

HEF4066B

Quad single-pole single-throw analog switch

Rev. 8 — 11 September 2014

Product data sheet

1. General description

The HEF4066B provides four single-pole, single-throw analog switch functions. Each switch has two input/output terminals (nY and nZ) and an active HIGH enable input (nE). When nE is LOW, the analog switch is turned off.

The HEF4066B is pin compatible with the HEF4016B but exhibits a much lower ON resistance. In addition the ON resistance is relatively constant over the full input signal range.

2. Features and benefits

- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Inputs and outputs are protected against electrostatic effects
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- Complies with JEDEC standard JESD 13-B

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
HEF4066BP	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	DIP14	plastic dual in-line package; 14 leads (300 mil)	SOT27-1
HEF4066BT	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1



5. Functional diagram

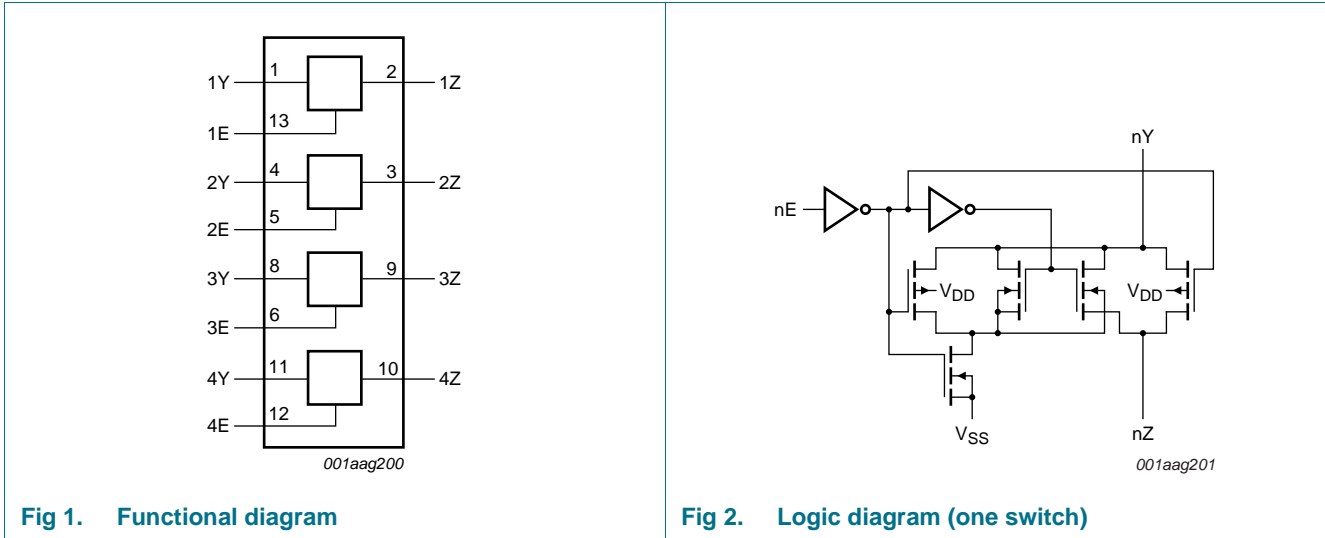


Fig 1. Functional diagram

Fig 2. Logic diagram (one switch)

6. Pinning information

6.1 Pinning

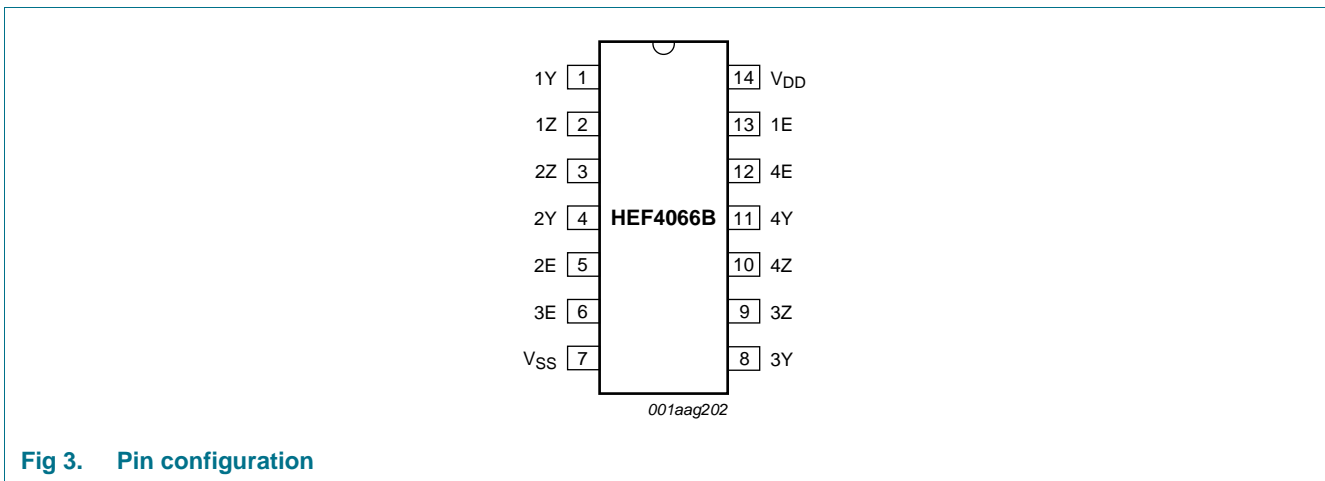


Fig 3. Pin configuration

6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1Y, 2Y, 3Y, 4Y	1, 4, 8, 11	independent input or output
1Z, 2Z, 3Z, 4Z	2, 3, 9, 10	independent input or output
1E, 2E, 3E, 4E	13, 5, 6, 12	enable input (active HIGH)
VSS	7	ground (0 V)
VDD	14	supply voltage

7. Functional description

Table 3. Function table^[1]

Input nE	Switch
H	ON
L	OFF

[1] H = HIGH voltage level; L = LOW voltage level.

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_{DD}	supply voltage		-0.5	+18	V
I_{IK}	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{DD} + 0.5\text{ V}$	-	± 10	mA
V_I	input voltage		-0.5	$V_{DD} + 0.5$	V
$I_{I/O}$	input/output current		[1] -	± 10	mA
T_{stg}	storage temperature		-65	+150	°C
T_{amb}	ambient temperature		-40	+85	°C
P_{tot}	total power dissipation	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			
		DIP14	[2] -	750	mW
		SO14	[3] -	500	mW
P	power dissipation	per switch	-	100	mW

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

[2] For DIP14 packages: above $T_{amb} = 70\text{ °C}$, P_{tot} derates linearly with 12 mW/K.

[3] For SO14 packages: above $T_{amb} = 70\text{ °C}$, P_{tot} derates linearly with 8 mW/K.

9. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DD}	supply voltage		3	-	15	V
V_I	input voltage		0	-	V_{DD}	V
T_{amb}	ambient temperature	in free air	-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{DD} = 5\text{ V}$	-	-	3.75	$\mu\text{s/V}$
		$V_{DD} = 10\text{ V}$	-	-	0.5	$\mu\text{s/V}$
		$V_{DD} = 15\text{ V}$	-	-	0.08	$\mu\text{s/V}$

10. Static characteristics

Table 6. Static characteristics

$V_{SS} = 0\text{ V}$; $V_I = V_{SS}$ or V_{DD} unless otherwise specified.

Symbol	Parameter	Conditions	V_{DD}	$T_{amb} = -40\text{ }^\circ\text{C}$		$T_{amb} = 25\text{ }^\circ\text{C}$		$T_{amb} = 85\text{ }^\circ\text{C}$		$T_{amb} = 125\text{ }^\circ\text{C}$		Unit
				Min	Max	Min	Max	Min	Max	Min	Max	
V_{IH}	HIGH-level input voltage	$ I_O < 1\text{ }\mu\text{A}$	5 V	3.5	-	3.5	-	3.5	-	3.5	-	V
			10 V	7.0	-	7.0	-	7.0	-	7.0	-	V
			15 V	11.0	-	11.0	-	11.0	-	11.0	-	V
V_{IL}	LOW-level input voltage	$ I_O < 1\text{ }\mu\text{A}$	5 V	-	1.5	-	1.5	-	1.5	-	1.5	V
			10 V	-	3.0	-	3.0	-	3.0	-	3.0	V
			15 V	-	4.0	-	4.0	-	4.0	-	4.0	V
I_I	input leakage current		15 V	-	± 0.1	-	± 0.1	-	± 1.0	-	± 1.0	μA
$I_{S(OFF)}$	OFF-state leakage current	per channel; see Figure 4	15 V	-	-	-	200	-	-	-	-	nA
I_{DD}	supply current	all valid input combinations	5 V	-	1.0	-	1.0	-	7.5	-	7.5	μA
			10 V	-	2.0	-	2.0	-	15.0	-	15.0	μA
			15 V	-	4.0	-	4.0	-	30.0	-	30.0	μA
C_I	input capacitance	nE input	-	-	-	7.5	-	-	-	-	pF	

10.1 Test circuit

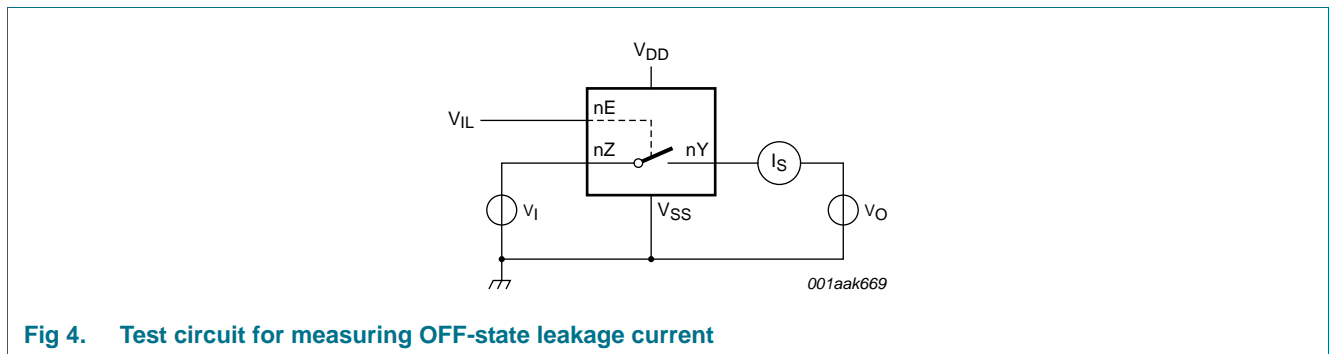


Fig 4. Test circuit for measuring OFF-state leakage current

10.2 ON resistance

Table 7. ON resistance

$T_{amb} = 25\text{ }^{\circ}\text{C}$; $I_{SW} = 200\text{ }\mu\text{A}$; $V_{SS} = 0\text{ V}$.

Symbol	Parameter	Conditions	V_{DD}	Typ	Max	Unit
$R_{ON(peak)}$	ON resistance (peak)	$V_I = 0\text{ V to }V_{DD}$; see Figure 5 and Figure 6	5 V	350	2500	Ω
			10 V	80	245	Ω
			15 V	60	175	Ω
$R_{ON(rail)}$	ON resistance (rail)	$V_I = 0\text{ V}$; see Figure 5 and Figure 6	5 V	115	340	Ω
			10 V	50	160	Ω
			15 V	40	115	Ω
		$V_I = V_{DD}$; see Figure 5 and Figure 6	5 V	120	365	Ω
			10 V	65	200	Ω
			15 V	50	155	Ω
ΔR_{ON}	ON resistance mismatch between channels	$V_I = 0\text{ V to }V_{DD}$; see Figure 5	5 V	25	-	Ω
			10 V	10	-	Ω
			15 V	5	-	Ω

10.2.1 ON resistance waveform and test circuit

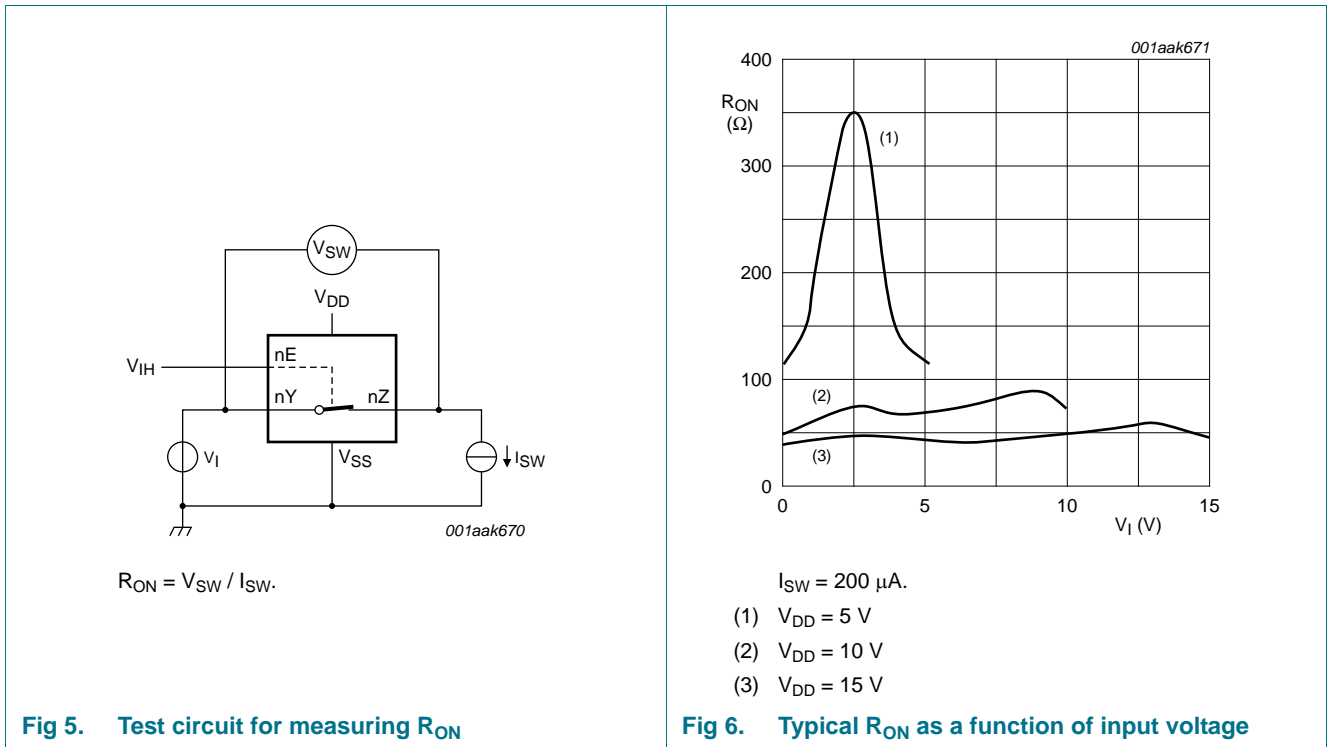


Fig 5. Test circuit for measuring R_{ON}

Fig 6. Typical R_{ON} as a function of input voltage

11. Dynamic characteristics

Table 8. Dynamic characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$; $V_{SS} = 0\text{ V}$; for test circuit see [Figure 9](#).

Symbol	Parameter	Conditions	V_{DD}	Typ	Max	Unit
t _{PHL}	HIGH to LOW propagation delay	nY, nZ to nZ, nY; see Figure 7	5 V	10	20	ns
			10 V	5	10	ns
			15 V	5	10	ns
		nY, nZ to nZ, nY; see Figure 7	5 V	10	20	ns
			10 V	5	10	ns
			15 V	5	10	ns
t _{PHZ}	HIGH to OFF-state propagation delay	nE to nY, nZ; see Figure 8	5 V	80	160	ns
			10 V	65	130	ns
			15 V	60	120	ns
t _{PZH}	OFF-state to HIGH propagation delay	nE to nY, nZ; see Figure 8	5 V	40	80	ns
			10 V	20	40	ns
			15 V	15	30	ns
t _{PLZ}	LOW to OFF-state propagation delay	nE to nY, nZ; see Figure 8	5 V	80	160	ns
			10 V	70	140	ns
			15 V	70	140	ns
t _{PZL}	OFF-state to LOW propagation delay	nE to nY, nZ; see Figure 8	5 V	45	90	ns
			10 V	20	40	ns
			15 V	15	30	ns

Table 9. Dynamic power dissipation P_D

P_D can be calculated from the formulas shown; $V_{SS} = 0\text{ V}$; $t_r = t_f \leq 20\text{ ns}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

Symbol	Parameter	V_{DD}	Typical formula for P _D (μW)	where:
P _D	dynamic power dissipation	5 V	$P_D = 2500 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f_i = input frequency in MHz; f_o = output frequency in MHz; C_L = output load capacitance in pF; V_{DD} = supply voltage in V; $\Sigma(C_L \times f_o)$ = sum of the outputs.
		10 V	$P_D = 11500 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	
		15 V	$P_D = 29000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	

11.1 Waveforms and test circuit

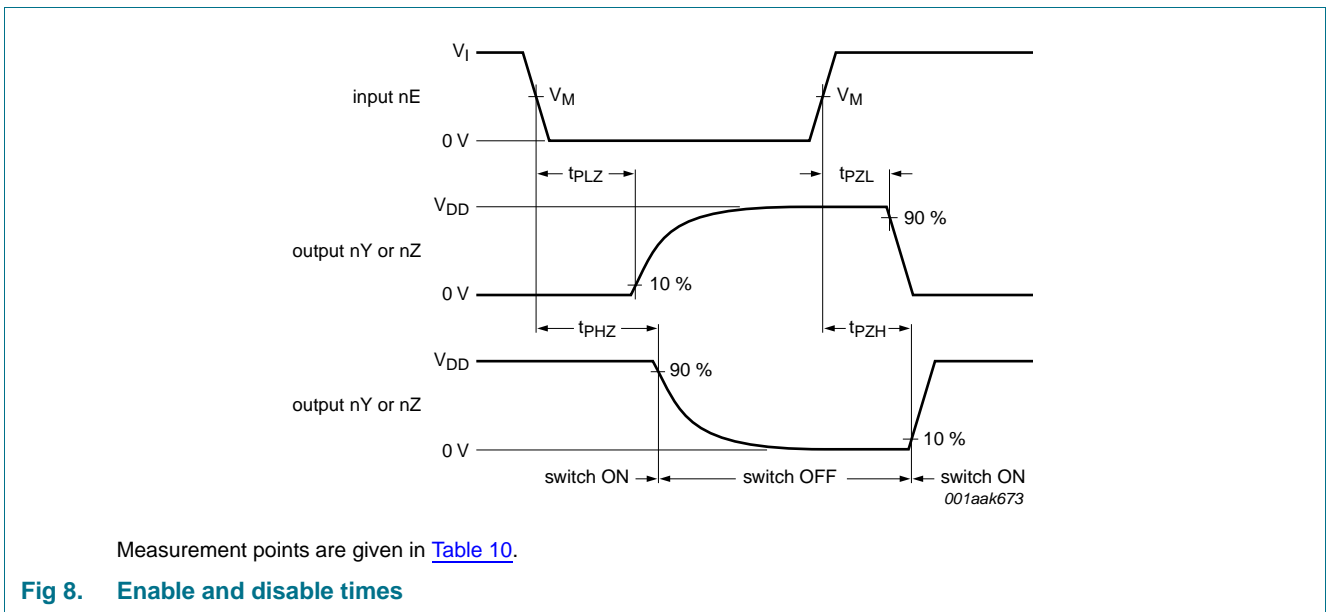
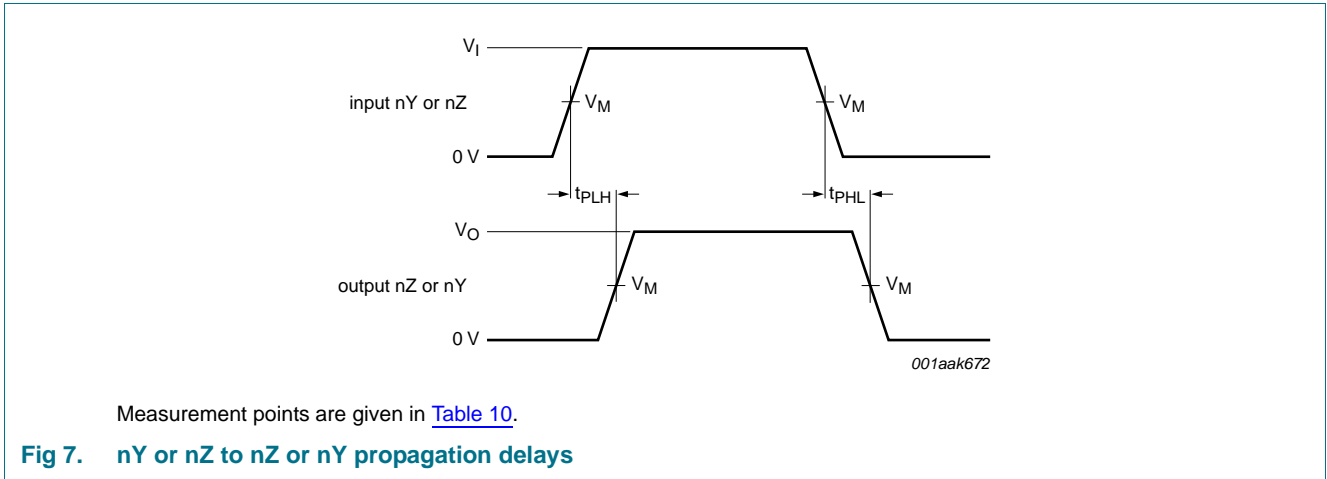


Table 10. Measurement points

Supply voltage	Input	Output
V_{DD}	V_M	V_M
5 V to 15 V	$0.5V_{DD}$	$0.5V_{DD}$

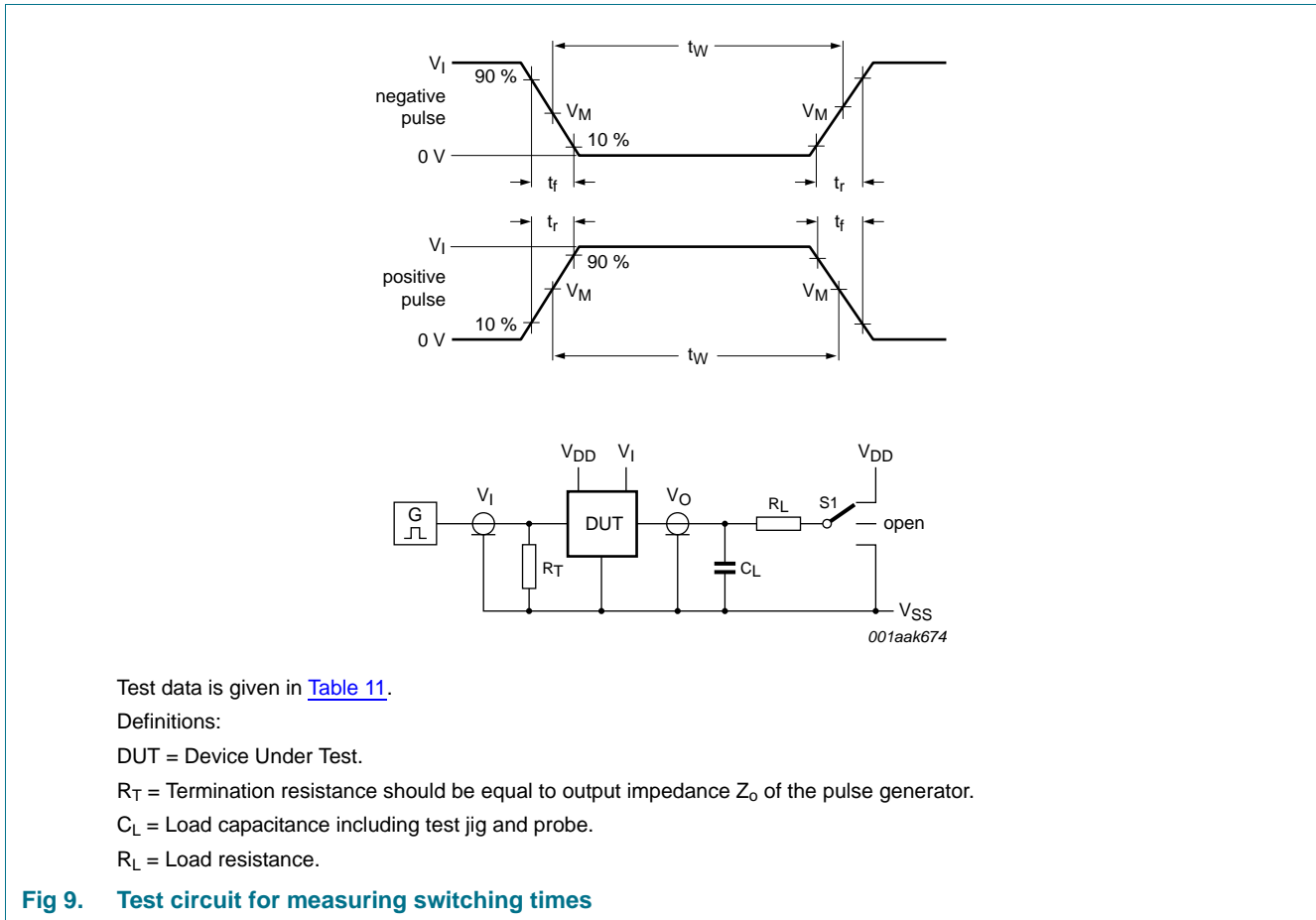


Table 11. Test data

Supply voltage	Input		Load		S1 position		
V_{DD}	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
5 V to 15 V	0 V or V_{DD}	≤ 20 ns	50 pF	10 k Ω	V_{SS}	V_{SS}	V_{DD}

11.2 Additional dynamic parameters

Table 12. Additional dynamic characteristics

$V_{SS} = 0$ V; $T_{amb} = 25$ °C.

Symbol	Parameter	Conditions	V_{DD}	Typ	Max	Unit	
THD	total harmonic distortion	see Figure 10 ; $R_L = 10$ k Ω ; $C_L = 15$ pF; channel ON; $V_I = 0.5V_{DD}$ (p-p); $f_i = 1$ kHz	5 V	[1]	0.25	-	%
			10 V	[1]	0.04	-	%
			15 V	[1]	0.04	-	%
V_{ct}	crosstalk voltage	nE input to switch; see Figure 11 ; $R_L = 10$ k Ω ; $C_L = 15$ pF; nE = V_{DD} (square-wave)	10 V		50	-	mV

Table 12. Additional dynamic characteristics ...continued

$V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

Symbol	Parameter	Conditions	V_{DD}	Typ	Max	Unit
Xtalk	crosstalk	between switches; see Figure 12; $f_i = 1\text{ MHz}$; $R_L = 1\text{ k}\Omega$; $V_I = 0.5V_{DD}$ (p-p)	10 V	[1]	-50	dB
α_{iso}	isolation (OFF-state)	see Figure 13; $f_i = 1\text{ MHz}$; $R_L = 1\text{ k}\Omega$; $C_L = 5\text{ pF}$; $V_I = 0.5V_{DD}$ (p-p)	10 V	[1]	-50	dB
$f_{(-3dB)}$	-3 dB frequency response	see Figure 14; $R_L = 1\text{ k}\Omega$; $C_L = 5\text{ pF}$; $V_I = 0.5V_{DD}$ (p-p)	10 V	[1]	90	MHz

[1] f_i is biased at $0.5V_{DD}$.

11.2.1 Test circuits

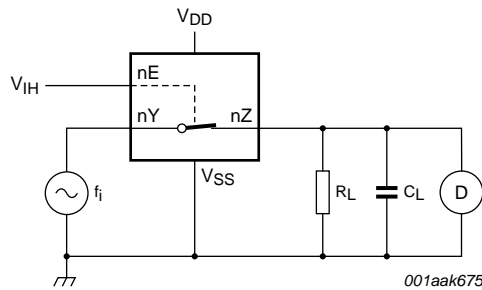
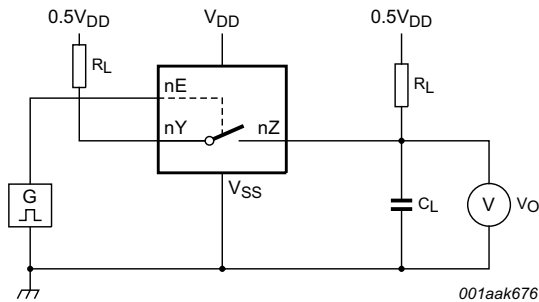
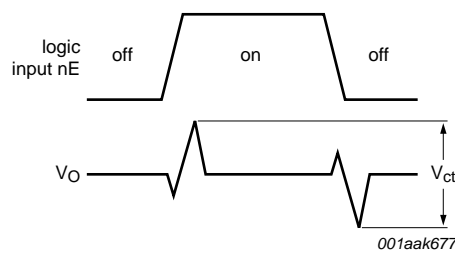


Fig 10. Test circuit for measuring total harmonic distortion

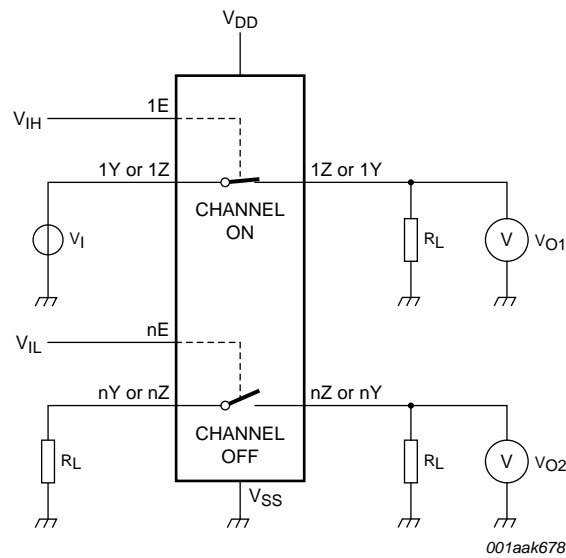


a. Test circuit



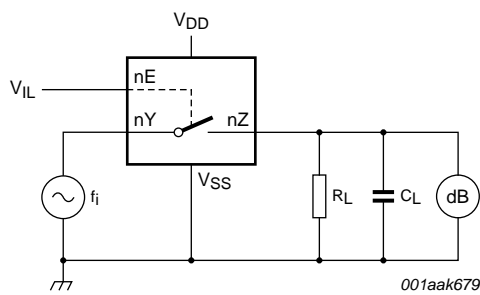
b. Input and output pulse definitions

Fig 11. Test circuit for measuring crosstalk voltage between digital input and switch



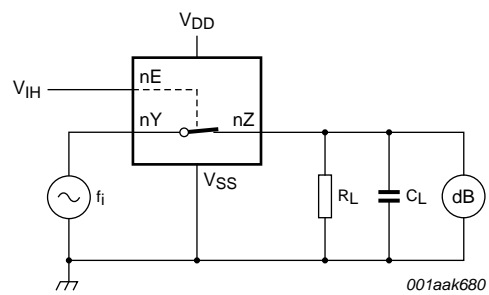
$20 \log_{10} (V_{O2} / V_{O1})$ or $20 \log_{10} (V_{O1} / V_{O2})$.

Fig 12. Test circuit for measuring crosstalk between switches



Adjust f_i voltage to obtain 0 dBm level at input.

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



Adjust f_i voltage to obtain 0 dBm level at output. Increase f_i frequency until dB meter reads -3 dB.

Fig 14. Test circuit for measuring frequency response

12. Package outline

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1

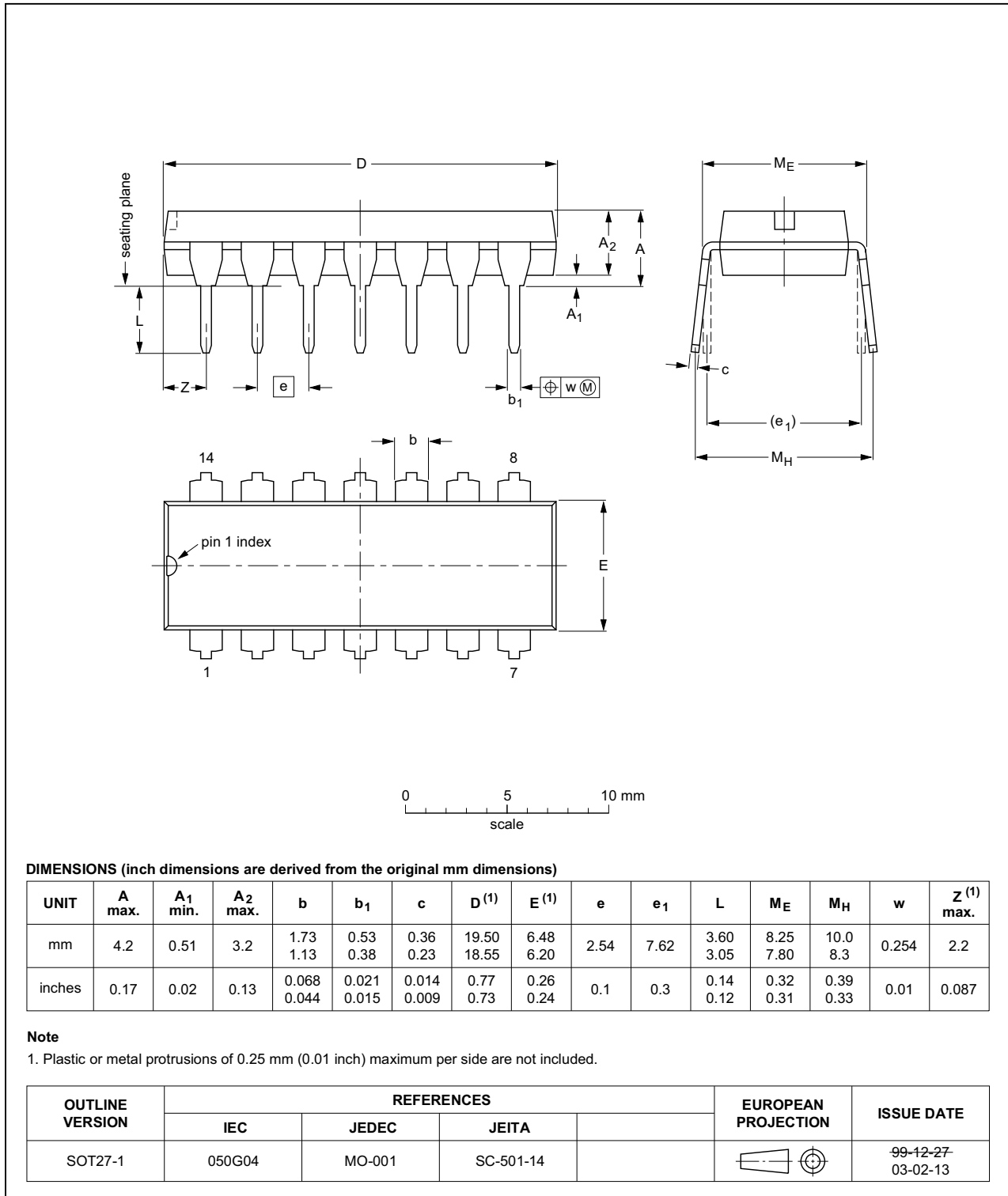


Fig 15. Package outline SOT27-1 (DIP14)

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

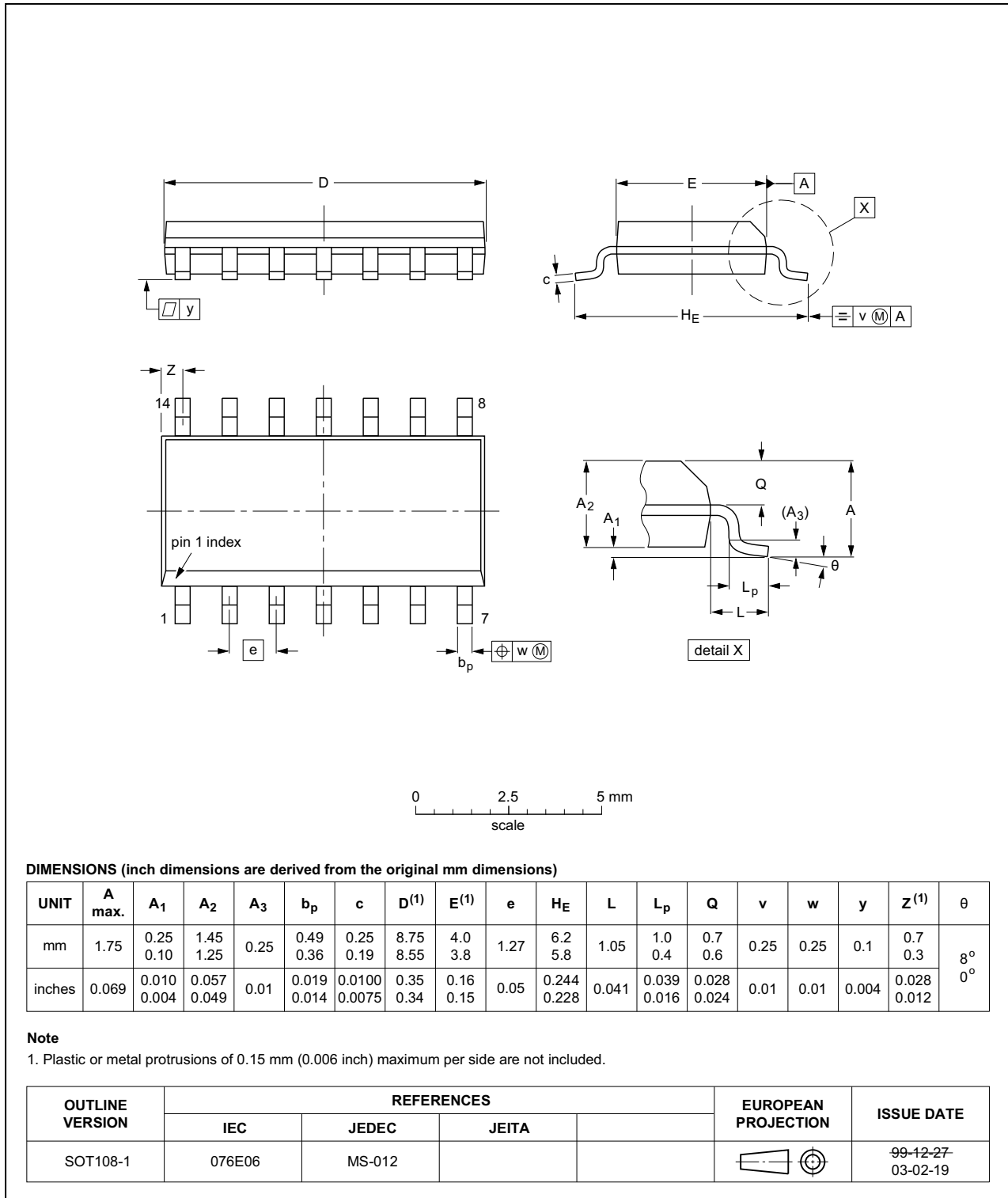


Fig 16. Package outline SOT108-1 (SO14)

13. Abbreviations

Table 13. Abbreviations

Acronym	Description
DUT	Device Under Test

14. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4066B v.8	20140911	Product data sheet	-	HEF4066B v.7
Modifications:	<ul style="list-style-type: none"> • Figure 11: Test circuit modified 			
HEF4066B v.7	20111116	Product data sheet	-	HEF4066B v.6
Modifications:	<ul style="list-style-type: none"> • Legal pages updated. • Changes in “General description”, “Features and benefits” and “Applications”. 			
HEF4066B v.6	20100325	Product data sheet	-	HEF4066B v.5
HEF4066B v.5	20100225	Product data sheet	-	HEF4066B v.4
HEF4066B v.4	20091013	Product data sheet	-	HEF4066B_CNV v.3
HEF4066B_CNV v.3	19950101	Product specification	-	HEF4066B_CNV v.2
HEF4066B_CNV v.2	19950101	Product specification	-	-

15. Legal information

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Document status ^{[1][2]}	Product status ^[3]	Definition
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[2] The term 'short data sheet' is explained in section "Definitions".

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