

# HEF4585B

## 4-bit magnitude comparator

Rev. 6 — 21 November 2011

Product data sheet

### 1. General description

The HEF4585B is a 4-bit magnitude comparator that compares two 4-bit words, A and B, and determines whether A is greater than B, A is equal to B, or A is less than B. Each word has four parallel inputs (A0 to A3 and B0 to B3) with A3 and B3 being the most significant inputs. Three outputs are provided: A greater than B (QA>B), A less than B (QA<B) and A equal to B (QA=B). Three expander inputs (IA>B, IA<B, and IA=B) allow cascading of the devices, to compare 8, 12, 16, ..., bits without external gates.

To operate a single device or a device in the least significant position in a cascaded chain, the expander inputs are connected as follows: IA=B = IA>B = HIGH and IA<B = LOW. All other cascaded devices have IA=B and IA<B connected to QA=B and QA<B respectively of the previous (less significant) device in the chain, while input IA>B is connected to a HIGH (see [Figure 6](#)). Operation is not restricted to pure binary code; the devices will work with any monotonic code. [Table 3](#) describes the operation of the device under all possible logic conditions.

It operates over a recommended  $V_{DD}$  power supply range of 3 V to 15 V referenced to  $V_{SS}$  (usually ground). Unused inputs must be connected to  $V_{DD}$ ,  $V_{SS}$ , or another input.

### 2. Features and benefits

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

### 3. Ordering information

**Table 1. Ordering information**

All types operate from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$

Type number	Package		Version
	Name	Description	
HEF4585BP	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
HEF4585BT	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1



4. Functional diagram

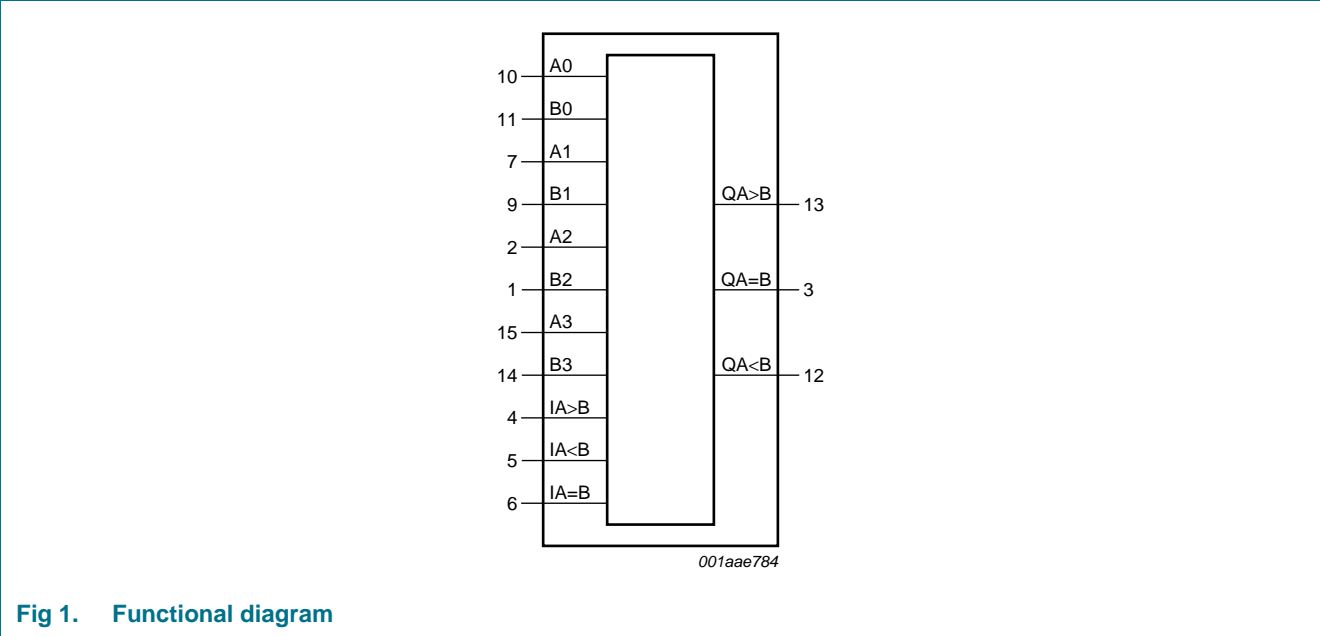


Fig 1. Functional diagram

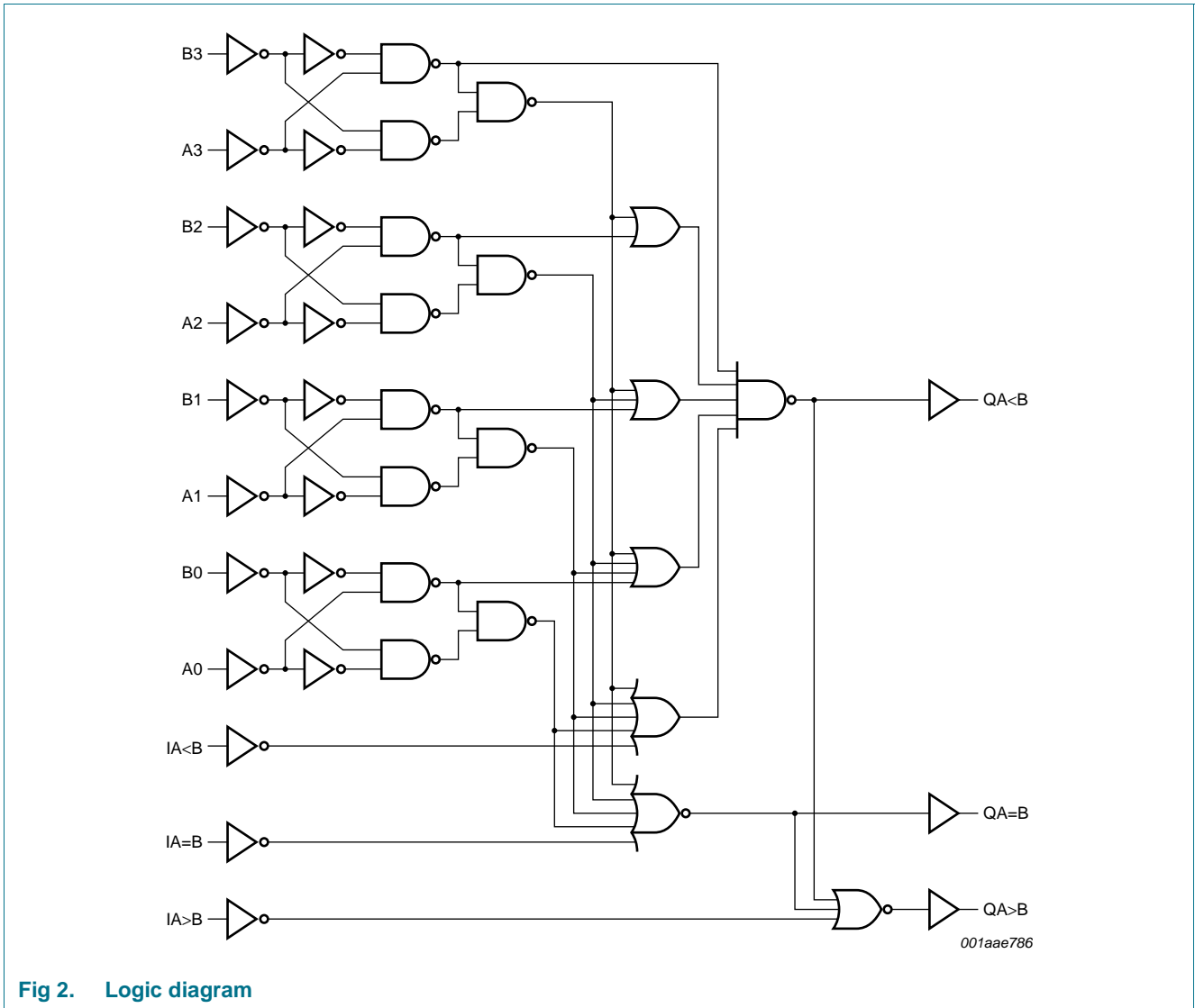
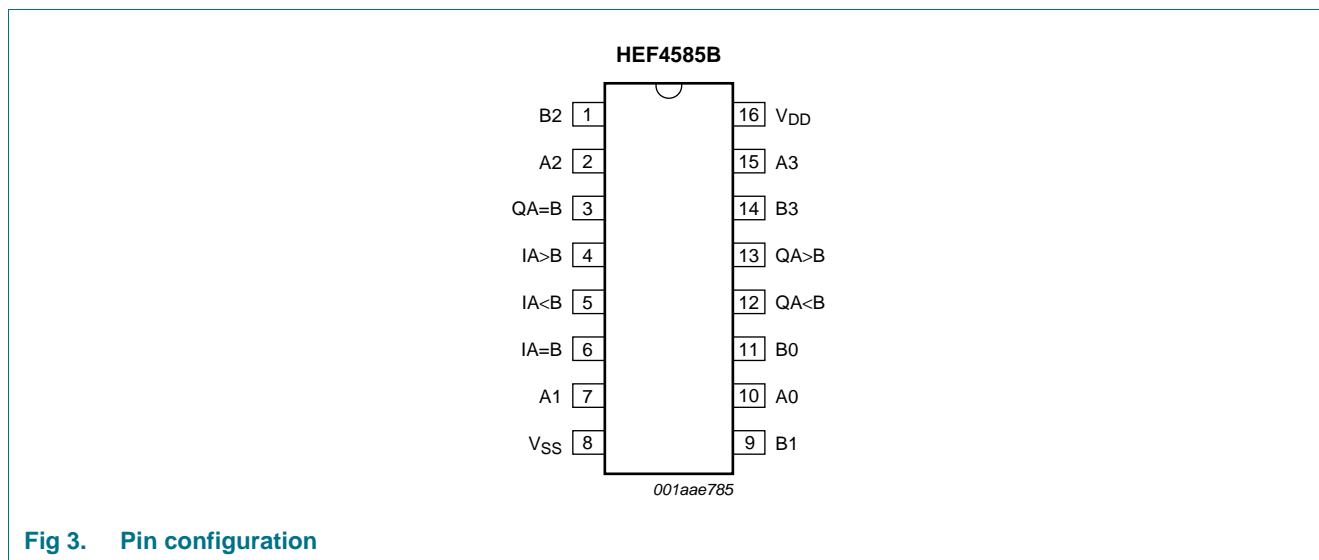


Fig 2. Logic diagram

## 5. Pinning information

### 5.1 Pinning



### 5.2 Pin description

**Table 2. Pin description**

Symbol	Pin	Description
A[0:3]	10, 7, 2, 15	word A parallel input
B[0:3]	11, 9, 1, 14	word B parallel input
IA>B	4	expander input
IA=B	6	expander input
IA<B	5	expander input
QA>B	13	A greater than B output
QA=B	3	A equal to B output
QA<B	12	A less than B output
V <sub>DD</sub>	16	supply voltage
V <sub>SS</sub>	8	ground supply voltage

## 6. Functional description

Table 3. Function selection [1]

Comparing inputs				Cascading inputs			Outputs		
A3, B3	A2, B2	A1, B1	A0, B0	IA>B	IA<B	IA=B	QA>B	QA<B	QA=B
A3 > B3	X	X	X	H	X	X	H	L	L
A3 < B3	X	X	X	X	X	X	L	H	L
A3 = B3	A2 > B2	X	X	H	X	X	H	L	L
		A2 < B2	X	X	X	X	X	L	H
	A2 = B2	A1 > B1	X	H	X	X	H	L	L
		A1 < B1	X	X	X	X	L	H	L
		A1 = B1	A0 > B0	H	X	X	H	L	L
	A0 < B0		X	X	X	L	H	L	L
	A0 = B0		X	L	H	L	L	L	H
			H	L	L	H	L	L	
			X	H	L	L	H	L	
			[2]						
			X	H	H	L	H	H	
			L	L	L	L	L	L	

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

[2] The first 11 lines describe the normal operation under all conditions that will occur in a single device or in a serial expansion scheme. The last 2 lines describe the operation under abnormal conditions on the cascading inputs. These conditions occur when the parallel expansion technique is used.

## 7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>DD</sub>	supply voltage		-0.5	+18	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>DD</sub> + 0.5 V	-	±10	mA
V <sub>I</sub>	input voltage		-0.5	V <sub>DD</sub> + 0.5	V
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>DD</sub> + 0.5 V	-	±10	mA
I <sub>I/O</sub>	input/output current		-	±10	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
T <sub>amb</sub>	ambient temperature		-40	+85	°C
P <sub>tot</sub>	total power dissipation	DIP16 package	[1]	750	mW
		SO16 package	[2]	500	mW
P	power dissipation	per output	-	100	mW

[1] For DIP16 package: P<sub>tot</sub> derates linearly with 12 mW/K above 70 °C.

[2] For SO16 package: P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.

## 8. 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	-	+85	°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	$\mu\text{s/V}$

## 9. Static characteristics

**Table 6. Static characteristics**

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

Symbol	Parameter	Conditions	$V_{DD}$	$T_{amb} = -40\text{ °C}$		$T_{amb} = 25\text{ °C}$		$T_{amb} = 85\text{ °C}$		Unit
				Min	Max	Min	Max	Min	Max	
$V_{IH}$	HIGH-level input voltage	$ I_O  < 1\ \mu\text{A}$	5 V	3.5	-	3.5	-	3.5	-	V
			10 V	7.0	-	7.0	-	7.0	-	V
			15 V	11.0	-	11.0	-	11.0	-	V
$V_{IL}$	LOW-level input voltage	$ I_O  < 1\ \mu\text{A}$	5 V	-	1.5	-	1.5	-	1.5	V
			10 V	-	3.0	-	3.0	-	3.0	V
			15 V	-	4.0	-	4.0	-	4.0	V
$V_{OH}$	HIGH-level output voltage	$ I_O  < 1\ \mu\text{A}$	5 V	4.95	-	4.95	-	4.95	-	V
			10 V	9.95	-	9.95	-	9.95	-	V
			15 V	14.95	-	14.95	-	14.95	-	V
$V_{OL}$	LOW-level output voltage	$ I_O  < 1\ \mu\text{A}$	5 V	-	0.05	-	0.05	-	0.05	V
			10 V	-	0.05	-	0.05	-	0.05	V
			15 V	-	0.05	-	0.05	-	0.05	V
$I_{OH}$	HIGH-level output current	$V_O = 2.5\text{ V}$	5 V	-	-1.7	-	-1.4	-	-1.1	mA
		$V_O = 4.6\text{ V}$	5 V	-	-0.52	-	-0.44	-	-0.36	mA
		$V_O = 9.5\text{ V}$	10 V	-	-1.3	-	-1.1	-	-0.9	mA
		$V_O = 13.5\text{ V}$	15 V	-	-3.6	-	-3.0	-	-2.4	mA
$I_{OL}$	LOW-level output current	$V_O = 0.4\text{ V}$	5 V	0.52	-	0.44	-	0.36	-	mA
		$V_O = 0.5\text{ V}$	10 V	1.3	-	1.1	-	0.9	-	mA
		$V_O = 1.5\text{ V}$	15 V	3.6	-	3.0	-	2.4	-	mA
$I_I$	input leakage current		15 V	-	$\pm 0.3$	-	$\pm 0.3$	-	$\pm 1.0$	$\mu\text{A}$
$I_{DD}$	supply current	$I_O = 0\text{ A}$	5 V	-	20	-	20	-	150	$\mu\text{A}$
			10 V	-	40	-	40	-	300	$\mu\text{A}$
			15 V	-	80	-	80	-	600	$\mu\text{A}$
$C_I$	input capacitance		-	-	-	-	7.5	-	-	pF

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

$V_{SS} = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ; for test circuit see [Figure 5](#) unless otherwise specified.

Symbol	Parameter	Conditions <sup>[1][2]</sup>	V <sub>DD</sub>	Extrapolation formula <sup>[3]</sup>	Min	Typ	Max	Unit
t <sub>PHL</sub>	HIGH to LOW propagation delay	An, Bn to Qn; see <a href="#">Figure 4</a>	5 V	133 ns + (0.55 ns/pF)C <sub>L</sub>	-	160	320	ns
			10 V	54 ns + (0.23 ns/pF)C <sub>L</sub>	-	65	130	ns
			15 V	37 ns + (0.16 ns/pF)C <sub>L</sub>	-	45	90	ns
		In to Qn; see <a href="#">Figure 4</a>	5 V	83 ns + (0.55 ns/pF)C <sub>L</sub>	-	110	220	ns
			10 V	34 ns + (0.23 ns/pF)C <sub>L</sub>	-	45	90	ns
			15 V	22 ns + (0.16 ns/pF)C <sub>L</sub>	-	30	60	ns
t <sub>PLH</sub>	LOW to HIGH propagation delay	An, Bn to Qn; see <a href="#">Figure 4</a>	5 V	123 ns + (0.55 ns/pF)C <sub>L</sub>	-	150	300	ns
			10 V	49 ns + (0.23 ns/pF)C <sub>L</sub>	-	60	120	ns
			15 V	37 ns + (0.16 ns/pF)C <sub>L</sub>	-	45	90	ns
		In to Qn; see <a href="#">Figure 4</a>	5 V	93 ns + (0.55 ns/pF)C <sub>L</sub>	-	120	240	ns
			10 V	39 ns + (0.23 ns/pF)C <sub>L</sub>	-	50	100	ns
			15 V	27 ns + (0.16 ns/pF)C <sub>L</sub>	-	35	70	ns
t <sub>t</sub>	transition time	see <a href="#">Figure 4</a>	5 V	10 ns + (1.00 ns/pF)C <sub>L</sub>	-	60	120	ns
			10 V	9 ns + (0.42 ns/pF)C <sub>L</sub>	-	30	60	ns
			15 V	6 ns + (0.28 ns/pF)C <sub>L</sub>	-	20	40	ns

[1] Qn is QA>B, QA<B or QA=B

[2] In is IA>B, IA<B or IA=B

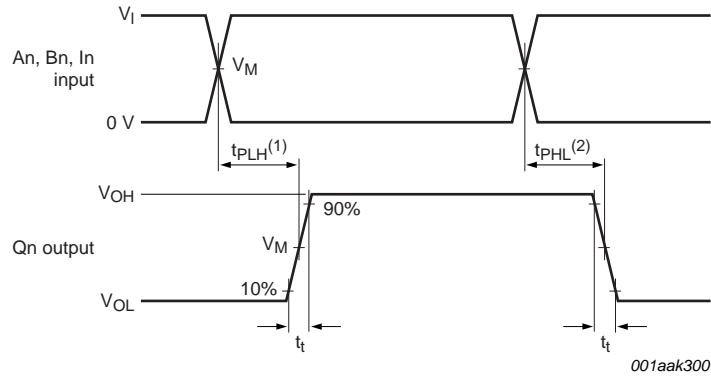
[3] The typical values of the propagation delay and transition times are calculated from the extrapolation formulas shown (C<sub>L</sub> in pF).

**Table 8. Dynamic power dissipation P<sub>D</sub>**

P<sub>D</sub> can be calculated from the formulas shown.  $V_{SS} = 0\text{ V}$ ;  $C_L = 50\text{ pF}$ ;  $t_r = t_f \leq 20\text{ ns}$ ;  $T_{amb} = 25\text{ °C}$ .

Symbol	Parameter	V <sub>DD</sub>	Typical formula for P <sub>D</sub> (μW)	where:
P <sub>D</sub>	dynamic power dissipation	5 V	$P_D = 1250 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f <sub>i</sub> = input frequency in MHz,
		10 V	$P_D = 5500 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f <sub>o</sub> = output frequency in MHz,
		15 V	$P_D = 15000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	C <sub>L</sub> = output load capacitance in pF, V <sub>DD</sub> = supply voltage in V, Σ(f <sub>o</sub> × C <sub>L</sub> ) = sum of the outputs.

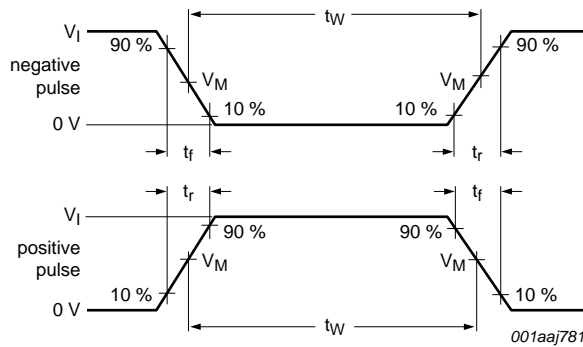
11. Waveforms



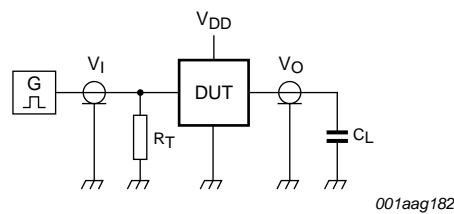
Measurement points shown in [Table 9](#)

- (1) Qn (QA>B, QA<B and QA=B) LOW to HIGH (t<sub>PLH</sub>(1)) transitions triggered by An, Bn or IA<B, IA>B and IA=B as shown by [Table 3](#).
- (2) Qn (QA>B, QA<B and QA=B) HIGH to LOW (t<sub>PHL</sub>(2)) transitions triggered by An, Bn or IA<B, IA>B and IA=B as shown by [Table 3](#).

Fig 4. Waveforms showing switching times



a. Input waveforms



b. Test circuit

Test data is given in [Table 9](#).

Definitions for test circuit:

DUT = Device Under Test

C<sub>L</sub> = Load capacitance including jig and probe capacitance;

R<sub>T</sub> = Termination resistance should be equal to output impedance Z<sub>o</sub> of the pulse generator.

Fig 5. Test circuit for measuring switching times

Table 9. Measurement points and test data

Supply voltage	Input			Load
	$V_I$	$V_M$	$t_r, t_f$	$C_L$
5 V to 15 V	$V_{DD}$	$0.5V_I$	$\leq 20$ ns	50 pF

## 12. Application information

Some examples of applications for the HEF4585B are:

- Process controllers
- Servo-motor control

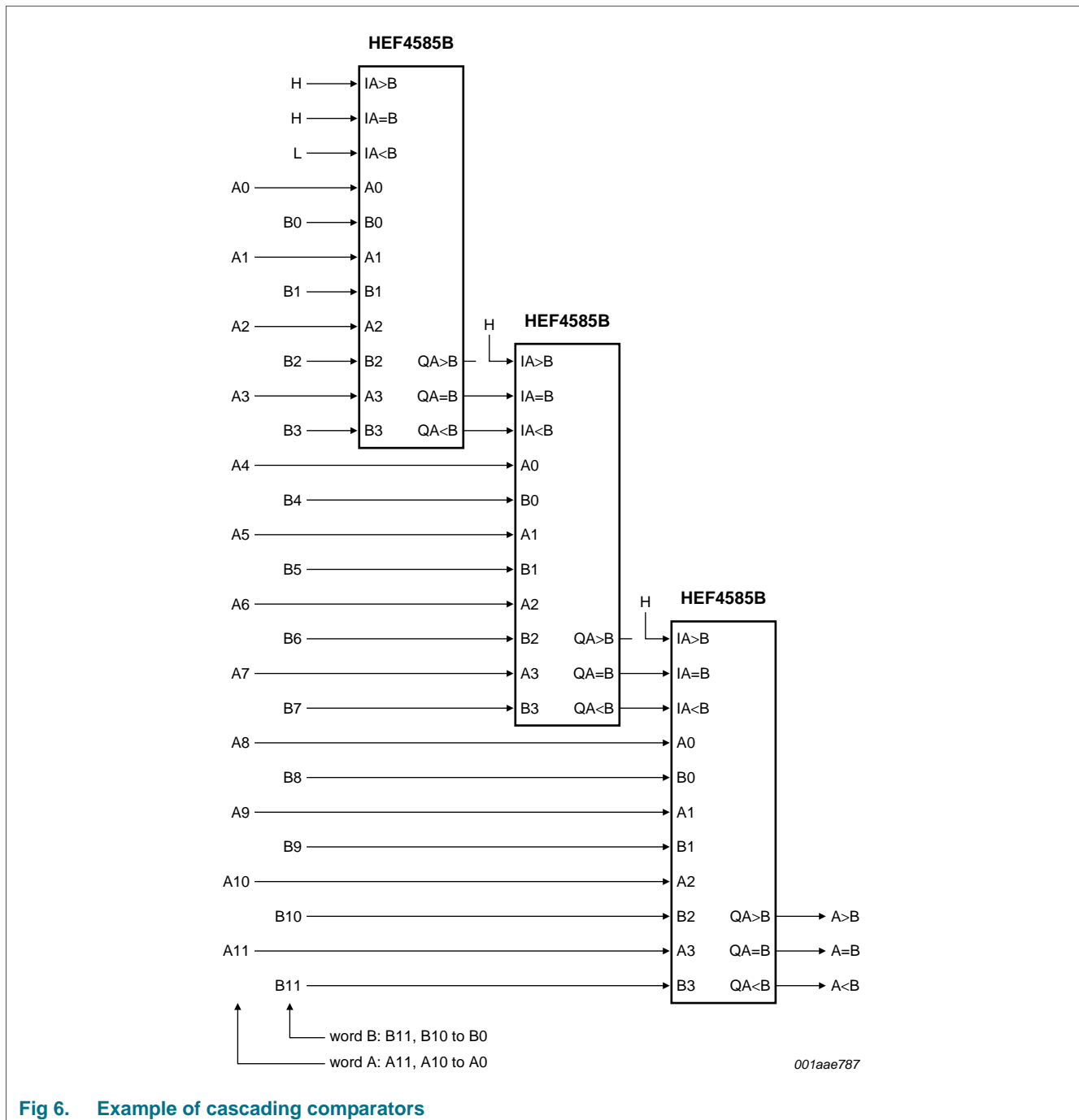


Fig 6. Example of cascading comparators

13. Package outline

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

SOT38-4

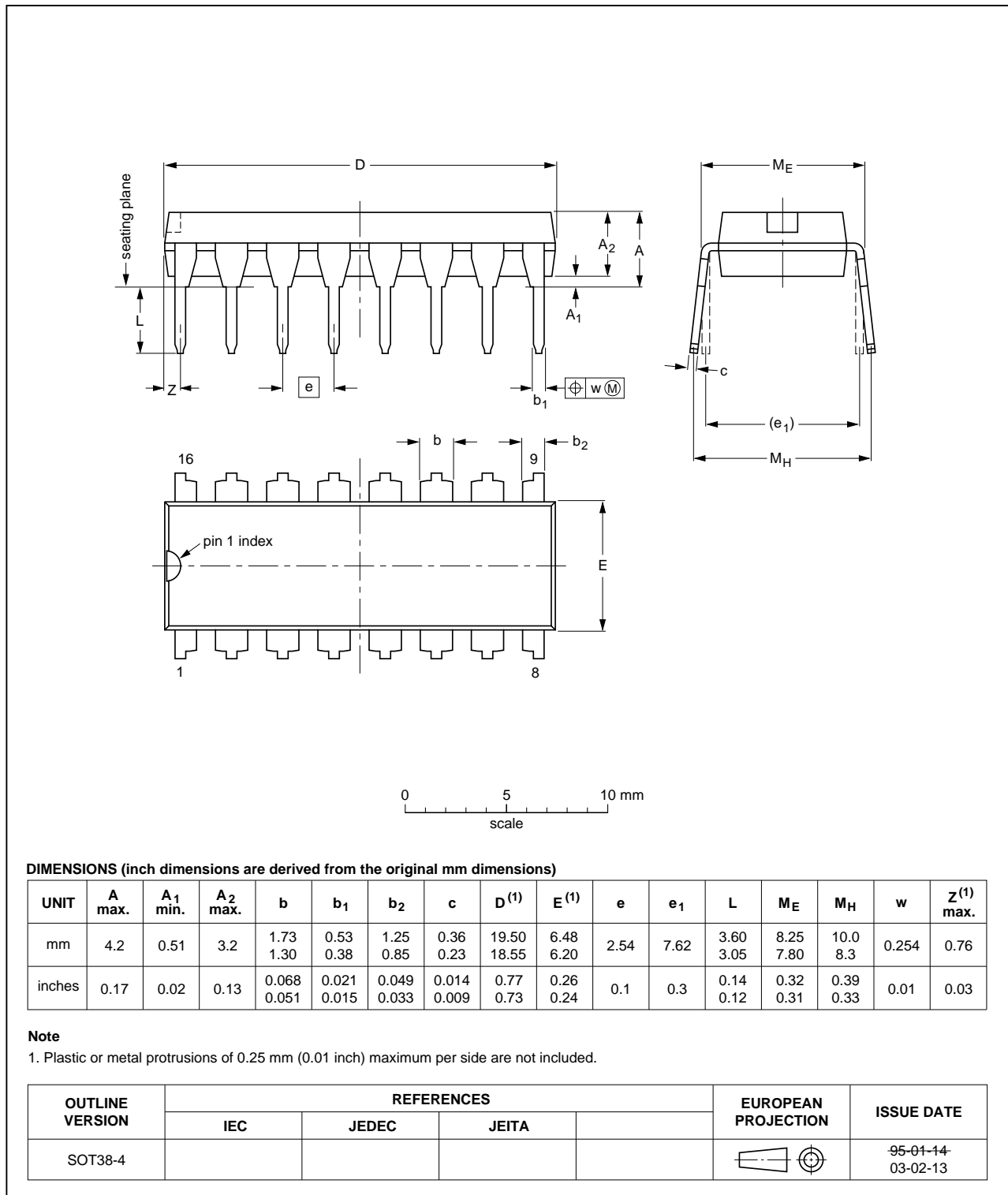


Fig 7. Package outline 38-4 (DIP16)

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

SOT109-1

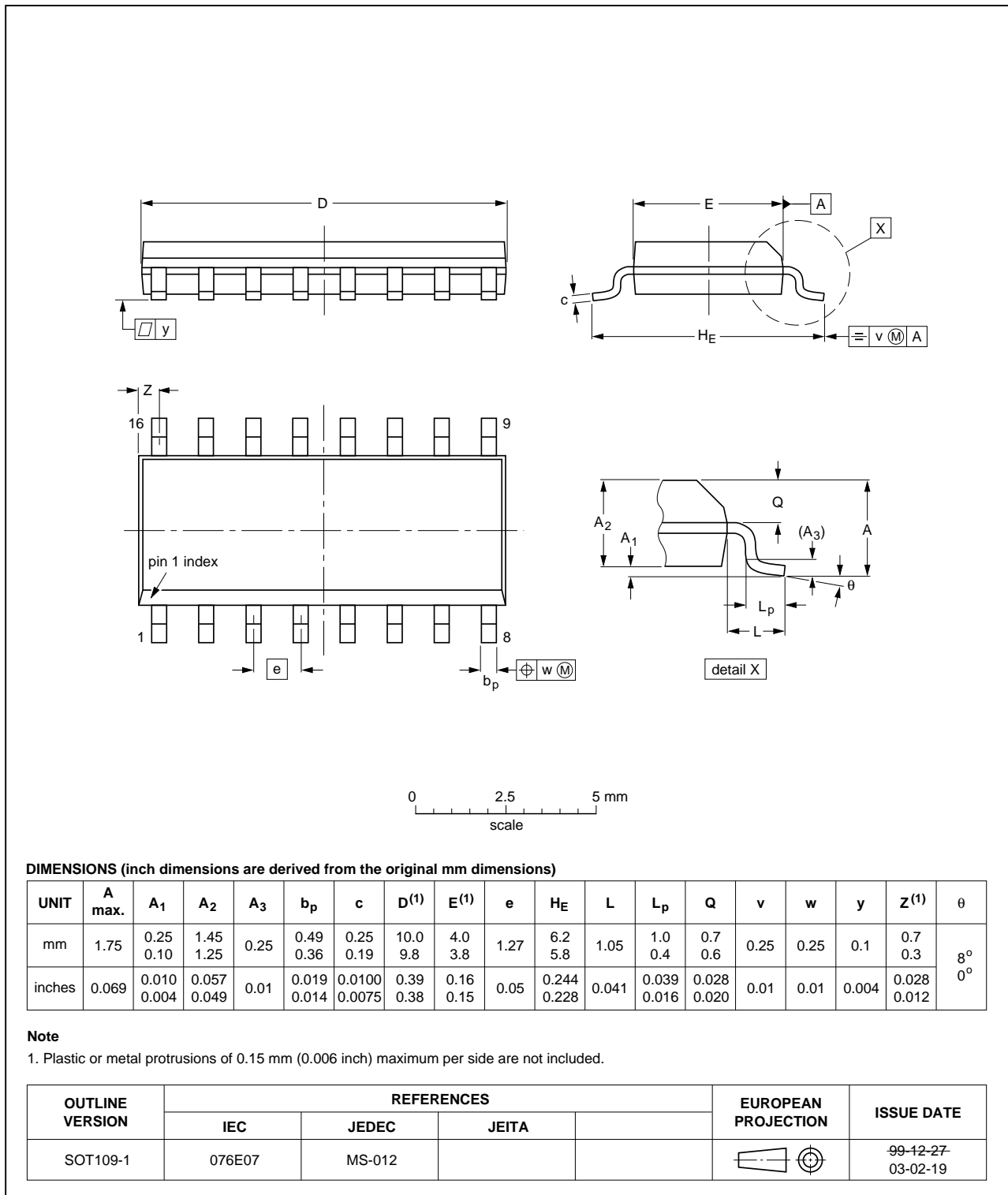


Fig 8. Package outline 109-1 (SO16)

## 14. Revision history

**Table 10. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4585B v.6	20111121	Product data sheet	-	HEF4585B v.5
Modifications:	<ul style="list-style-type: none"><li>• Section Applications removed</li><li>• <a href="#">Table 6</a>: I<sub>OH</sub> minimum values changed to maximum</li></ul>			
HEF4585B v.5	20091222	Product data sheet	-	HEF4585B v.4
HEF4585B v.4	20090810	Product data sheet	-	HEF4585B_CNV v.3
HEF4585B_CNV v.3	19950101	Product specification	-	HEF4585B_CNV v.2
HEF4585B_CNV v.2	19950101	Product specification	-	-

## 15. Legal information

### 15.1 Data sheet status

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

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

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

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-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management