# **HEF4067B**

# 16-channel analog multiplexer/demultiplexer Rev. 6 — 16 November 2011

**Product data sheet** 

#### 1. **General description**

The HEF4067B is a 16-channel analog multiplexer/demultiplexer with four address inputs (A0 to A3), an active LOW enable input (E), sixteen independent inputs/outputs (Y0 to Y15) and a common input/output (Z). The device contains sixteen bidirectional analog switches, each with one side connected to an independent input/output (Y0 to Y15) and the other side connected to the common input/output (Z). With E LOW, one of the sixteen switches is selected (low-impedance ON-state) by A0 to A3. All unselected switches are in the high-impedance OFF-state. With E HIGH all switches are in the high-impedance OFF-state, independent of A0 to A3. The analog inputs/outputs (Y0 to Y15 and Z) can swing between  $V_{DD}$  as a positive limit and  $V_{SS}$  as a negative limit.  $V_{DD}$  to  $V_{SS}$  may not exceed 15 V.

#### Features and benefits 2.

- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Specified from -40 °C to +85 °C
- Complies with JEDEC standard JESD 13-B

#### 3. **Applications**

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

## Ordering information

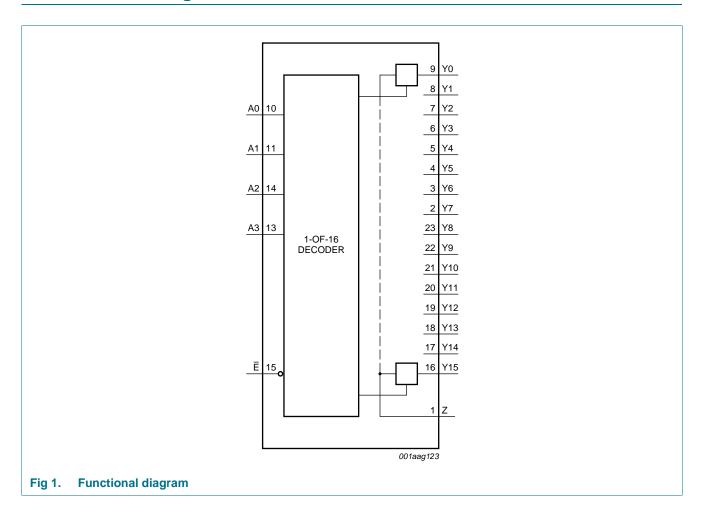
Table 1. **Ordering information** 

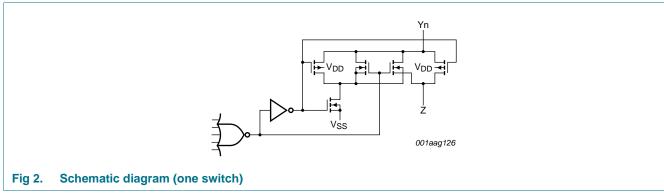
Type number	Package	ackage									
	Temperature range	Name	Description	Version							
HEF4067BP	–40 °C to +85 °C	DIP24	plastic dual in-line package; 24 leads (600 mil)	SOT101-1							
HEF4067BT	–40 °C to +85 °C	SO24	plastic small outline package; 24 leads; body width 7.5 mm	SOT137-1							



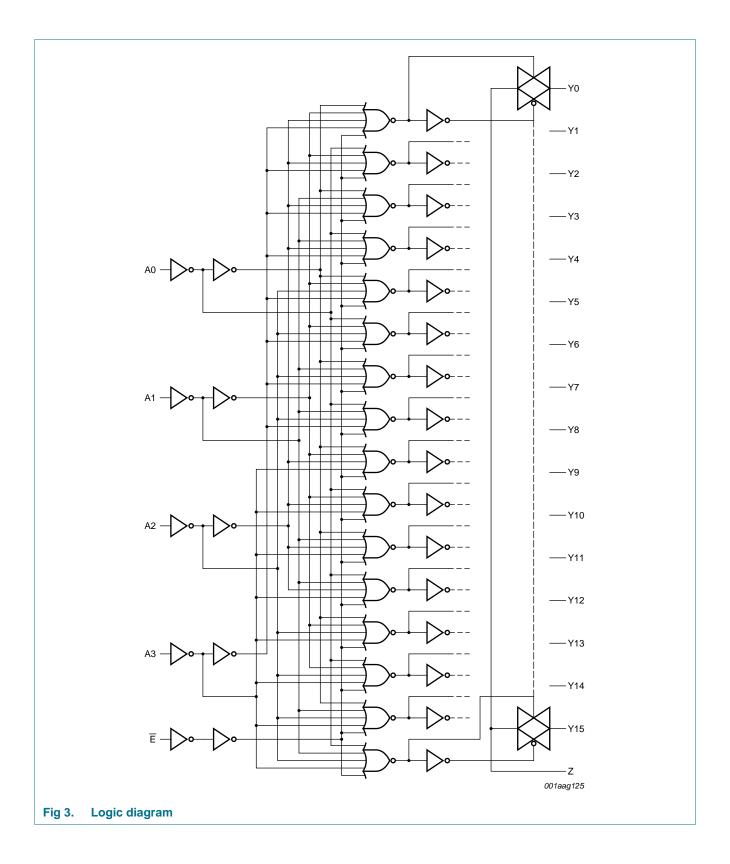
16-channel analog multiplexer/demultiplexer

## 5. Functional diagram





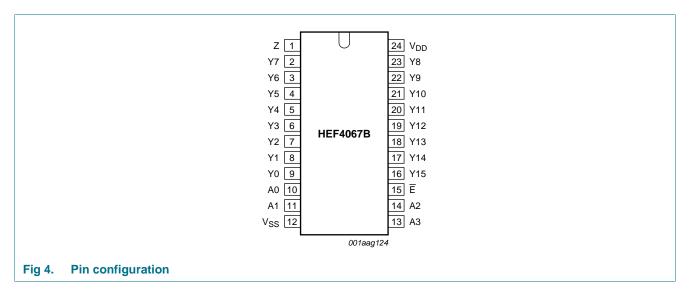
## 16-channel analog multiplexer/demultiplexer



## 16-channel analog multiplexer/demultiplexer

## 6. Pinning information

#### 6.1 Pinning



## 6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
Z	1	common input/output
Y0 to Y15	9, 8, 7, 6, 5, 4, 3, 2, 23, 22, 21, 20, 19, 18, 17, 16	independent input/output
A0 to A3	10, 11, 14, 13	address input
V <sub>SS</sub>	12	ground (0 V)
Ē	15	enable input (active LOW)
$V_{DD}$	24	supply voltage

#### 16-channel analog multiplexer/demultiplexer

# 7. Functional description

Table 3. Function table[1]

Control	Address		Channel ON		
E	A3	A2	A1	A0	
L	L	L	L	L	Y0 = Z
L	L	L	L	Н	Y1 = Z
L	L	L	Н	L	Y2 = Z
L	L	L	Н	Н	Y3 = Z
L	L	Н	L	L	Y4 = Z
L	L	Н	L	Н	Y5 = Z
L	L	Н	Н	L	Y6 = Z
L	L	Н	Н	Н	Y7 = Z
L	Н	L	L	L	Y8 = Z
L	Н	L	L	Н	Y9 = Z
L	Н	L	Н	L	Y10 = Z
L	Н	L	Н	Н	Y11 = Z
L	Н	Н	L	L	Y12 = Z
L	Н	Н	L	Н	Y13 = Z
L	Н	Н	Н	L	Y14 = Z
L	Н	Н	Н	Н	Y15 = Z
Н	Χ	Χ	Χ	X	none

<sup>[1]</sup> 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  $V_{\rm SS} = 0~{\rm V}$  (ground).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DD}$	supply voltage		-0.5	+18	V
I <sub>IK</sub>	input clamping current	pins An and $\overline{E}$ ; V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>DD</sub> + 0.5 V	-	±10	mA
VI	input voltage		-0.5	$V_{DD} + 0.5$	V
I <sub>I/O</sub>	input/output current		<u>[1]</u> -	±10	mA
$I_{DD}$	supply current		-	50	mA
$T_{stg}$	storage temperature		-65	+150	°C
T <sub>amb</sub>	ambient temperature		-40	+85	°C

#### 16-channel analog multiplexer/demultiplexer

Table 4. Limiting values ...continued

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
P <sub>tot</sub>	total power dissipation	$T_{amb} = -40  ^{\circ}\text{C} \text{ to } +125  ^{\circ}\text{C}$			
		DIP24	<u>[2]</u> _	750	mW
		SO24	<u>[3]</u> _	500	mW
Р	power dissipation	per output	-	100	mW

<sup>[1]</sup> To avoid drawing V<sub>DD</sub> current out of terminal Z, when switch current flows into terminals Yn, the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal Z, no V<sub>DD</sub> current will flow out of terminals Yn, in this case there is no limit for the voltage drop across the switch, but the voltages at Y and Z may not exceed V<sub>DD</sub> or V<sub>SS</sub>.

## 9. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
$V_{DD}$	supply voltage		3	-	15	V
VI	input voltage		0	-	$V_{DD}$	V
T <sub>amb</sub>	ambient temperature	in free air	-40	-	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{DD} = 5 V$	-	-	3.75	μs/V
		V <sub>DD</sub> = 10 V	-	-	0.5	μs/V
		V <sub>DD</sub> = 15 V	-	-	0.08	μs/V

#### 10. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions	$V_{DD}$	T <sub>amb</sub> =	-40 °C	T <sub>amb</sub> = +25 °C		T <sub>amb</sub> = +85 °C		Unit
				Min	Max	Min	Max	Min	Max	
$V_{IL}$	LOW-level input	$ I_{O}  < 1 \mu A$								
	voltage	$V_0 = 0.5 \text{ V or } 4.5 \text{ V}$	5 V	-	1	-	1	-	1	V
		$V_0 = 1.0 \text{ V or } 9.0 \text{ V}$	10 V	-	2	-	2	-	2	V
		$V_0 = 1.5 \text{ V or } 13.5 \text{ V}$	15 V	-	2.5	-	2.5	-	2.5	V
V <sub>IH</sub>	HIGH-level input voltage	$ I_{O}  < 1 \mu A$								
		$V_0 = 0.5 \text{ V or } 4.5 \text{ V}$	5 V	4	-	4	-	4	-	V
		$V_0 = 1.0 \text{ V or } 9.0 \text{ V}$	10 V	8	-	8	-	8	-	V
		$V_0 = 1.5 \text{ V or } 13.5 \text{ V}$	15 V	12.5	-	12.5	-	12.5	-	V
I <sub>I</sub>	input leakage current	$V_I = 0 \text{ V or } 15 \text{ V}$	15 V	-	±0.3	-	±0.3	-	±1.0	μΑ
l <sub>OZ</sub>	OFF-state output	output at V <sub>DD</sub>	15 V	-	1.6	-	1.6	-	12.0	μΑ
	current	output at V <sub>SS</sub>	15 V	-	-1.6	-	-1.6	-	-12.0	μΑ

<sup>[2]</sup> For DIP24 packages: above T<sub>amb</sub> = 70 °C, P<sub>tot</sub> derates linearly at 12 mW/K.

<sup>[3]</sup> For SO24 packages: above  $T_{amb}$  = 70 °C,  $P_{tot}$  derates linearly at 8 mW/K.

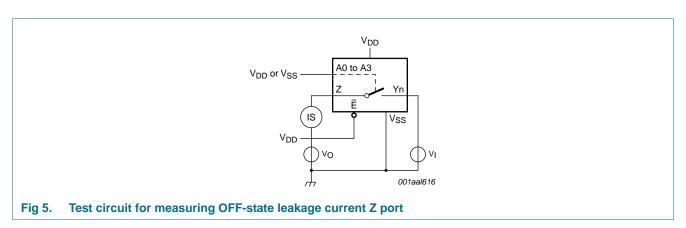
#### 16-channel analog multiplexer/demultiplexer

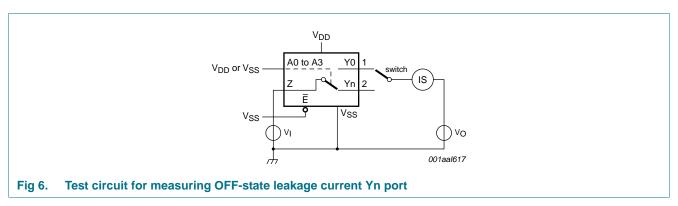
 Table 6.
 Static characteristics ...continued

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

Symbol	Parameter	Conditions	$V_{DD}$	T <sub>amb</sub> =	–40 °C	T <sub>amb</sub> =	+25 °C	T <sub>amb</sub> = +85 °C		Unit
				Min	Max	Min	Max	Min	Max	
I <sub>S(OFF)</sub>	OFF-state leakage current	Z port; all channels OFF; see Figure 5	15 V	-	-	-	1000	-	-	nA
		Yn port; per channel; see Figure 6	15 V	-	-	-	200	-	-	nA
I <sub>DD</sub>	supply current	all valid input combinations; $I_O = 0 A$	5 V	-	20	-	20	-	150	μΑ
			10 V	-	40	-	40	-	300	μΑ
			15 V	-	80	-	80	-	600	μΑ
Cı	input capacitance	digital inputs	15 V	-	-	-	7.5	-	-	pF

#### 10.1 Test circuits





#### 16-channel analog multiplexer/demultiplexer

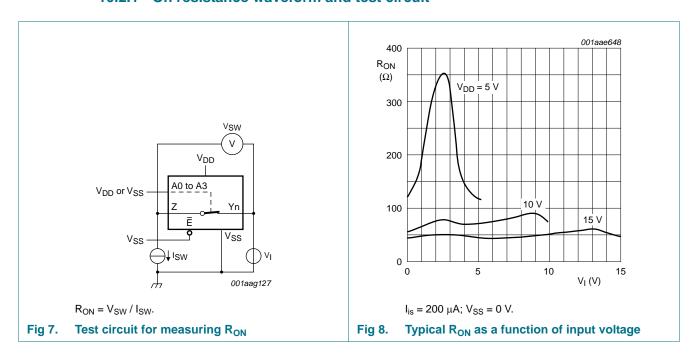
#### 10.2 On resistance

Table 7. ON resistance

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

Symbol	Parameter	Conditions	$V_{DD}$	Тур	Max	Unit
R <sub>ON(peak)</sub>	ON resistance (peak)	$V_I = 0 \text{ V to } V_{DD}$ ; see <u>Figure 7</u> and	5 V	350	2500	Ω
		Figure 8	10 V	80	245	Ω
			15 V	60	175	Ω
R <sub>ON(rail)</sub>	ON resistance (rail)	V <sub>I</sub> = 0 V; see <u>Figure 7</u> and <u>Figure 8</u>	5 V	115	340	Ω
			10 V	50	160	Ω
			15 V	40	115	Ω
		$V_I = V_{DD}$ ; see Figure 7 and Figure 8	5 V	120	365	Ω
			10 V	65	200	Ω
			15 V	50	155	Ω
$\Delta R_{ON}$	ON resistance mismatch	$V_I = 0 \text{ V to } V_{DD}$ ; see <u>Figure 7</u>	5 V	25	-	Ω
	between channels		10 V	10	-	Ω
			15 V	5	-	Ω

#### 10.2.1 On resistance waveform and test circuit



## 16-channel analog multiplexer/demultiplexer

# 11. Dynamic characteristics

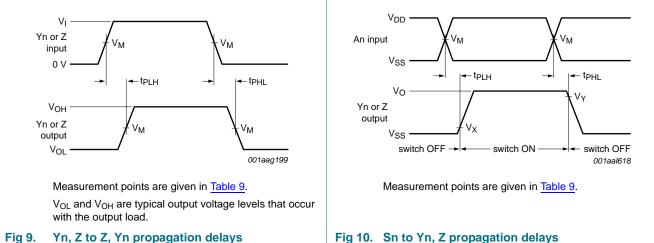
Table 8. Dynamic characteristics

 $T_{amb} = 25$  °C;  $V_{SS} = 0$  V; for test circuit see <u>Figure 12</u>.

Symbol	Parameter	Conditions	$V_{DD}$	Min	Тур	Max	Unit
t <sub>PHL</sub>	HIGH to LOW propagation delay	Yn, Z to Z, Yn; see Figure 9	5 V	-	30	60	ns
			10 V	-	15	25	ns
			15 V	-	10	20	ns
		An to Yn, Z; see Figure 10	5 V	-	190	380	ns
			10 V	-	70	145	ns
			15 V	-	50	100	ns
t <sub>PLH</sub>	LOW to HIGH propagation delay	Yn, Z to Z, Yn; see Figure 9	5 V	-	25	50	ns
			10 V	-	10	20	ns
			15 V	-	10	20	ns
		An to Yn, Z; see Figure 10	5 V	-	175	345	ns
			10 V	-	70	140	ns
			15 V	-	50	100	ns
t <sub>PHZ</sub>	HIGH to OFF-state propagation delay	E to Yn, Z; see Figure 11	5 V	-	195	385	ns
			10 V	-	140	280	ns
			15 V	-	130	260	ns
$t_{PLZ}$	LOW to OFF-state propagation delay	E to Yn, Z; see Figure 11	5 V	-	215	435	ns
			10 V	-	180	355	ns
			15 V	-	170	340	ns
t <sub>PZH</sub>	OFF-state to HIGH propagation delay	E to Yn, Z; see Figure 11	5 V	-	155	315	ns
			10 V	-	70	135	ns
		E to Yn, Z; see Figure 11	15 V	-	50	100	ns
t <sub>PZL</sub>	OFF-state to LOW propagation delay		5 V	-	170	340	ns
			10 V	-	70	140	ns
			15 V	-	50	100	ns

#### 16-channel analog multiplexer/demultiplexer

#### 11.1 Waveforms and test circuit



Yn, Z to Z, Yn propagation delays Fig 9.

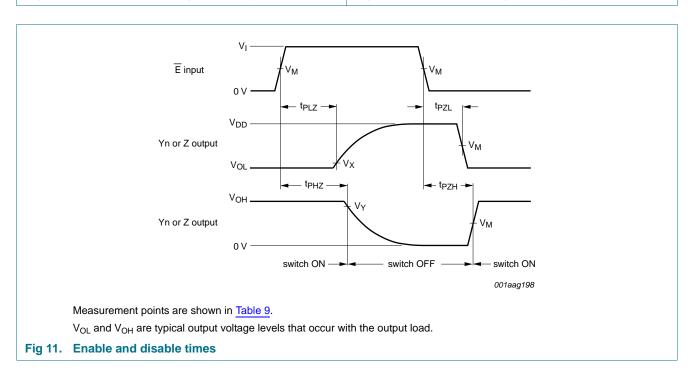
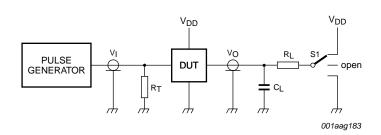


Table 9. **Measurement points** 

Supply voltage	Input		Output				
V <sub>CC</sub>	V <sub>M</sub>	VI	V <sub>M</sub>	$V_X$	V <sub>Y</sub>		
5 V to 15 V	0.5V <sub>DD</sub>	GND to $V_{\rm DD}$	0.5V <sub>DD</sub>	10%	90%		

#### 16-channel analog multiplexer/demultiplexer



Test data is given in Table 10.

Definitions test circuit:

 $R_T$  = termination resistance should be equal to output impedance  $Z_0$  of the pulse generator

 $C_L$  = load capacitance including jig and probe capacitance

 $R_L$  = load resistor

S1 = test selection switch

Fig 12. Test circuit for measuring switching times

Table 10. Test data

Input			Load		S1 position					
Yn, Z	An and E	t <sub>r</sub> , t <sub>f</sub>	V <sub>M</sub>	CL	$R_L$	t <sub>PHL</sub> [1]	t <sub>PLH</sub>	$t_{PZH}, t_{PHZ}$	$t_{PZL}, t_{PLZ}$	other
$V_{DD}$ or $V_{SS}$	$V_{DD}$ or $V_{SS}$	≤ 20 ns	$0.5V_{DD}$	50 pF	10 k $\Omega$	$V_{DD}$ or $V_{SS}$	$V_{SS}$	$V_{SS}$	$V_{DD}$	$V_{SS}$

[1] For Yn to Z or Z to Yn propagation delays use  $V_{SS}$ . For An or to Yn or Z propagation delays use  $V_{DD}$ .

#### 16-channel analog multiplexer/demultiplexer

## 11.2 Additional dynamic parameters

Table 11. Additional dynamic characteristics

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

Symbol	Parameter	Conditions	$V_{DD}$	Тур	Max	Unit
THD	total harmonic distortion	see Figure 13; $R_L = 10 \text{ k}\Omega$ ; $C_L = 15 \text{ pF}$ ;	5 V	[1] 0.25	-	%
		channel ON; $V_I = 0.5V_{DD}$ (p-p); $f_i = 1$ kHz	10 V	<u>[1]</u> 0.04	-	%
		$i_{\parallel} = 1 \text{ KHZ}$	15 V	<u>[1]</u> 0.04	-	%
f <sub>(-3dB)</sub>	-3 dB frequency response	see Figure 14; $R_L = 1 \text{ k}\Omega$ ; $C_L = 5 \text{ pF}$ ;	5 V	<u>[1]</u> 13	-	MHz
		channel ON; $V_I = 0.5V_{DD}$ (p-p)	10 V	<u>[1]</u> 40	-	MHz
			15 V	<u>[1]</u> 70	-	MHz
$\alpha_{\text{iso}}$	isolation (OFF-state)	see Figure 15; $f_i$ = 1 MHz; $R_L$ = 1 $k\Omega$ ; $C_L$ = 5 pF; channel OFF; $V_I$ = 0.5 $V_{DD}$ (p-p)	10 V	<u>[1]</u> –50	-	dB
V <sub>ct</sub>	crosstalk voltage	digital inputs to switch; see Figure 16; $\underline{R}_L = 10 \text{ k}\Omega$ ; $C_L = 15 \text{ pF}$ ; $\overline{E}$ or $An = V_{DD}$ (square-wave)	10 V	50	-	mV
Xtalk	crosstalk	between switches; see Figure 17; $f_i = 1$ MHz; $R_L = 1$ k $\Omega$ ; $V_I = 0.5V_{DD}$ (p-p)	10 V	[1] -50	-	dB

<sup>[1]</sup>  $f_i$  is biased at 0.5  $V_{DD}$ ;  $V_I = 0.5 V_{DD}$  (p-p).

#### Table 12. Dynamic power dissipation P<sub>D</sub>

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

<i>D</i>			/ 00 - / 1/ umb	
Symbol	Parameter	$V_{DD}$	Typical formula for $P_D$ ( $\mu$ W)	where:
P <sub>D</sub> dynamic power dissipation	5 V	$P_D = 1000 \times f_i + \Sigma (f_o \times C_L) \times V_{DD}^2$	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	$P_D = 15000 \times f_i + \Sigma (f_o \times C_L) \times V_{DD}^2$	$C_L$ = output load capacitance in pF;	
				$V_{DD}$ = supply voltage in V;
				$\Sigma(C_L \times f_o)$ = sum of the outputs.

#### 11.2.1 Test circuits

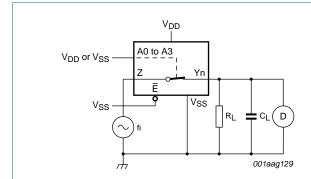


Fig 13. Test circuit for measuring total harmonic distortion

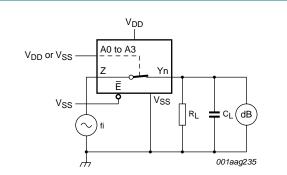
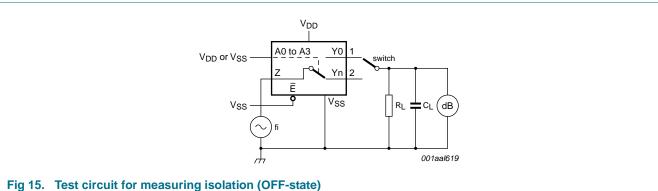
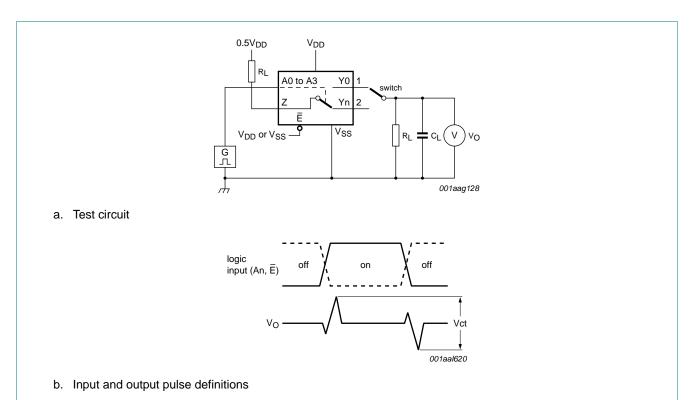


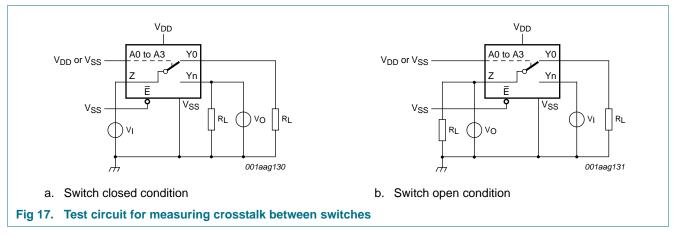
Fig 14. Test circuit for measuring frequency response

#### 16-channel analog multiplexer/demultiplexer









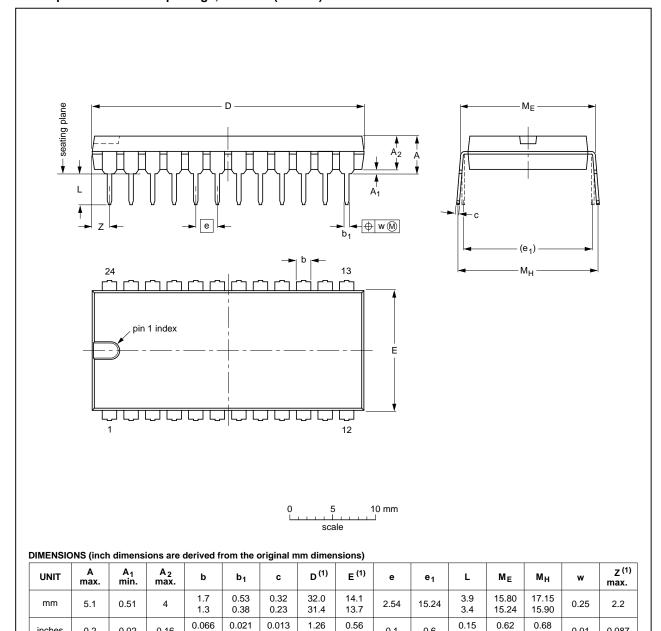
HEF4067B

#### 16-channel analog multiplexer/demultiplexer

## 12. Package outline

#### DIP24: plastic dual in-line package; 24 leads (600 mil)

SOT101-1



inches

0.2

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

0.051

OUTLINE		REFER	EUROPEAN	ISSUE DATE		
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE
SOT101-1	051G02	MO-015	SC-509-24			<del>99-12-27</del> 03-02-13

0.6

Fig 18. Package outline SOT101-1 (DIP24)

0.02

0.16

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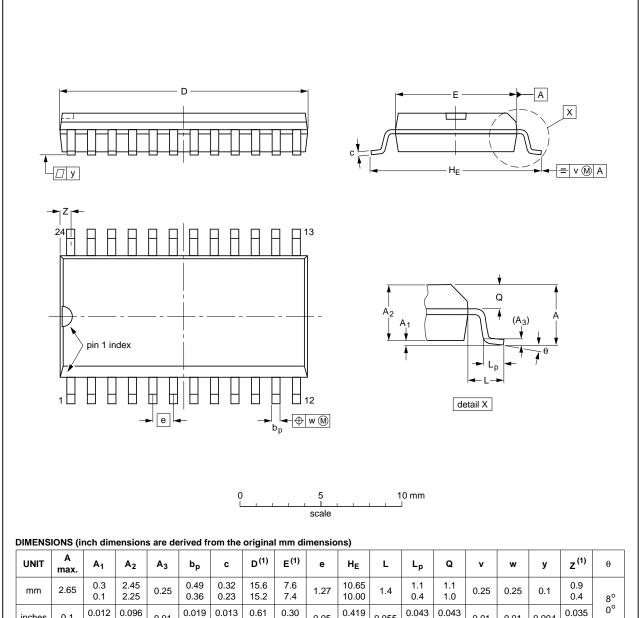
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0.01

0.087

#### SO24: plastic small outline package; 24 leads; body width 7.5 mm

SOT137-1



UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	bp	С	D <sup>(1)</sup>	E <sup>(1)</sup>	е	HE	L	Lp	Q	٧	w	у	z <sup>(1)</sup>	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	15.6 15.2	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8°
inches	0.1	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.61 0.60	0.30 0.29	0.05	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	0°

#### Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE		REFER	EUROPEAN	ISSUE DATE		
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE
SOT137-1	075E05	MS-013				<del>-99-12-27</del> 03-02-19

Fig 19. Package outline SOT137-1 (SO24)

HEF4067B

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## 16-channel analog multiplexer/demultiplexer

## 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
HEF4067B v.6	20111116	Product data sheet	-	HEF4067B v.5
Modifications:	<ul> <li>Legal page</li> </ul>	s updated.		
	<ul> <li>Changes in</li> </ul>	"General description", "Fea	tures and benefits" and	"Applications".
HEF4067B v.5	20100325	Product data sheet	-	HEF4067B v.4
HEF4067B v.4	20100308	Product data sheet	-	HEF4067B_CNV v.3
HEF4067B_CNV v.3	19950101	Product specification	-	HEF4067B_CNV v.2
HEF4067B_CNV v.2	19950101	Product specification	-	-

#### 16-channel analog multiplexer/demultiplexer

## 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 <a href="http://www.nxp.com">http://www.nxp.com</a>.

#### 15.2 Definitions

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#### 16-channel analog multiplexer/demultiplexer

## 17. Contents

1	General description
2	Features and benefits
3	Applications
4	Ordering information 1
5	Functional diagram 2
6	Pinning information 4
6.1	Pinning 4
6.2	Pin description 4
7	Functional description 5
8	Limiting values 5
9	Recommended operating conditions 6
10	Static characteristics 6
10.1	Test circuits 7
10.2	On resistance
10.2.1	On resistance waveform and test circuit 8
11	Dynamic characteristics 9
11.1	Waveforms and test circuit 10
11.2	Additional dynamic parameters 12
11.2.1	Test circuits
12	Package outline
13	Abbreviations
14	Revision history
15	Legal information 17
15.1	Data sheet status 17
15.2	Definitions
15.3	Disclaimers
15.4	Trademarks
16	Contact information
17	Contents

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