6 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 4.5 V to 5.5 V | - | 1.2 | 0.8 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 5.5 V; V _{EE} = 0 V | - | - | ±0.1 | μA |
| 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 Figure 11 | | | | |
| | | per channel | - | - | ±0.1 | μA |
| | | all channels | - | - | ±0.4 | μA |
| I _{S(ON)} | ON-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 Figure 12 | - | - | ±0.4 | μA |
| 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 V; V _{EE} = 0 V | - | - | 8.0 | μA |
| | | V _{CC} = 5.0 V; V _{EE} = -5.0 V | - | - | 16.0 | μA |
| ΔI _{CC} | additional supply current | per input; V _I = V _{CC} - 2.1 V; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V; V _{EE} = 0 V | - | 50 | 180 | μA |
| 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 |
|--|---------------------------|--|-----|-----|-------|------|
| T_{amb} = -40 °C to +85 °C | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 4.5 V to 5.5 V | 2.0 | - | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 4.5 V to 5.5 V | - | - | 0.8 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 5.5 V; V _{EE} = 0 V | - | - | ±1.0 | µA |
| 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 Figure 11 | | | | |
| | | per channel | - | - | ±1.0 | µA |
| | | all channels | - | - | ±4.0 | µA |
| I _{S(ON)} | ON-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 Figure 12 | - | - | ±4.0 | µA |
| 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 V; V _{EE} = 0 V | - | - | 80.0 | µA |
| | | V _{CC} = 5.0 V; V _{EE} = -5.0 V | - | - | 160.0 | µA |
| ΔI _{CC} | additional supply current | per input; V _I = V _{CC} - 2.1 V; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V; V _{EE} = 0 V | - | - | 225 | µA |
| T_{amb} = -40 °C to +125 °C | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 4.5 V to 5.5 V | 2.0 | - | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 4.5 V to 5.5 V | - | - | 0.8 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 5.5 V; V _{EE} = 0 V | - | - | ±1.0 | µA |
| 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 Figure 11 | | | | |
| | | per channel | - | - | ±1.0 | µA |
| | | all channels | - | - | ±4.0 | µA |
| I _{S(ON)} | ON-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 Figure 12 | - | - | ±4.0 | µA |
| 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 V; V _{EE} = 0 V | - | - | 160.0 | µA |
| | | V _{CC} = 5.0 V; V _{EE} = -5.0 V | - | - | 320.0 | µA |
| ΔI _{CC} | additional supply current | per input; V _I = V _{CC} - 2.1 V; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V; V _{EE} = 0 V | - | - | 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 | | |
|---|-------------------|--|---------------|--|-----|------|-----|----|
| T_{amb} = 25 °C | | | | | | | | |
| t_{pd} | propagation delay | V_{is} to V_{os} ; $R_L = \infty\ \Omega$; see Figure 13 [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 Figure 14 [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 Figure 14 [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 Figure 14 [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 Figure 14 [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 | |
| $T_{amb} = -40\text{ °C to }+85\text{ °C}$ | | | | | | | |
| t_{pd} | propagation delay | V_{is} to V_{os} ; $R_L = \infty\ \Omega$; see Figure 13 [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 Figure 14 [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 Figure 14 [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 Figure 14 [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 Figure 14 [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 | |
|--|-------------------|--|-----|-----|-----|------|--|
| T_{amb} = -40 °C to +125 °C | | | | | | | |
| t _{pd} | propagation delay | V _{is} to V _{os} ; R _L = ∞ Ω; see Figure 13 [1] | | | | | |
| | | V _{CC} = 2.0 V; V _{EE} = 0 V | - | - | 90 | ns | |
| | | V _{CC} = 4.5 V; V _{EE} = 0 V | - | - | 18 | ns | |
| | | V _{CC} = 6.0 V; V _{EE} = 0 V | - | - | 15 | ns | |
| | | V _{CC} = 4.5 V; V _{EE} = -4.5 V | - | - | 12 | ns | |
| t _{on} | turn-on time | \bar{E} to V _{os} ; R _L = ∞ Ω; see Figure 14 [2] | | | | | |
| | | V _{CC} = 2.0 V; V _{EE} = 0 V | - | - | 520 | ns | |
| | | V _{CC} = 4.5 V; V _{EE} = 0 V | - | - | 104 | ns | |
| | | V _{CC} = 6.0 V; V _{EE} = 0 V | - | - | 88 | ns | |
| | | V _{CC} = 4.5 V; V _{EE} = -4.5 V | - | - | 77 | ns | |
| | | Sn to V _{os} ; R _L = ∞ Ω; see Figure 14 [2] | | | | | |
| | | V _{CC} = 2.0 V; V _{EE} = 0 V | - | - | 520 | ns | |
| | | V _{CC} = 4.5 V; V _{EE} = 0 V | - | - | 104 | ns | |
| | | V _{CC} = 6.0 V; V _{EE} = 0 V | - | - | 88 | ns | |
| | | V _{CC} = 4.5 V; V _{EE} = -4.5 V | - | - | 77 | ns | |
| t _{off} | turn-off time | \bar{E} to V _{os} ; R _L = 1 kΩ; see Figure 14 [3] | | | | | |
| | | V _{CC} = 2.0 V; V _{EE} = 0 V | - | - | 435 | ns | |
| | | V _{CC} = 4.5 V; V _{EE} = 0 V | - | - | 87 | ns | |
| | | V _{CC} = 6.0 V; V _{EE} = 0 V | - | - | 74 | ns | |
| | | V _{CC} = 4.5 V; V _{EE} = -4.5 V | - | - | 72 | ns | |
| | | Sn to V _{os} ; R _L = 1 kΩ; see Figure 14 [3] | | | | | |
| | | V _{CC} = 2.0 V; V _{EE} = 0 V | - | - | 435 | ns | |
| | | V _{CC} = 4.5 V; V _{EE} = 0 V | - | - | 87 | ns | |
| | | V _{CC} = 6.0 V; V _{EE} = 0 V | - | - | 74 | ns | |
| | | V _{CC} = 4.5 V; V _{EE} = -4.5 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 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_i = input frequency in MHz;

f_o = output frequency in MHz;

N = number of inputs switching;

Σ{(C_L + C_{sw}) × V_{CC}² × 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

$GND = 0\text{ V}$; $t_r = t_f = 6\text{ ns}$; $C_L = 50\text{ pF}$; 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 |
|--|-------------------------------|--|-----|-----|-----|------|
| $T_{amb} = 25\text{ °C}$ | | | | | | |
| t_{pd} | propagation delay | V_{is} to V_{os} ; $R_L = \infty\ \Omega$; see Figure 13 [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 Figure 14 [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 Figure 14 [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 Figure 14 [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 Figure 14 [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 |
| $T_{amb} = -40\text{ °C to }+85\text{ °C}$ | | | | | | |
| t_{pd} | propagation delay | V_{is} to V_{os} ; $R_L = \infty\ \Omega$; see Figure 13 [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 Figure 14 [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 Figure 14 [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_{off} | turn-off time | \bar{E} to V_{OS} ; $R_L = 1 \text{ k}\Omega$; see Figure 14 [3] | | | | |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = 0 \text{ V}$ | - | - | 56 | ns |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = -4.5 \text{ V}$ | - | - | 40 | ns |
| | | Sn to V_{OS} ; $R_L = 1 \text{ k}\Omega$; see Figure 14 [3] | | | | |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = 0 \text{ V}$ | - | - | 56 | ns |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = -4.5 \text{ V}$ | - | - | 40 | ns |
| $T_{\text{amb}} = -40 \text{ }^\circ\text{C}$ to $+125 \text{ }^\circ\text{C}$ | | | | | | |
| t_{pd} | propagation delay | V_{is} to V_{OS} ; $R_L = \infty \Omega$; see Figure 13 [1] | | | | |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = 0 \text{ V}$ | - | - | 18 | ns |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = -4.5 \text{ V}$ | - | - | 12 | ns |
| t_{on} | turn-on time | \bar{E} to V_{OS} ; $R_L = 1 \text{ k}\Omega$; see Figure 14 [2] | | | | |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = 0 \text{ V}$ | - | - | 83 | ns |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = -4.5 \text{ V}$ | - | - | 59 | ns |
| | | Sn to V_{OS} ; $R_L = 1 \text{ k}\Omega$; see Figure 14 [2] | | | | |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = 0 \text{ V}$ | - | - | 83 | ns |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = -4.5 \text{ V}$ | - | - | 59 | ns |
| t_{off} | turn-off time | \bar{E} to V_{OS} ; $R_L = 1 \text{ k}\Omega$; see Figure 14 [3] | | | | |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = 0 \text{ V}$ | - | - | 68 | ns |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = -4.5 \text{ V}$ | - | - | 48 | ns |
| | | Sn to V_{OS} ; $R_L = 1 \text{ k}\Omega$; see Figure 14 [3] | | | | |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = 0 \text{ V}$ | - | - | 68 | ns |
| | | $V_{\text{CC}} = 4.5 \text{ V}$; $V_{\text{EE}} = -4.5 \text{ V}$ | - | - | 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 μW).

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

N = number of inputs switching;

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

C_L = output load capacitance in pF;

C_{sw} = switch capacitance in pF;

V_{CC} = supply voltage in V.



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 ^[1] | C_L | R_L | |
| t_{PHL}, t_{PLH} | [2] | pulse | < 2 ns | 6 ns | 50 pF | 1 k Ω | open |
| t_{PZH}, t_{PHZ} | [2] | V_{CC} | < 2 ns | 6 ns | 50 pF | 1 k Ω | V_{EE} |
| t_{PZL}, t_{PLZ} | [2] | V_{EE} | < 2 ns | 6 ns | 50 pF | 1 k Ω | 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_{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.

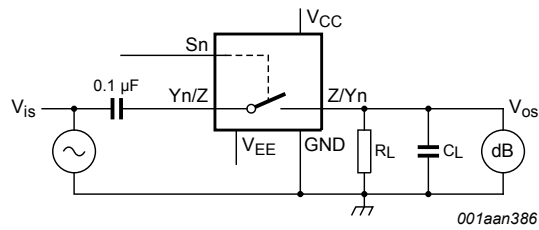
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit | |
|----------------------|--------------------------|--|-----|------|-----|------|-----|
| d _{sin} | sine-wave distortion | f _i = 1 kHz; R _L = 10 kΩ; see Figure 16 | | | | | |
| | | V _{is} = 4.0 V (p-p); V _{CC} = 2.25 V; V _{EE} = -2.25 V | - | 0.04 | - | % | |
| | | V _{is} = 8.0 V (p-p); V _{CC} = 4.5 V; V _{EE} = -4.5 V | - | 0.02 | - | % | |
| | | f _i = 10 kHz; R _L = 10 kΩ; see Figure 16 | | | | | |
| | | 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 | - | % | |
| α _{iso} | isolation (OFF-state) | R _L = 600 Ω; f _i = 1 MHz; see Figure 17 | | | | | |
| | | 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 Ω; f _i = 1 MHz; E or Sn square wave between V _{CC} and GND; t _r = t _f = 6 ns; see Figure 18 | | | | | |
| | | V _{CC} = 4.5 V; V _{EE} = 0 V | - | 110 | - | mV | |
| | | V _{CC} = 4.5 V; V _{EE} = -4.5 V | - | 220 | - | mV | |
| f _{i(-3dB)} | -3 dB frequency response | R _L = 50 Ω; see Figure 19 | | | | | |
| | | 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 Ω).

[2] Adjust input voltage V_{is} to 0 dBm level at V_{os} 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)

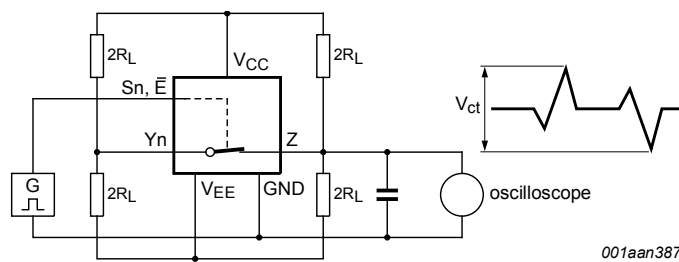


Figure 18. Test circuit for measuring crosstalk between control input and any switch



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

a. Test circuit



b. Typical frequency response

Figure 19. Test circuit for frequency response

12 Package outline

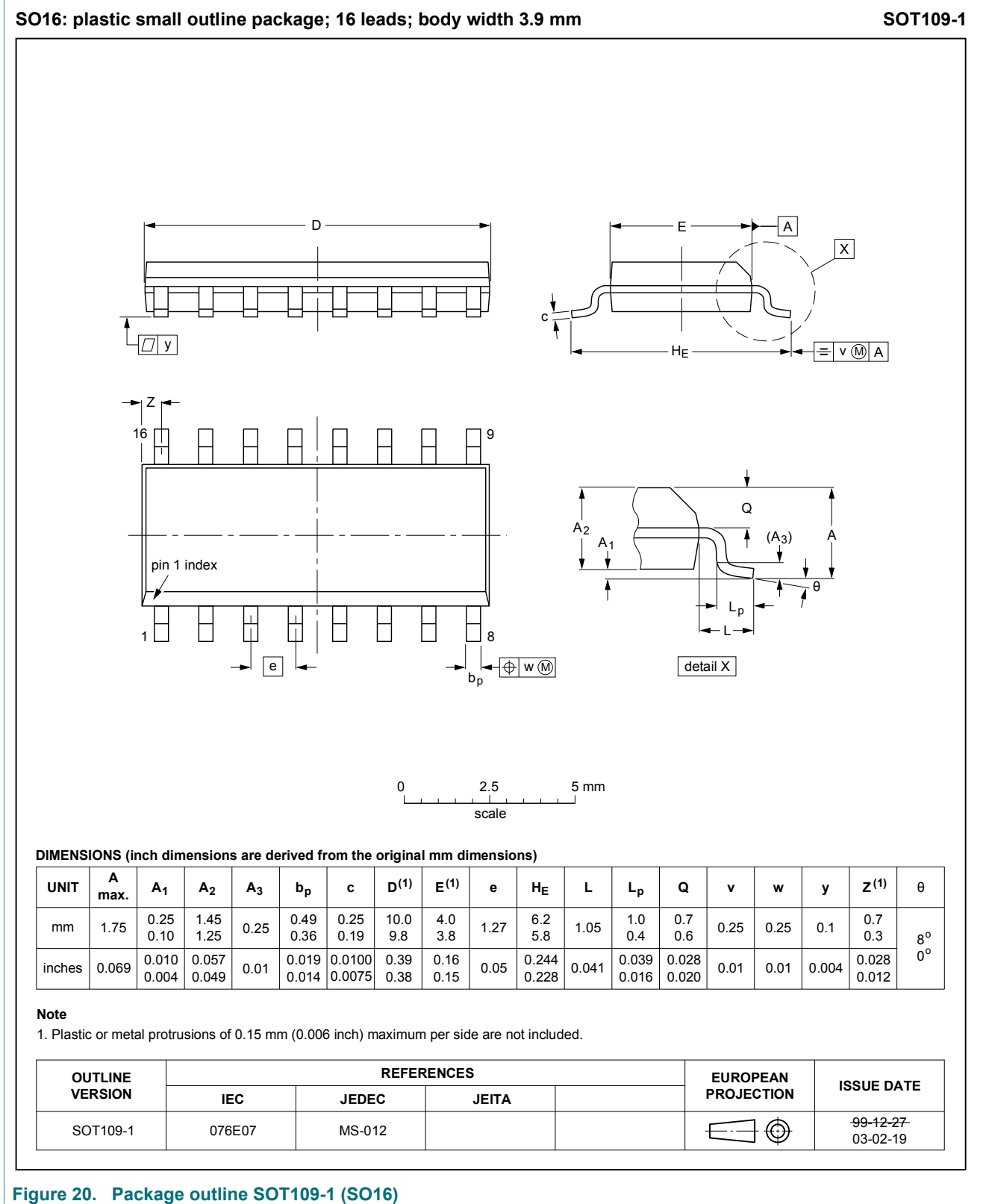


Figure 20. Package outline SOT109-1 (SO16)

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 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 | 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 ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽²⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | 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"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. | | | |
| 74HC_HCT4051 v.8 | 20160205 | Product data sheet | - | 74HC_HCT4051 v.7 |
| Modifications: | <ul style="list-style-type: none"> Type numbers 74HC4051N and 74HCT4051N (SOT38-4) removed. | | | |
| 74HC_HCT4051 v.7 | 20120719 | Product data sheet | - | 74HC_HCT4051 v.6 |
| Modifications: | <ul style="list-style-type: none"> CDM added to features. | | | |
| 74HC_HCT4051 v.6 | 20111213 | Product data sheet | - | 74HC_HCT4051 v.5 |
| Modifications: | <ul style="list-style-type: none"> 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 |

15 Legal information

15.1 Data sheet status

| Document status ^{[1][2]} | Product status ^[3] | 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.nexperia.com>.

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