HEF4067B-Q100

16-channel analog multiplexer/demultiplexer

Rev. 3 — 6 January 2022 Product data sheet

1. General description

The HEF4067B-Q100 is a single-pole 16-throw analog switch (SP16T) suitable for use in analog or digital 16:1 multiplexer/demultiplexer applications. The switch features four digital select inputs (A0, A1, A2 and A3), sixteen independent inputs/outputs (Yn), a common input/output (Z) and a digital enable input ($\overline{E}$). When $\overline{E}$ 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_{DD}.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 3) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 3)
  - Specified from -40 °C to +85 °C
- Wide supply voltage range from 3.0 V to 15.0 V
- CMOS low power dissipation
- High noise immunity
- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- ESD protection:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- 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
HEF4067BT-Q100	-40 °C to +85 °C	SO24	plastic small outline package; 24 leads; body width 7.5 mm	SOT137-1

nexperia

5. Functional diagram

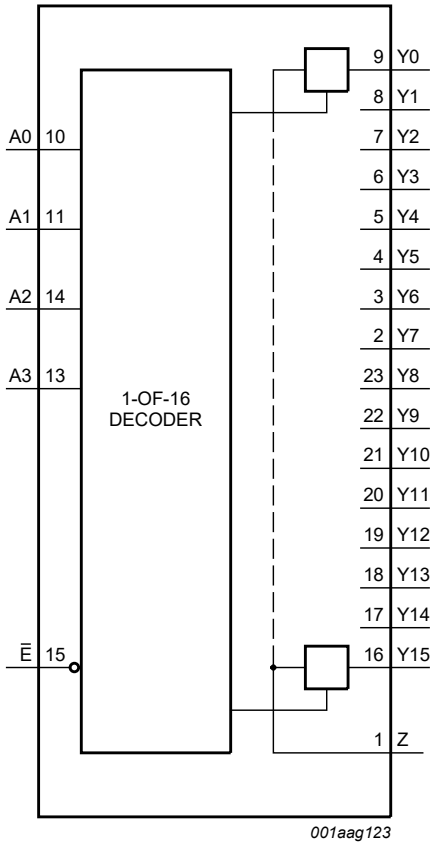


Fig. 1. Functional diagram

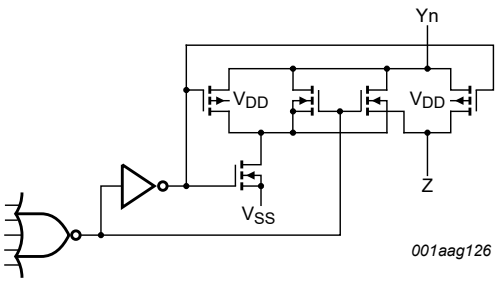


Fig. 2. Schematic diagram (one switch)

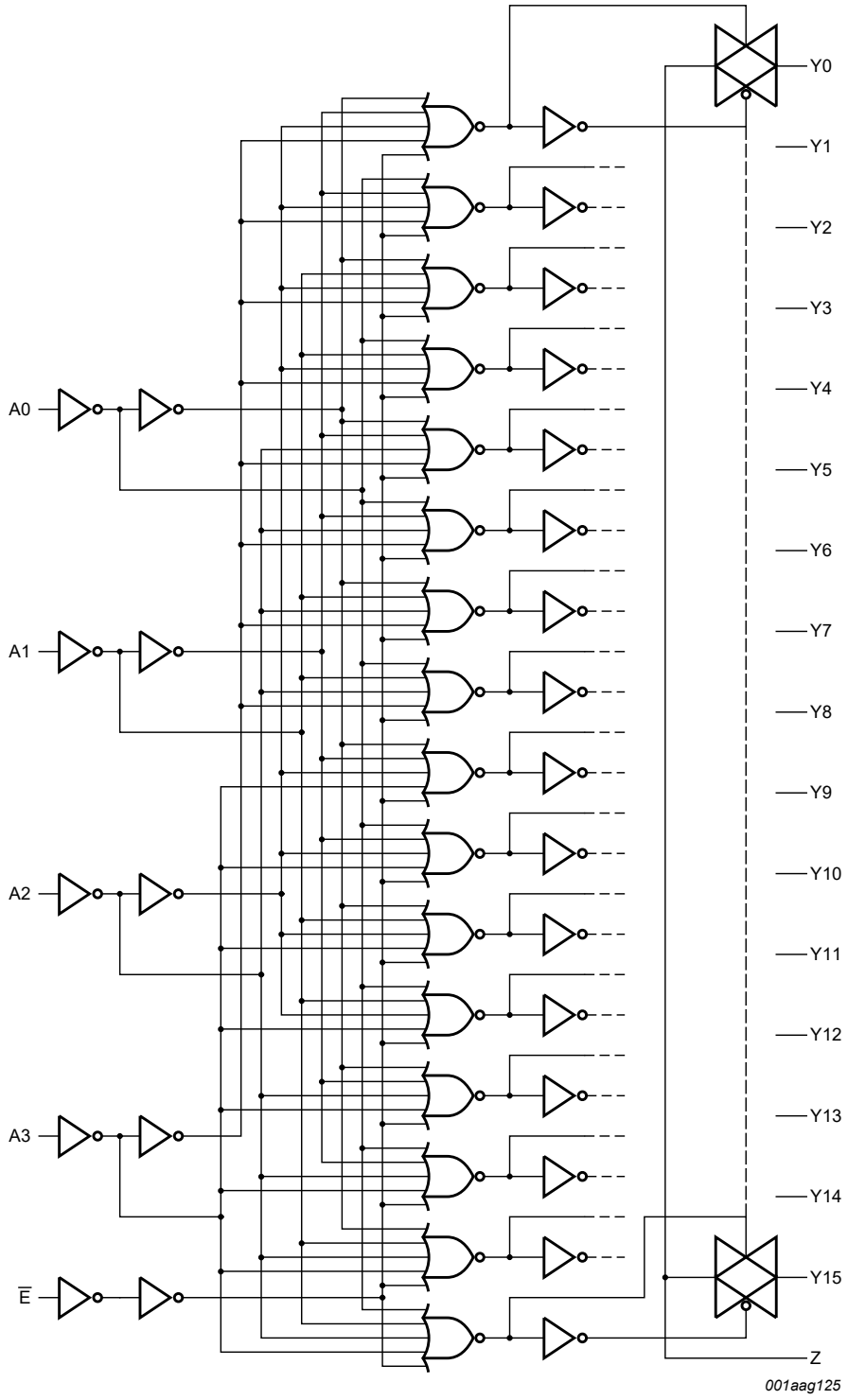


Fig. 3. Logic diagram

6. Pinning information

6.1. Pinning

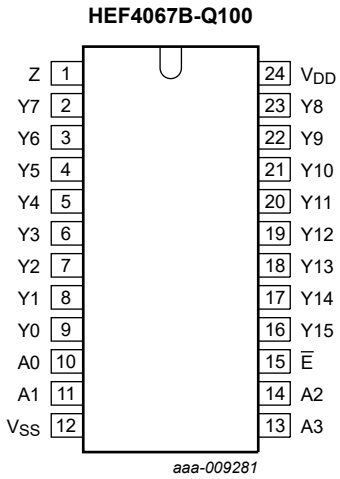


Fig. 4. Pin configuration

6.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
Z	1	common input/output
Y0, Y1, Y2, Y3, Y4, Y5, Y6, Y7, Y8, Y9, Y10, Y11, Y12, Y13, Y14, Y15	9, 8, 7, 6, 5, 4, 3, 2, 23, 22, 21, 20, 19, 18, 17, 16	independent input/output
A0, A1, A2, A3	10, 11, 14, 13	address input
V_{SS}	12	ground (0 V)
$\overline{E}$	15	enable input (active LOW)
V_{DD}	24	supply voltage

7. Functional description

Table 3. Function table

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

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

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	-	±10	mA
V_I	input voltage		-0.5	V_{DD} + 0.5	V
$I_{I/O}$	input/output current	[1]	-	±10	mA
I_{DD}	supply current		-	50	mA
T_{stg}	storage temperature		-65	+150	°C
T_{amb}	ambient temperature		-40	+85	°C
P_{tot}	total power dissipation	T_{amb} = -40 °C to +85 °C	-	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 Yn, 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 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_{DD} or V_{SS}.

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	°C
Δt/ΔV	input transition rise and fall rate	V_{DD} = 5 V	-	-	3.75	µs/V
		V_{DD} = 10 V	-	-	0.5	µs/V
		V_{DD} = 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_{amb} = -40 °C		T_{amb} = +25 °C		T_{amb} = +85 °C		Unit
				Min	Max	Min	Max	Min	Max	
V_{IL}	LOW-level input voltage	$\|I_O\|$ < 1 µA								
		V_O = 0.5 V or 4.5 V	5 V	-	1	-	1	-	1	V
		V_O = 1.0 V or 9.0 V	10 V	-	2	-	2	-	2	V
		V_O = 1.5 V or 13.5 V	15 V	-	2.5	-	2.5	-	2.5	V
V_{IH}	HIGH-level input voltage	$\|I_O\|$ < 1 µA								
		V_O = 0.5 V or 4.5 V	5 V	4	-	4	-	4	-	V
		V_O = 1.0 V or 9.0 V	10 V	8	-	8	-	8	-	V
		V_O = 1.5 V or 13.5 V	15 V	12.5	-	12.5	-	12.5	-	V
I_I	input leakage current	V_I = 0 V or 15 V	15 V	-	±0.3	-	±0.3	-	±1.0	µA
I_{OZ}	OFF-state output current	output at V_{DD}	15 V	-	1.6	-	1.6	-	12.0	µA
		output at V_{SS}	15 V	-	-1.6	-	-1.6	-	-12.0	µA
$I_{S(OFF)}$	OFF-state leakage current	Z port; all channels OFF; see Fig. 5	15 V	-	-	-	1000	-	-	nA
		Yn port; per channel; see Fig. 6	15 V	-	-	-	200	-	-	nA
I_{DD}	supply current	all valid input combinations; I_O = 0 A	5 V	-	20	-	20	-	150	µA
			10 V	-	40	-	40	-	300	µA
			15 V	-	80	-	80	-	600	µA
C_I	input capacitance	digital inputs	15 V	-	-	-	7.5	-	-	pF

10.1. Test circuits

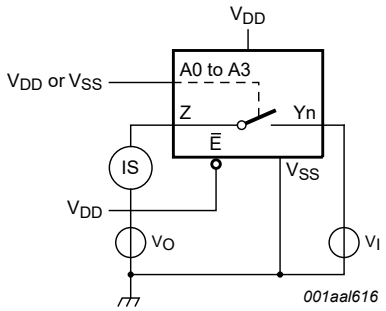


Fig. 5. Test circuit for measuring OFF-state leakage current Z port

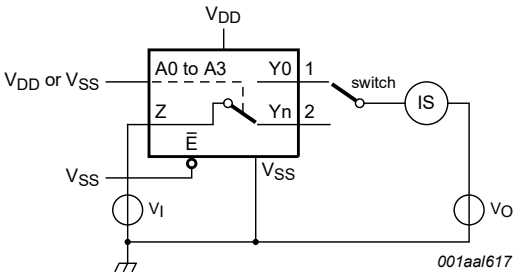


Fig. 6. Test circuit for measuring OFF-state leakage current Yn port

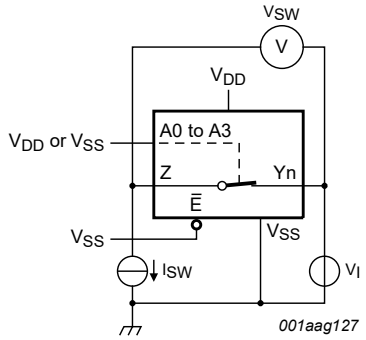
10.2. On resistance

Table 7. ON resistance

T_{amb} = 25 °C; I_{SW} = 200 µA; V_{SS} = 0 V.

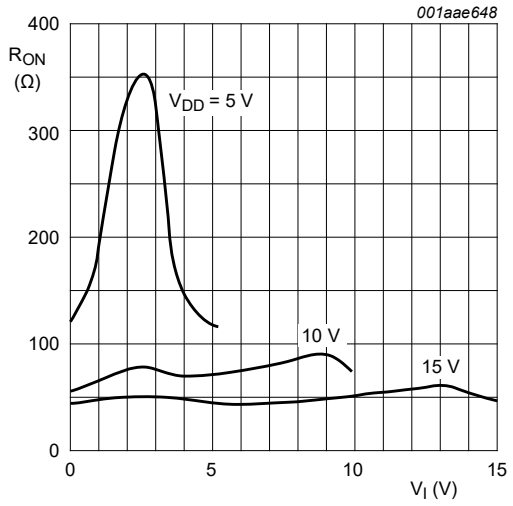
Symbol	Parameter	Conditions	V_{DD}	Typ	Max	Unit
$R_{ON(peak)}$	ON resistance (peak)	V_I = 0 V to V_{DD}; see Fig. 7 and Fig. 8	5 V	350	2500	Ω
			10 V	80	245	Ω
			15 V	60	175	Ω
$R_{ON(rail)}$	ON resistance (rail)	V_I = 0 V; see Fig. 7 and Fig. 8	5 V	115	340	Ω
			10 V	50	160	Ω
			15 V	40	115	Ω
		V_I = V_{DD}; see Fig. 7 and Fig. 8	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 V to V_{DD}; see Fig. 7	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 µA; V_{SS} = 0 V.

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

11. Dynamic characteristics

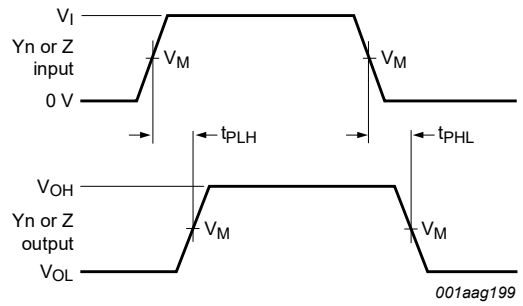
Table 8. Dynamic characteristics

T_{amb} = 25 °C; V_{SS} = 0 V; for test circuit see Fig. 12.

Symbol	Parameter	Conditions	V_{DD}	Min	Typ	Max	Unit
t_{PHL}	HIGH to LOW propagation delay	Yn, Z to Z, Yn; see Fig. 9	5 V	-	30	60	ns
			10 V	-	15	25	ns
			15 V	-	10	20	ns
		An to Yn, Z; see Fig. 10	5 V	-	190	380	ns
			10 V	-	70	145	ns
			15 V	-	50	100	ns
t_{PLH}	LOW to HIGH propagation delay	Yn, Z to Z, Yn; see Fig. 9	5 V	-	25	50	ns
			10 V	-	10	20	ns
			15 V	-	10	20	ns
		An to Yn, Z; see Fig. 10	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 Yn, Z; see Fig. 11	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 Yn, Z; see Fig. 11	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 Yn, Z; see Fig. 11	5 V	-	155	315	ns
			10 V	-	70	135	ns
			15 V	-	50	100	ns

Symbol	Parameter	Conditions	V_{DD}	Min	Typ	Max	Unit
t_{PZL}	OFF-state to LOW propagation delay	$\overline{E}$ to Yn, Z; see Fig. 11	5 V	-	170	340	ns
			10 V	-	70	140	ns
			15 V	-	50	100	ns

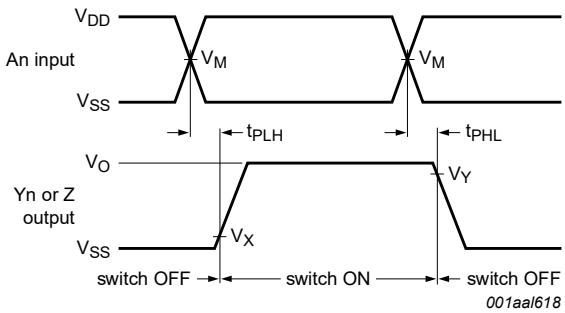
11.1. Waveforms and test circuit



Measurement points are given in Table 9.

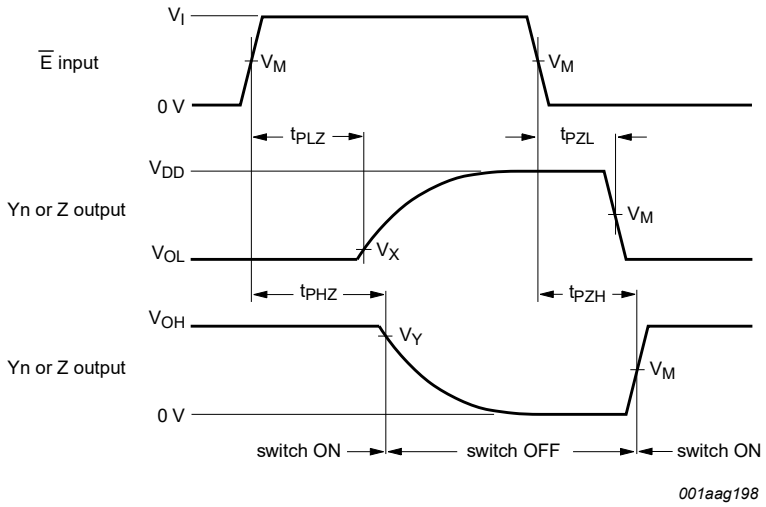
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

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



Measurement points are given in Table 9.

Fig. 10. An to Yn, Z propagation delays



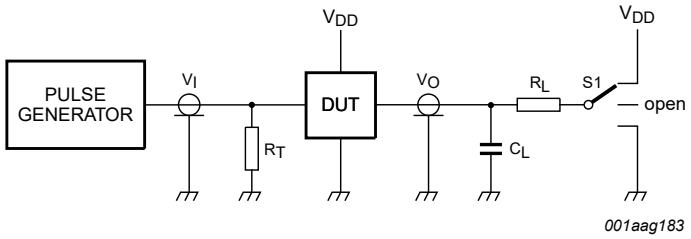
Measurement points are shown in Table 9.

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	0.5 × V_{DD}	GND to V_{DD}	0.5 × V_{DD}	10%	90%



Test data is given in Table 10.

Definitions test circuit:

R_T = termination resistance should be equal to output impedance Z_o 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 $\overline{E}$**	**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}	≤ 20 ns	0.5 × V_{DD}	50 pF	10 kΩ	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 V; T_{amb} = 25 °C.

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

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

Table 12. Dynamic power dissipationP_D

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

Symbol	Parameter	V_{DD}	Typical formula for P_D (µW)	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

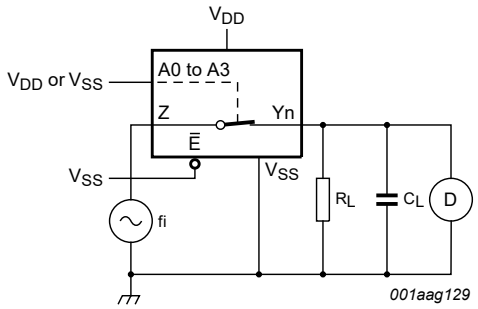


Fig. 13. Test circuit for measuring total harmonic distortion

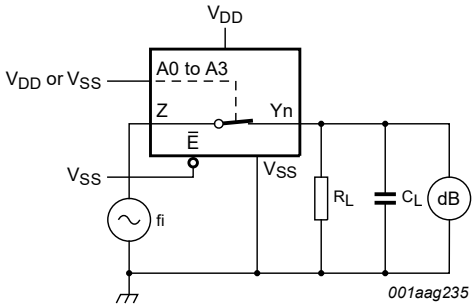


Fig. 14. Test circuit for measuring frequency response

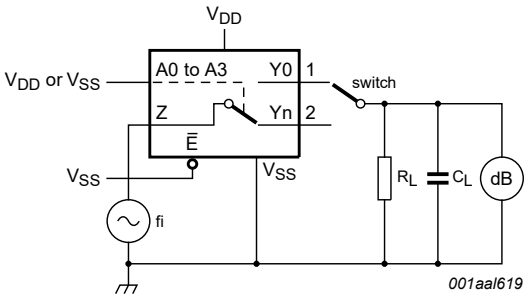
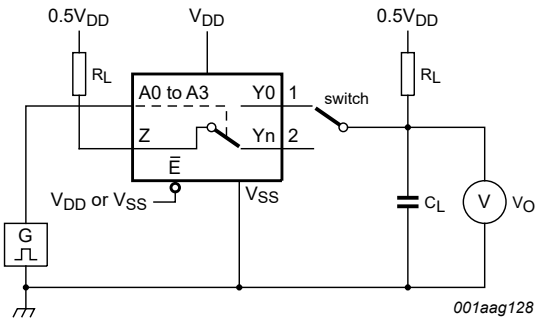
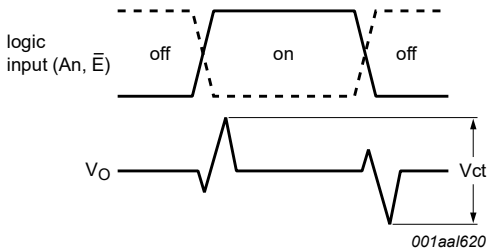


Fig. 15. Test circuit for measuring isolation (OFF-state)

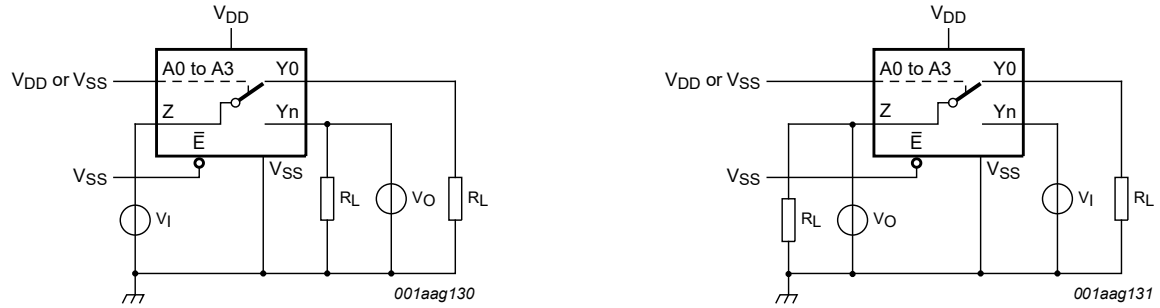


a. Test circuit



b. Input and output pulse definitions

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



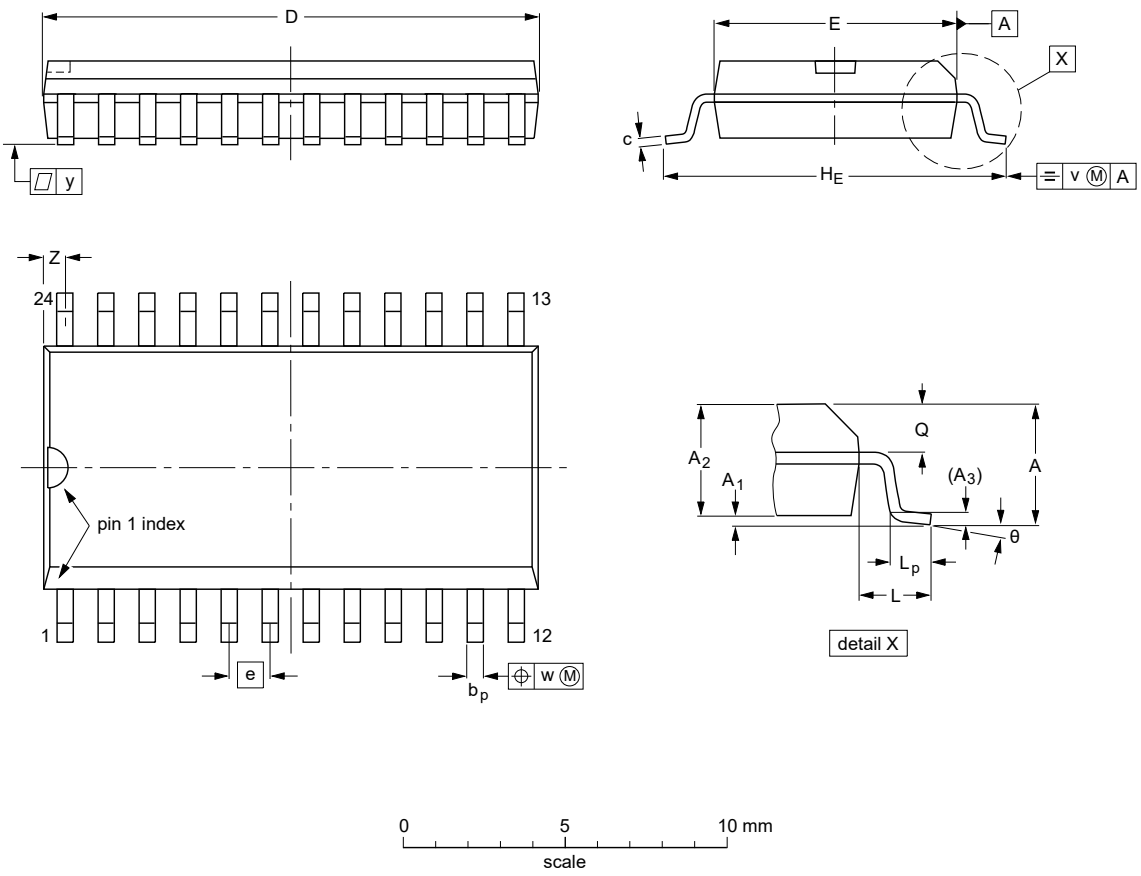
a. Switch closed condition

b. Switch open condition

Fig. 17. Test circuit for measuring crosstalk between switches

12. Package outline

SO24: plastic small outline package; 24 leads; body width 7.5 mm **SOT137-1**



DIMENSIONS (inch dimensions are derived from the original mm 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	2.65	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° 0°
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	

Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT137-1	075E05	MS-013				~~99-12-27~~ 03-02-19

Fig. 18. Package outline SOT137-1 (SO24)

13. Abbreviations

Table 13. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
MM	Machine Model

14. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4067B_Q100 v.3	20220110	Product data sheet	-	HEF4067B_Q100 v.2
Modifications:	• 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. • Section 1 and Section 2 updated.			
HEF4067B_Q100 v.2	20140911	Product data sheet	-	HEF4067B_Q100 v.1
Modifications:	• Fig. 16: Test circuit modified			
HEF4067B_Q100 v.1	20130924	Product data sheet	-	-

15. Legal information

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 https://www.nexperia.com.

Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Nexperia takes no responsibility for the content in this document if provided by an information source outside of Nexperia.

In no event shall Nexperia be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Nexperia's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of Nexperia.

Right to make changes — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use in automotive applications — This Nexperia product has been qualified for use in automotive applications. Unless otherwise agreed in writing, the product is not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an Nexperia product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Nexperia and its suppliers accept no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Nexperia does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Nexperia products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Nexperia does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nexperia.com/profile/terms, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

Contents

For more information, please visit: http://www.nexperia.com
For sales office addresses, please send an email to: salesaddresses@nexperia.com
Date of release: 6 January 2022