

# HEF4067B

## 16-channel analog multiplexer/demultiplexer

Rev. 7 — 11 September 2014

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 ( $\overline{E}$ ), 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  $\overline{E}$  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  $\overline{E}$  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.

### 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. 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
HEF4067BP	$-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$	DIP24	plastic dual in-line package; 24 leads (600 mil)	SOT101-1
HEF4067BT	$-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$	SO24	plastic small outline package; 24 leads; body width 7.5 mm	SOT137-1



5. Functional diagram

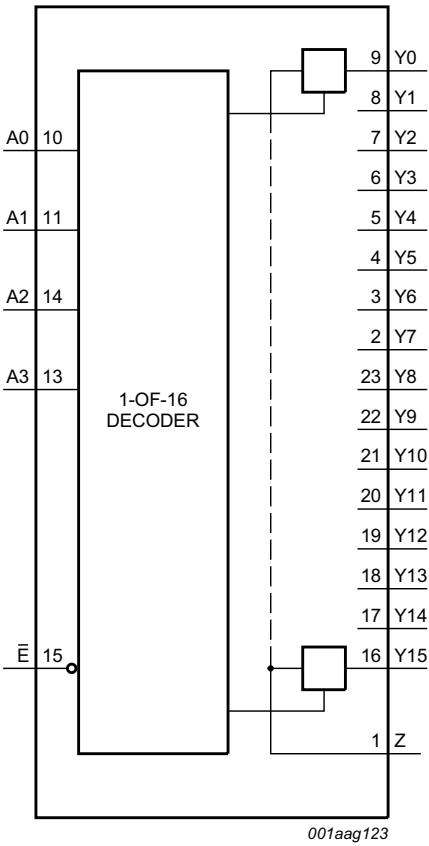


Fig 1. Functional diagram

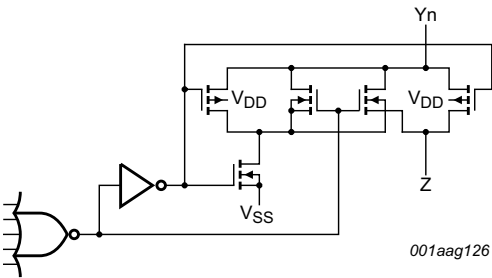


Fig 2. Schematic diagram (one switch)

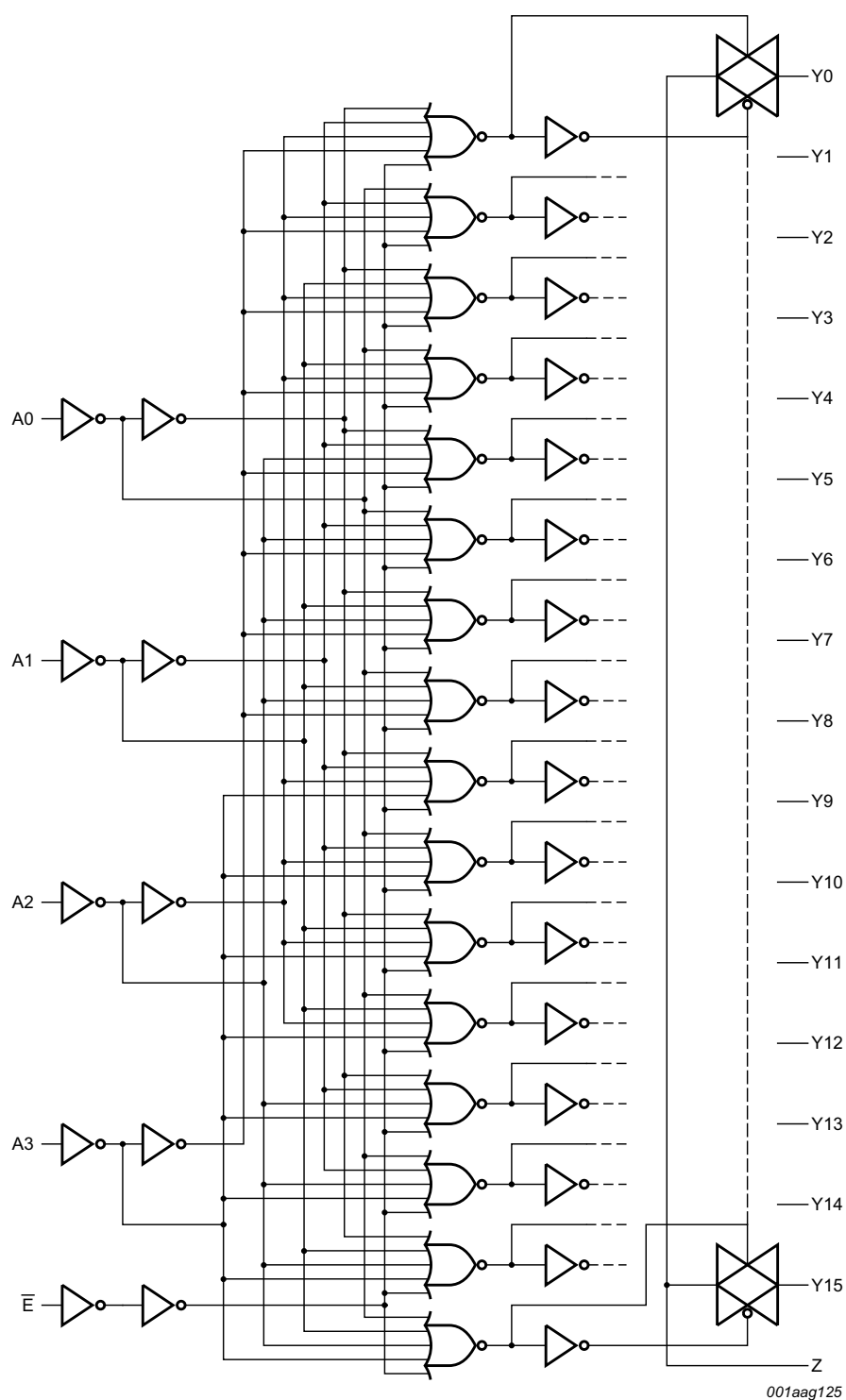
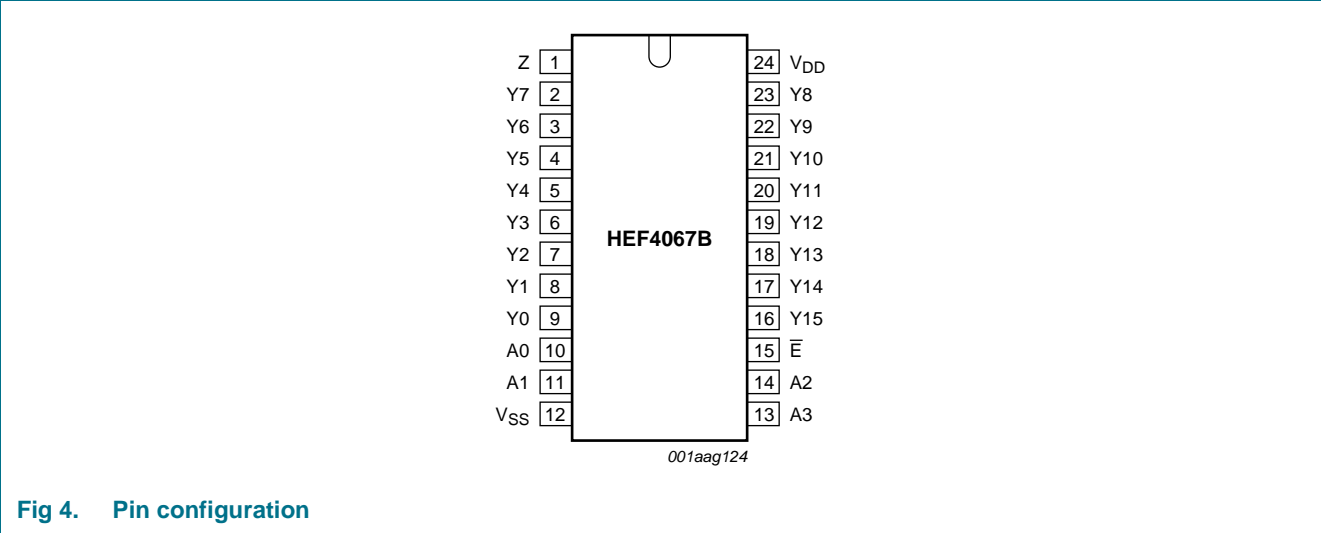


Fig 3. Logic diagram

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)
$\overline{E}$	15	enable input (active LOW)
V <sub>DD</sub>	24	supply voltage

## 7. Functional description

Table 3. Function table<sup>[1]</sup>

Control	Address				Channel ON
$\overline{E}$	A3	A2	A1	A0	
L	L	L	L	L	Y0 = Z
L	L	L	L	H	Y1 = Z
L	L	L	H	L	Y2 = Z
L	L	L	H	H	Y3 = Z
L	L	H	L	L	Y4 = Z
L	L	H	L	H	Y5 = Z
L	L	H	H	L	Y6 = Z
L	L	H	H	H	Y7 = Z
L	H	L	L	L	Y8 = Z
L	H	L	L	H	Y9 = Z
L	H	L	H	L	Y10 = Z
L	H	L	H	H	Y11 = Z
L	H	H	L	L	Y12 = Z
L	H	H	L	H	Y13 = Z
L	H	H	H	L	Y14 = Z
L	H	H	H	H	Y15 = Z
H	X	X	X	X	none

[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  $V_{SS} = 0$  V (ground).

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

**Table 4.** Limiting values ...continuedIn accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to  $V_{SS} = 0$  V (ground).

Symbol	Parameter	Conditions	Min	Max	Unit
$P_{tot}$	total power dissipation	$T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$			
		DIP24	[2] -	750	mW
		SO24	[3] -	500	mW
P	power dissipation	per output	-	100	mW

- [1] To avoid drawing  $V_{DD}$  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  $V_{DD}$  current will flow out of terminals  $Y_n$ , in this case there is no limit for the voltage drop across the switch, but the voltages at Y and Z may not exceed  $V_{DD}$  or  $V_{SS}$ .
- [2] For DIP24 packages: above  $T_{amb} = 70\text{ }^{\circ}\text{C}$ ,  $P_{tot}$  derates linearly at 12 mW/K.
- [3] For SO24 packages: above  $T_{amb} = 70\text{ }^{\circ}\text{C}$ ,  $P_{tot}$  derates linearly at 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	-	+85	$^{\circ}\text{C}$
$\Delta t/\Delta V$	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 $V_{SS} = 0$  V;  $V_I = V_{SS}$  or  $V_{DD}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	$V_{DD}$		$T_{amb} = -40\text{ }^{\circ}\text{C}$		$T_{amb} = +25\text{ }^{\circ}\text{C}$		$T_{amb} = +85\text{ }^{\circ}\text{C}$		Unit
					Min	Max	Min	Max	Min	Max	
$V_{IL}$	LOW-level input voltage	$ I_O  < 1\text{ }\mu\text{A}$									
		$V_O = 0.5\text{ V}$ or $4.5\text{ V}$	5 V		-	1	-	1	-	1	V
		$V_O = 1.0\text{ V}$ or $9.0\text{ V}$	10 V		-	2	-	2	-	2	V
		$V_O = 1.5\text{ V}$ or $13.5\text{ V}$	15 V		-	2.5	-	2.5	-	2.5	V
$V_{IH}$	HIGH-level input voltage	$ I_O  < 1\text{ }\mu\text{A}$									
		$V_O = 0.5\text{ V}$ or $4.5\text{ V}$	5 V		4	-	4	-	4	-	V
		$V_O = 1.0\text{ V}$ or $9.0\text{ V}$	10 V		8	-	8	-	8	-	V
		$V_O = 1.5\text{ V}$ or $13.5\text{ V}$	15 V		12.5	-	12.5	-	12.5	-	V
$I_I$	input leakage current	$V_I = 0\text{ V}$ or $15\text{ V}$	15 V		-	$\pm 0.3$	-	$\pm 0.3$	-	$\pm 1.0$	$\mu\text{A}$
$I_{OZ}$	OFF-state output current	output at $V_{DD}$	15 V		-	1.6	-	1.6	-	12.0	$\mu\text{A}$
		output at $V_{SS}$	15 V		-	-1.6	-	-1.6	-	-12.0	$\mu\text{A}$

Table 6. Static characteristics ...continued  
 $V_{SS} = 0\text{ V}$ ;  $V_I = V_{SS}$  or  $V_{DD}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	$V_{DD}$	$T_{amb} = -40\text{ }^{\circ}\text{C}$		$T_{amb} = +25\text{ }^{\circ}\text{C}$		$T_{amb} = +85\text{ }^{\circ}\text{C}$		Unit
				Min	Max	Min	Max	Min	Max	
$I_{S(OFF)}$	OFF-state leakage current	Z port; all channels OFF; see Figure 5	15 V	-	-	-	1000	-	-	nA
		$Y_n$ port; per channel; see Figure 6	15 V	-	-	-	200	-	-	nA
$I_{DD}$	supply current	all valid input combinations; $I_O = 0\text{ A}$	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	digital inputs	15 V	-	-	-	7.5	-	-	pF

10.1 Test circuits

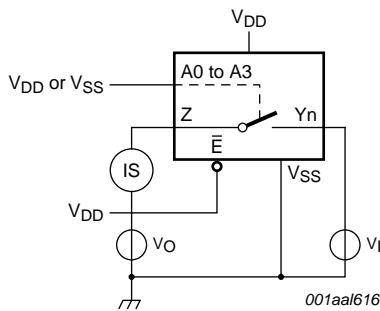


Fig 5. Test circuit for measuring OFF-state leakage current Z port

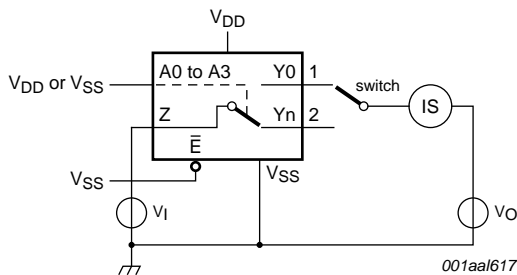


Fig 6. Test circuit for measuring OFF-state leakage current Yn port

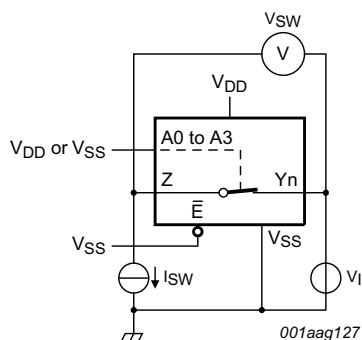
## 10.2 On resistance

### Table 7. ON resistance

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

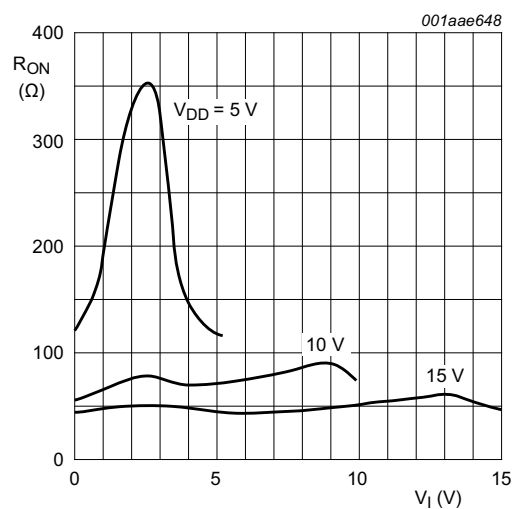
Symbol	Parameter	Conditions	V <sub>DD</sub>	Typ	Max	Unit
R <sub>ON(peak)</sub>	ON resistance (peak)	V <sub>I</sub> = 0 V to V <sub>DD</sub> ; see <a href="#">Figure 7</a> and <a href="#">Figure 8</a>	5 V	350	2500	Ω
			10 V	80	245	Ω
			15 V	60	175	Ω
R <sub>ON(rail)</sub>	ON resistance (rail)	V <sub>I</sub> = 0 V; see <a href="#">Figure 7</a> and <a href="#">Figure 8</a>	5 V	115	340	Ω
			10 V	50	160	Ω
			15 V	40	115	Ω
		V <sub>I</sub> = V <sub>DD</sub> ; see <a href="#">Figure 7</a> and <a href="#">Figure 8</a>	5 V	120	365	Ω
			10 V	65	200	Ω
			15 V	50	155	Ω
ΔR <sub>ON</sub>	ON resistance mismatch between channels	V <sub>I</sub> = 0 V to V <sub>DD</sub> ; see <a href="#">Figure 7</a>	5 V	25	-	Ω
			10 V	10	-	Ω
			15 V	5	-	Ω

### 10.2.1 On resistance waveform and test circuit



$$R_{ON} = V_{SW} / I_{SW}.$$

**Fig 7. Test circuit for measuring  $R_{ON}$**


$$I_{IS} = 200 \mu A; V_{SS} = 0 V.$$

**Fig 8. Typical  $R_{ON}$  as a function of input voltage**



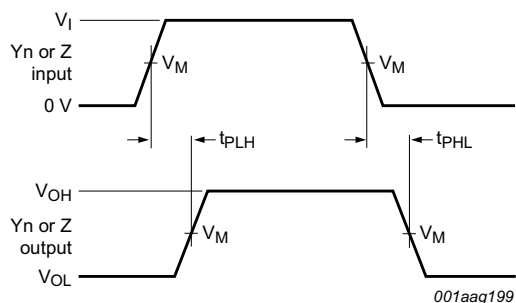
## 11. Dynamic characteristics

**Table 8. Dynamic characteristics**

$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $V_{SS} = 0\text{ V}$ ; for test circuit see [Figure 12](#).

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

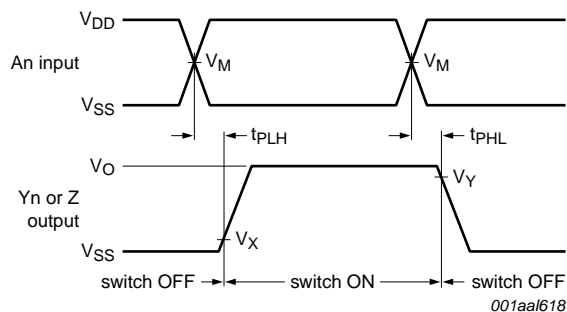
## 11.1 Waveforms and test circuit



Measurement points are given in [Table 9](#).

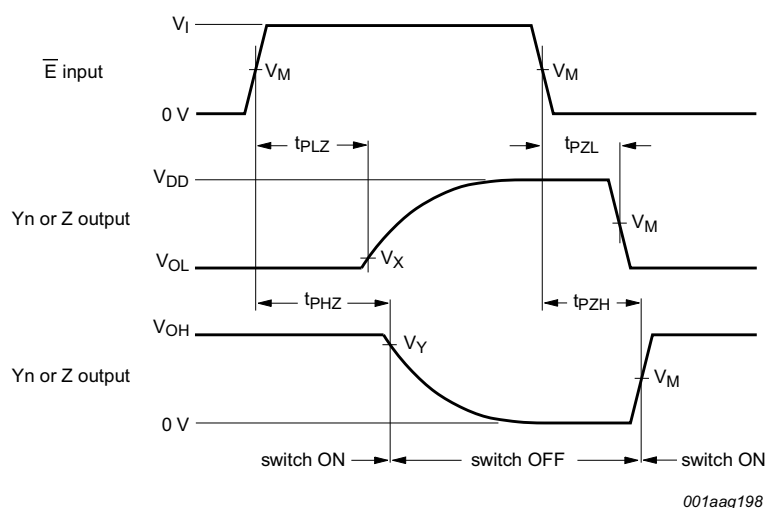
$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

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



Measurement points are given in [Table 9](#).

**Fig 10. Sn to Yn, Z propagation delays**



Measurement points are shown in [Table 9](#).

$V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 11. Enable and disable times**

### Table 9. Measurement points

Supply voltage	Input		Output		
$V_{CC}$	$V_M$	$V_I$	$V_M$	$V_X$	$V_Y$
5 V to 15 V	$0.5V_{DD}$	GND to $V_{DD}$	$0.5V_{DD}$	10%	90%

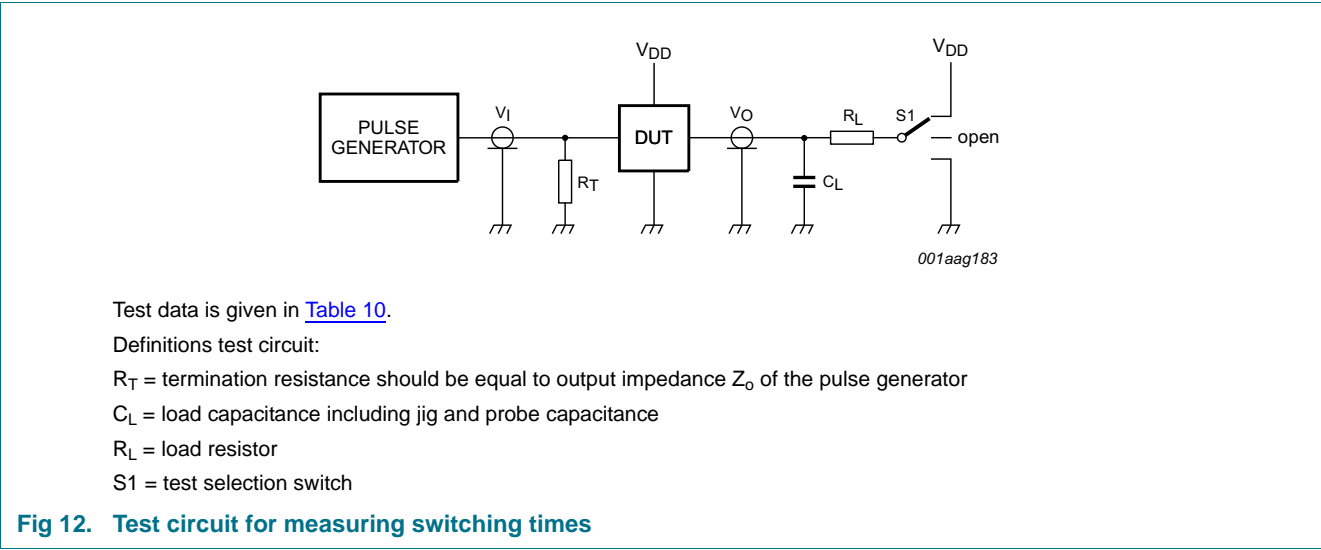


Table 10. Test data

Input				Load		S1 position				
Yn, Z	An and $\bar{E}$	$t_r, t_f$	$V_M$	$C_L$	$R_L$	$t_{PHL}$ [1]	$t_{PLH}$	$t_{PZH}, t_{PHZ}$	$t_{PZL}, t_{PLZ}$	other
$V_{DD}$ or $V_{SS}$	$V_{DD}$ or $V_{SS}$	$\leq 20$ 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  $V_{DD}$ .

## 11.2 Additional dynamic parameters

**Table 11. Additional dynamic characteristics**

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

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

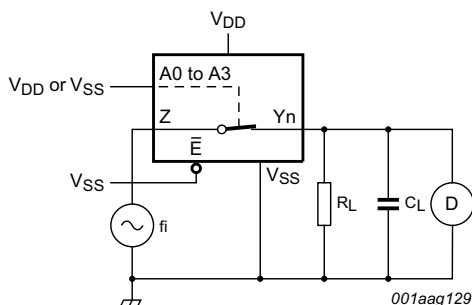
[1]  $f_i$  is biased at  $0.5 V_{DD}$ ;  $V_I = 0.5V_{DD}$  (p-p).

**Table 12. Dynamic power dissipation  $P_D$**

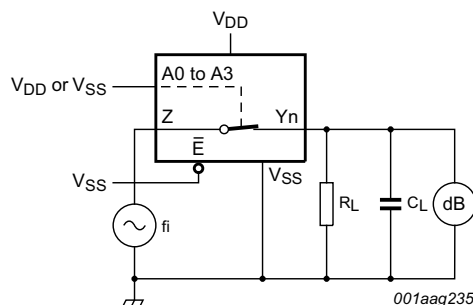
$P_D$  can be calculated from the formulas shown;  $V_{SS} = 0\text{ V}$ ;  $t_r = t_f \leq 20\text{ ns}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

Symbol	Parameter	$V_{DD}$	Typical formula for $P_D$ ( $\mu\text{W}$ )	where:
$P_D$	dynamic power dissipation	5 V	$P_D = 1000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	$f_i$ = 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	$P_D = 5500 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	
		15 V	$P_D = 15000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	

### 11.2.1 Test circuits



**Fig 13. Test circuit for measuring total harmonic distortion**



**Fig 14. Test circuit for measuring frequency response**

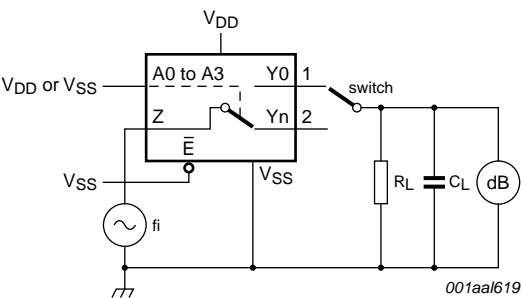
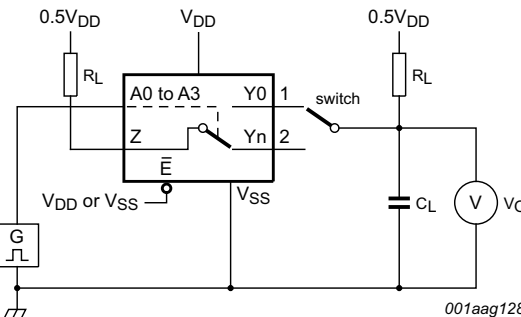
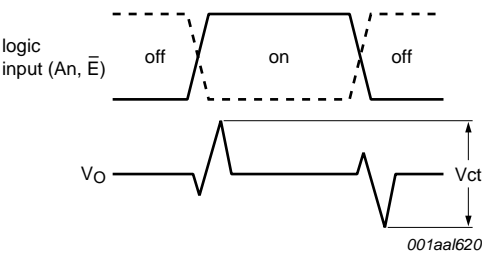


Fig 15. Test circuit for measuring isolation (OFF-state)

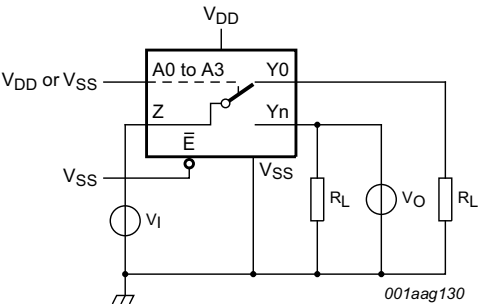


a. Test circuit

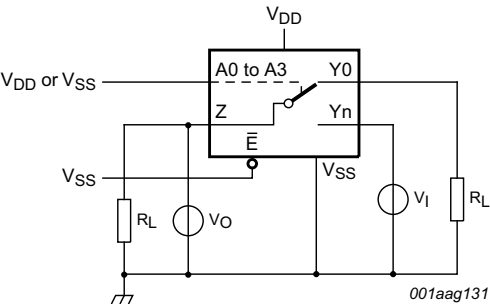


b. Input and output pulse definitions

Fig 16. Test circuit for measuring crosstalk voltage between digital inputs and switch



a. Switch closed condition



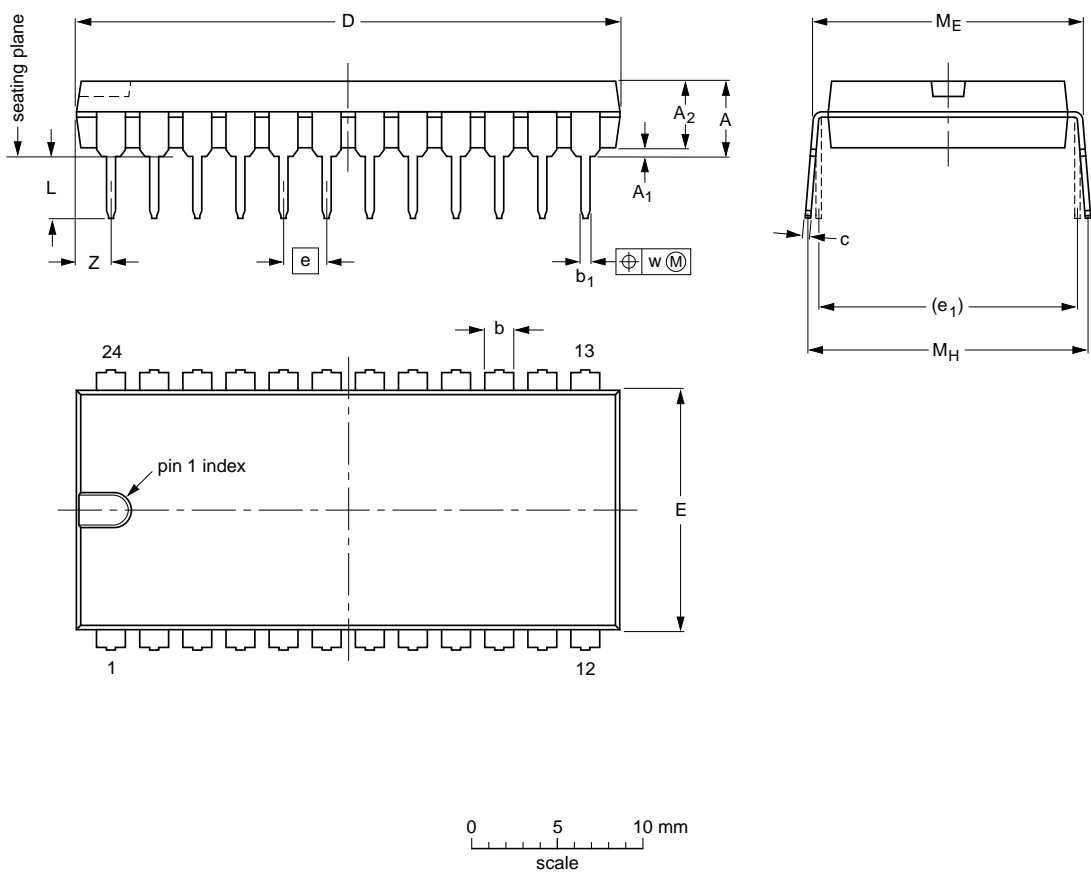
b. Switch open condition

Fig 17. Test circuit for measuring crosstalk between switches

12. Package outline

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

SOT101-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A <sub>1</sub> min.	A <sub>2</sub> max.	b	b <sub>1</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	e <sub>1</sub>	L	M <sub>E</sub>	M <sub>H</sub>	w	Z <sup>(1)</sup> max.
mm	5.1	0.51	4	1.7 1.3	0.53 0.38	0.32 0.23	32.0 31.4	14.1 13.7	2.54	15.24	3.9 3.4	15.80 15.24	17.15 15.90	0.25	2.2
inches	0.2	0.02	0.16	0.066 0.051	0.021 0.015	0.013 0.009	1.26 1.24	0.56 0.54	0.1	0.6	0.15 0.13	0.62 0.60	0.68 0.63	0.01	0.087

Note

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

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

Fig 18. Package outline SOT101-1 (DIP24)

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

SOT137-1

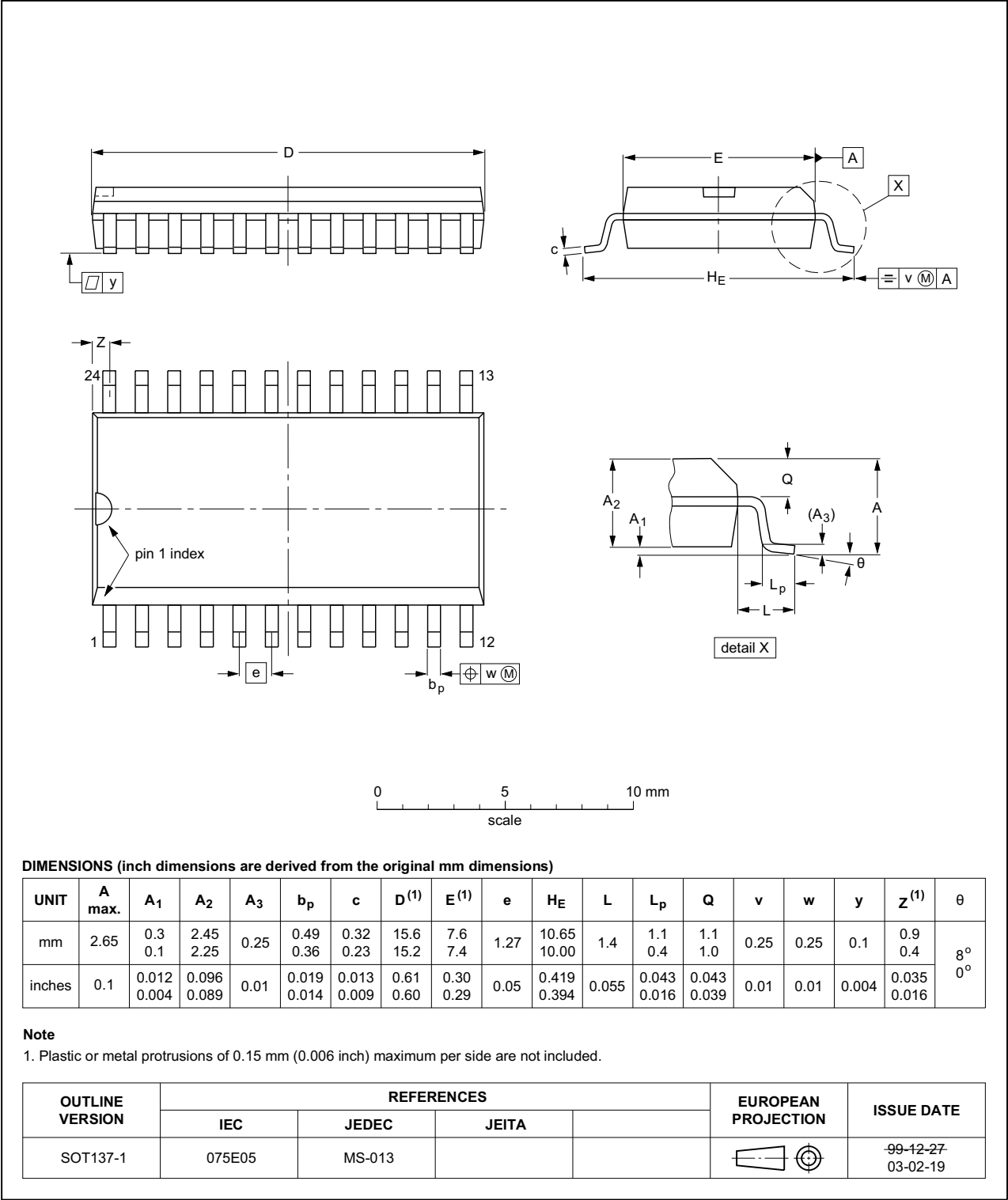


Fig 19. Package outline SOT137-1 (SO24)

## 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.7	20140911	Product data sheet	-	HEF4067B v.6
Modifications:	<ul style="list-style-type: none"><li>• <a href="#">Figure 16</a>: Test circuit modified</li></ul>			
HEF4067B v.6	20111116	Product data sheet	-	HEF4067B v.5
Modifications:	<ul style="list-style-type: none"><li>• Legal pages updated.</li><li>• Changes in “General description”, “Features and benefits” and “Applications”.</li></ul>			
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	-	-



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

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Date of release: 11 September 2014

Document identifier: HEF4067B

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