

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 (E). When 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

5. Functional diagram

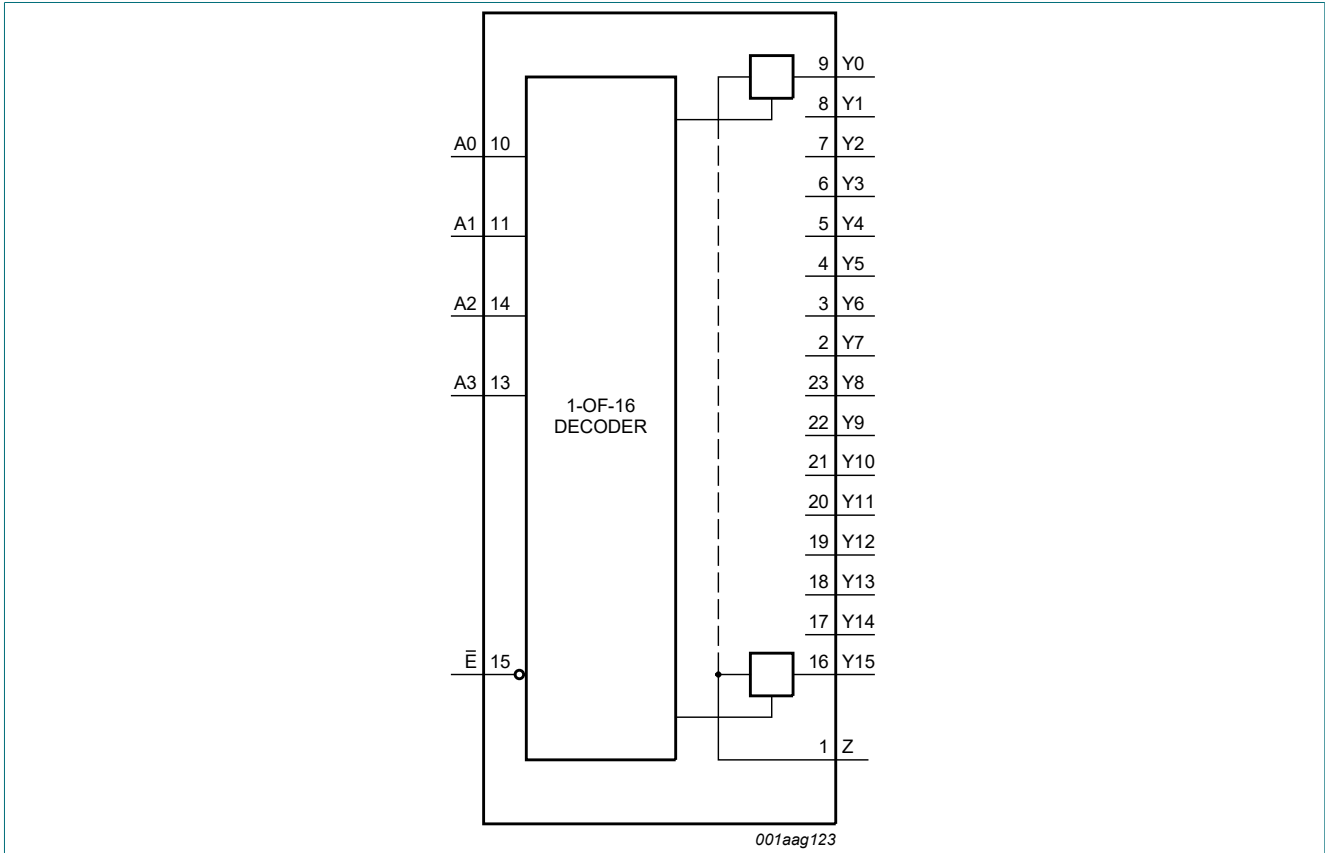


Fig. 1. Functional diagram

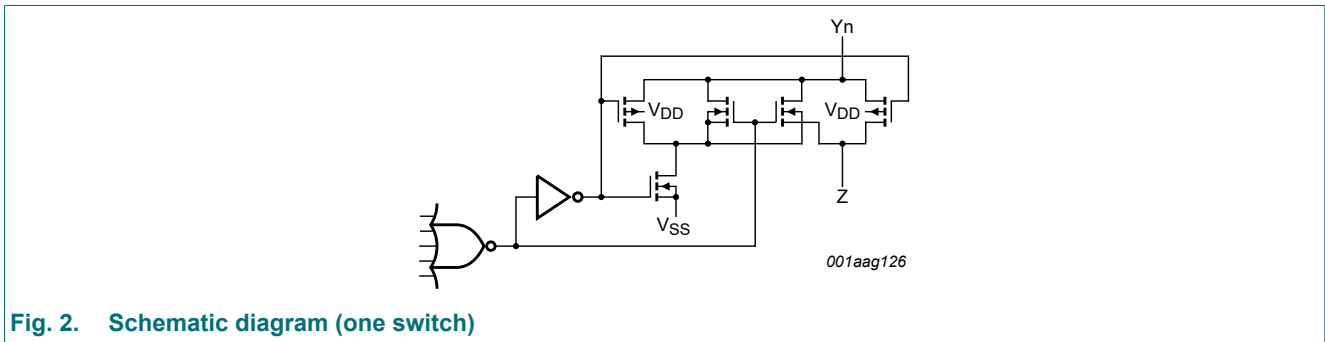


Fig. 2. Schematic diagram (one switch)

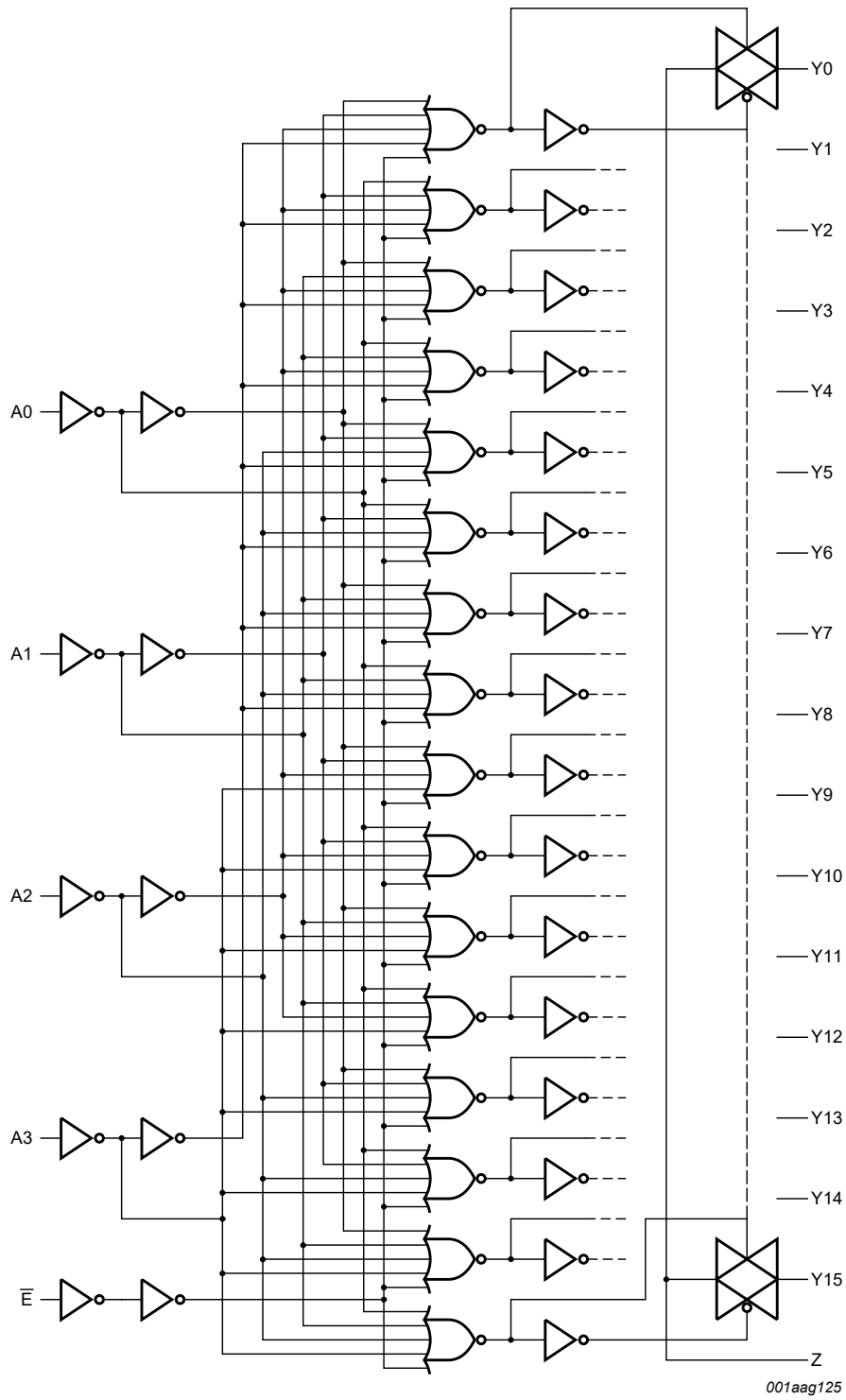


Fig. 3. Logic diagram

6. Pinning information

6.1. Pinning

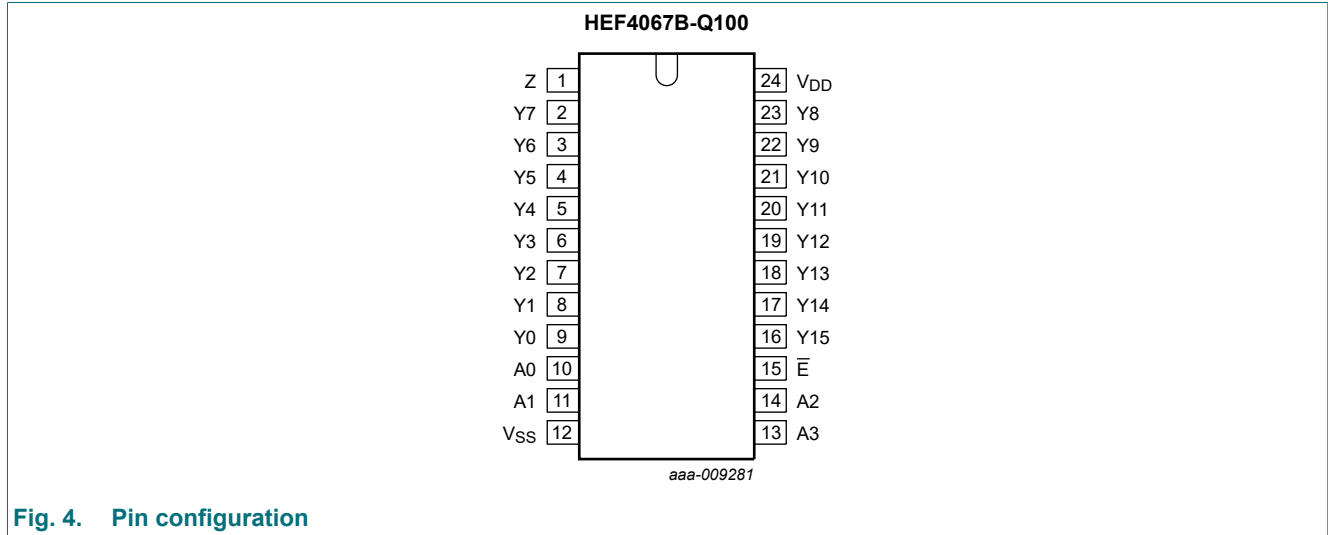


Fig. 4. Pin configuration

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)
\bar{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
	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 $V_{SS} = 0\text{ V}$ (ground).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DD}	supply voltage		-0.5	+18	V
I_{IK}	input clamping current	pins An and \bar{E} ; $V_I < -0.5\text{ V}$ 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
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	$T_{amb} = -40\text{ °C}$ to $+85\text{ °C}$	-	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
$\Delta t/\Delta V$	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}	$T_{amb} = -40\text{ °C}$		$T_{amb} = +25\text{ °C}$		$T_{amb} = +85\text{ °C}$		Unit
				Min	Max	Min	Max	Min	Max	
V_{IL}	LOW-level input voltage	$ I_{O1} < 1\ \mu\text{A}$								
		$V_O = 0.5\text{ V}$ or 4.5 V	5 V	-	1	-	1	-	1	V
		$V_O = 1.0\text{ V}$ or 9.0 V	10 V	-	2	-	2	-	2	V
		$V_O = 1.5\text{ V}$ or 13.5 V	15 V	-	2.5	-	2.5	-	2.5	V
V_{IH}	HIGH-level input voltage	$ I_{O1} < 1\ \mu\text{A}$								
		$V_O = 0.5\text{ V}$ or 4.5 V	5 V	4	-	4	-	4	-	V
		$V_O = 1.0\text{ V}$ or 9.0 V	10 V	8	-	8	-	8	-	V
		$V_O = 1.5\text{ V}$ or 13.5 V	15 V	12.5	-	12.5	-	12.5	-	V
I_I	input leakage current	$V_I = 0\text{ V}$ 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; $I_O = 0\text{ A}$	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

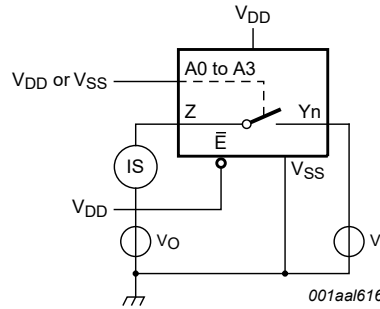


Fig. 5. Test circuit for measuring OFF-state leakage current Z port

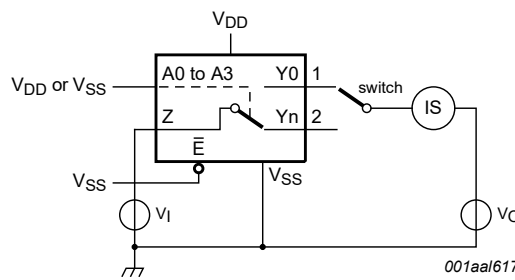


Fig. 6. Test circuit for measuring OFF-state leakage current Yn port

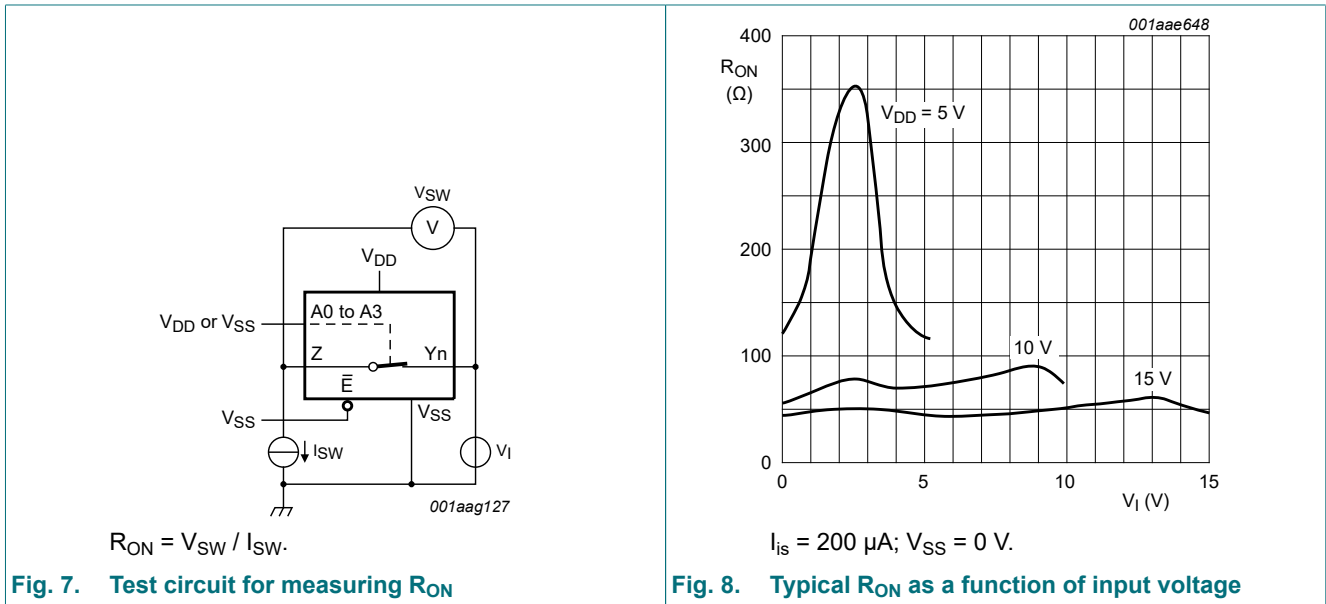
10.2. On resistance

Table 7. ON resistance

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

Symbol	Parameter	Conditions	V _{DD}	Typ	Max	Unit
R _{ON(peak)}	ON resistance (peak)	V _I = 0 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



11. Dynamic characteristics

Table 8. Dynamic characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$; $V_{SS} = 0\text{ V}$; for test circuit see Fig. 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 Fig. 9	5 V	-	30	60	ns
			10 V	-	15	25	ns
			15 V	-	10	20	ns
		A_n to Y_n, 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	Y_n, Z to Z, Y_n ; see Fig. 9	5 V	-	25	50	ns
			10 V	-	10	20	ns
			15 V	-	10	20	ns
		A_n to Y_n, 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	\bar{E} to Y_n, 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	\bar{E} to Y_n, 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	\bar{E} to Y_n, 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	\bar{E} to Y _n , 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

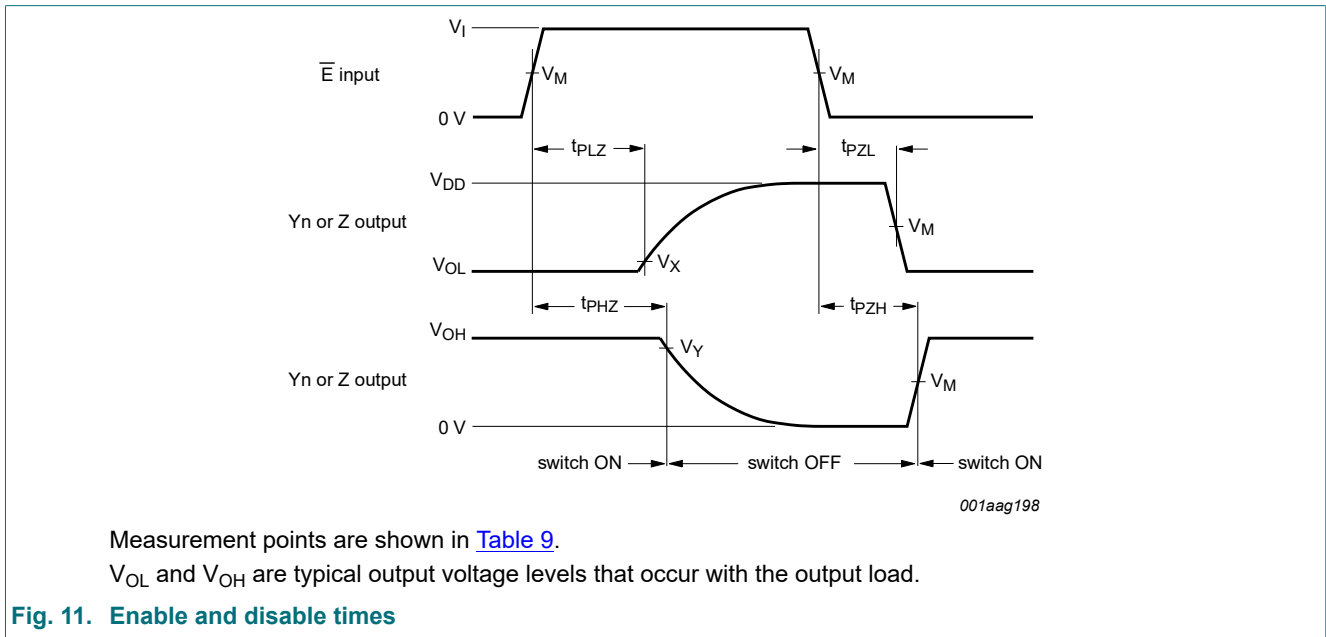
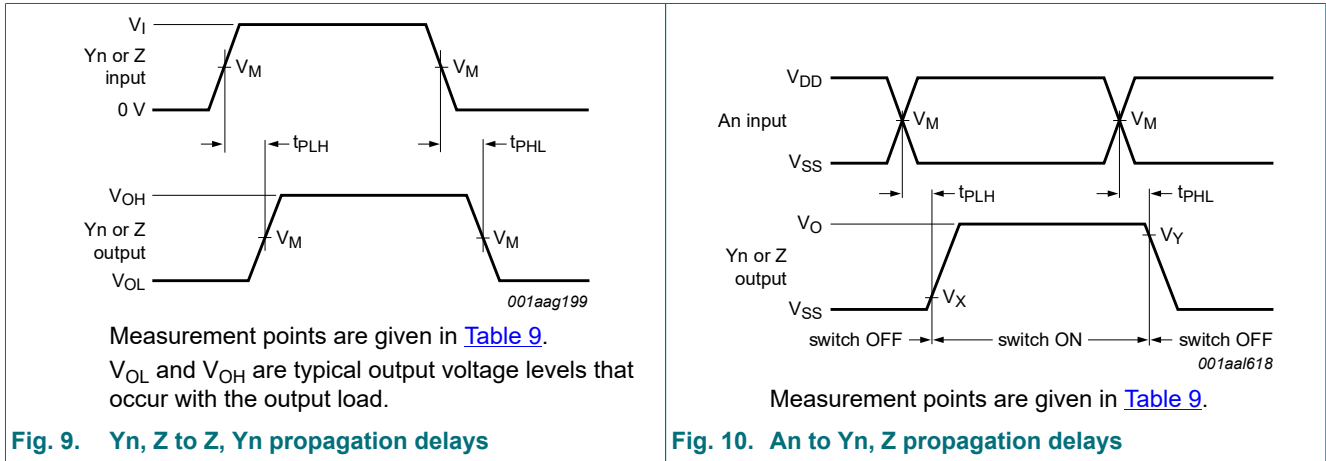


Table 9. Measurement points

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%

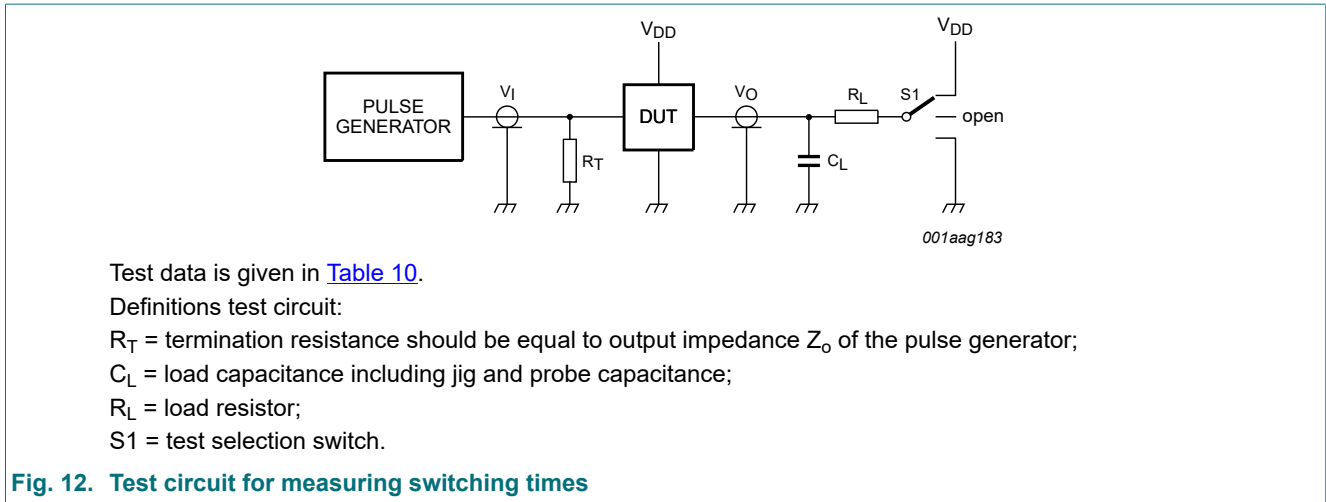


Fig. 12. Test circuit for measuring switching times

Table 10. Test data

Input				Load		S1 position				
Yn, Z	An and 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	$0.5 \times V_{DD}$	50 pF	10 k Ω	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 ; $R_L = 10$ k Ω ; $C_L = 15$ pF; channel ON; $V_I = 0.5 \times V_{DD}$ (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 ; $R_L = 1$ k Ω ; $C_L = 5$ pF; channel ON; $V_I = 0.5 \times V_{DD}$ (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; $R_L = 1$ k Ω ; $C_L = 5$ pF; [1] channel OFF; $V_I = 0.5 \times V_{DD}$ (p-p)	10 V	-50	-	dB
V_{ct}	crosstalk voltage	digital inputs to switch; see Fig. 16 ; $R_L = 10$ k Ω ; $C_L = 15$ pF; \bar{E} or An = V_{DD} (square-wave)	10 V	50	-	mV
Xtalk	crosstalk	between switches; see Fig. 17 ; $f_i = 1$ MHz; $R_L = 1$ k Ω ; $V_I = 0.5 \times V_{DD}$ (p-p)	[1] 10 V	-50	-	dB

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

Table 12. Dynamic power dissipation P_D

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

Symbol	Parameter	V_{DD}	Typical formula for P_D (μ 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

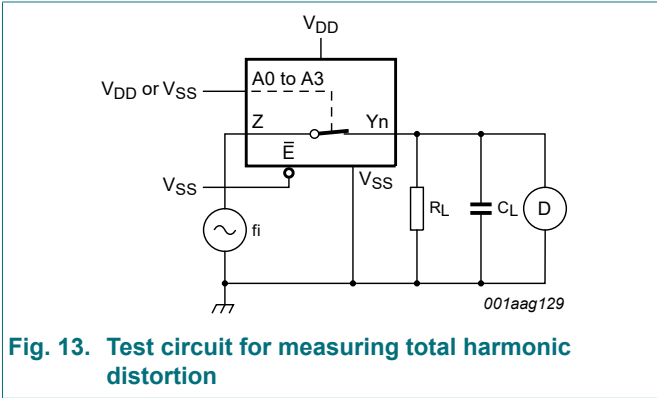


Fig. 13. Test circuit for measuring total harmonic distortion

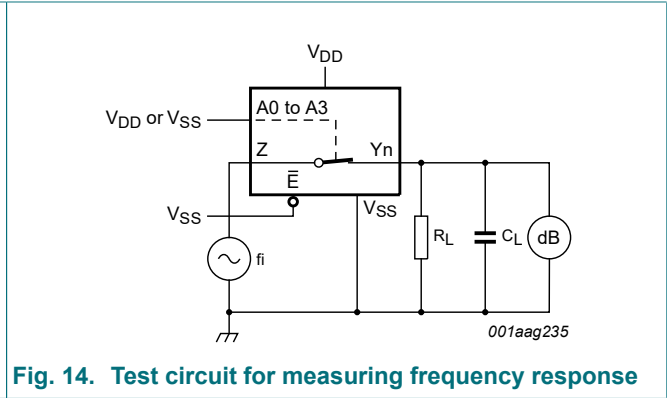


Fig. 14. Test circuit for measuring frequency response

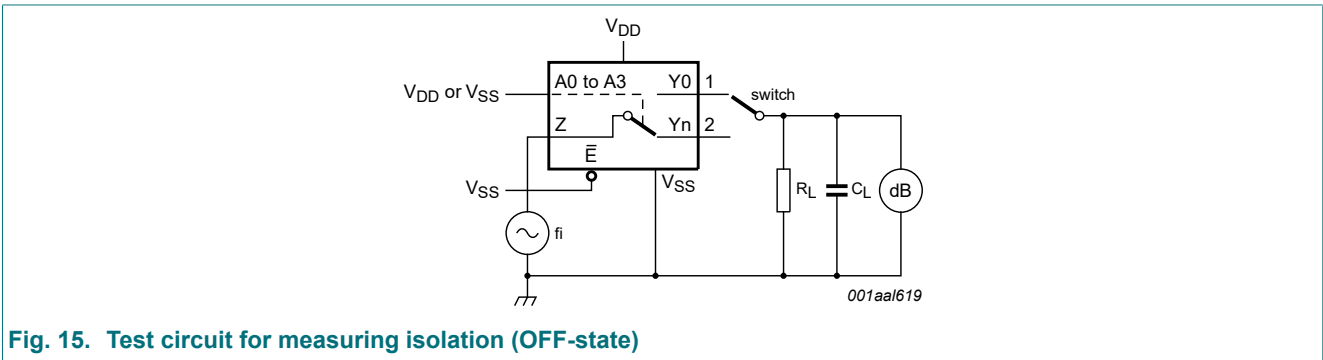


Fig. 15. Test circuit for measuring isolation (OFF-state)

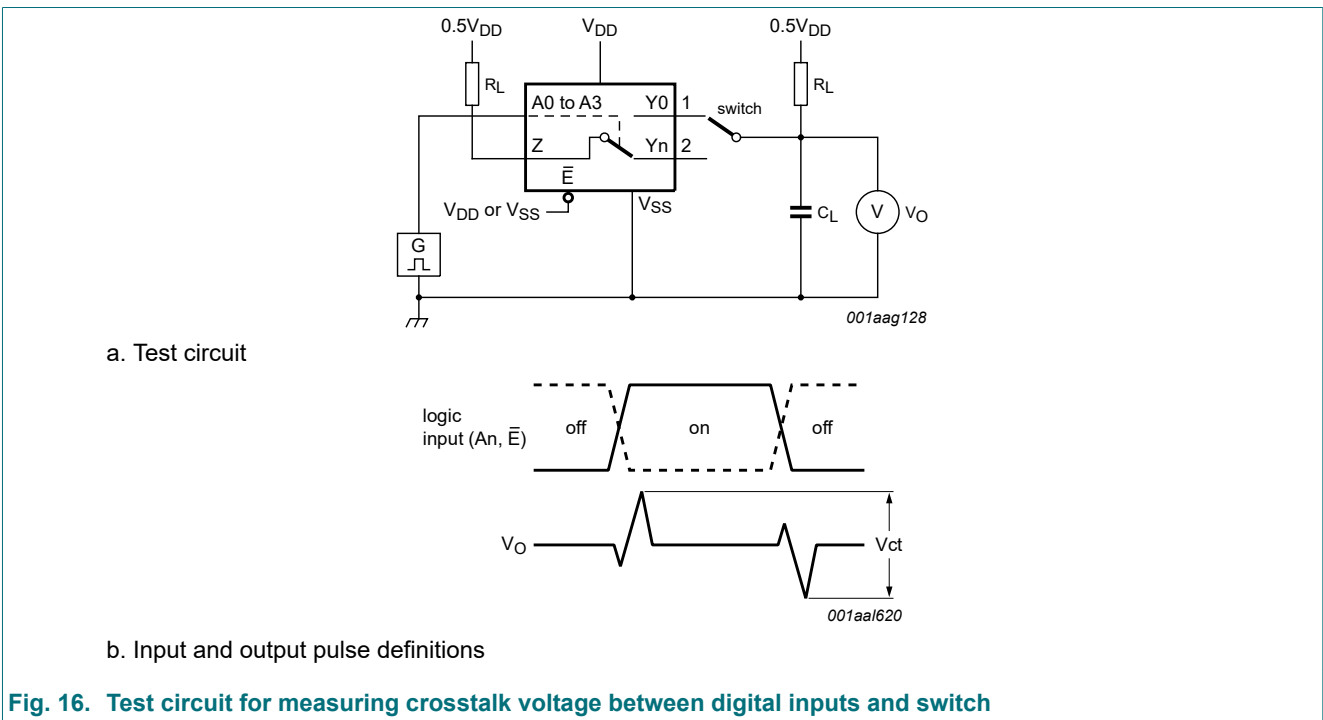


Fig. 16. Test circuit for measuring crosstalk voltage between digital inputs and switch

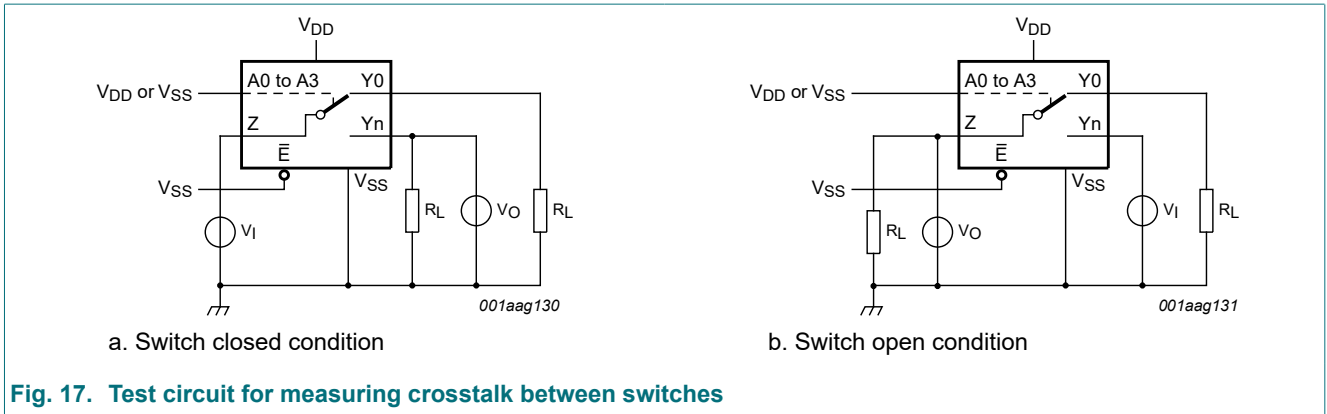


Fig. 17. Test circuit for measuring crosstalk between switches

12. Package outline

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

SOT137-1

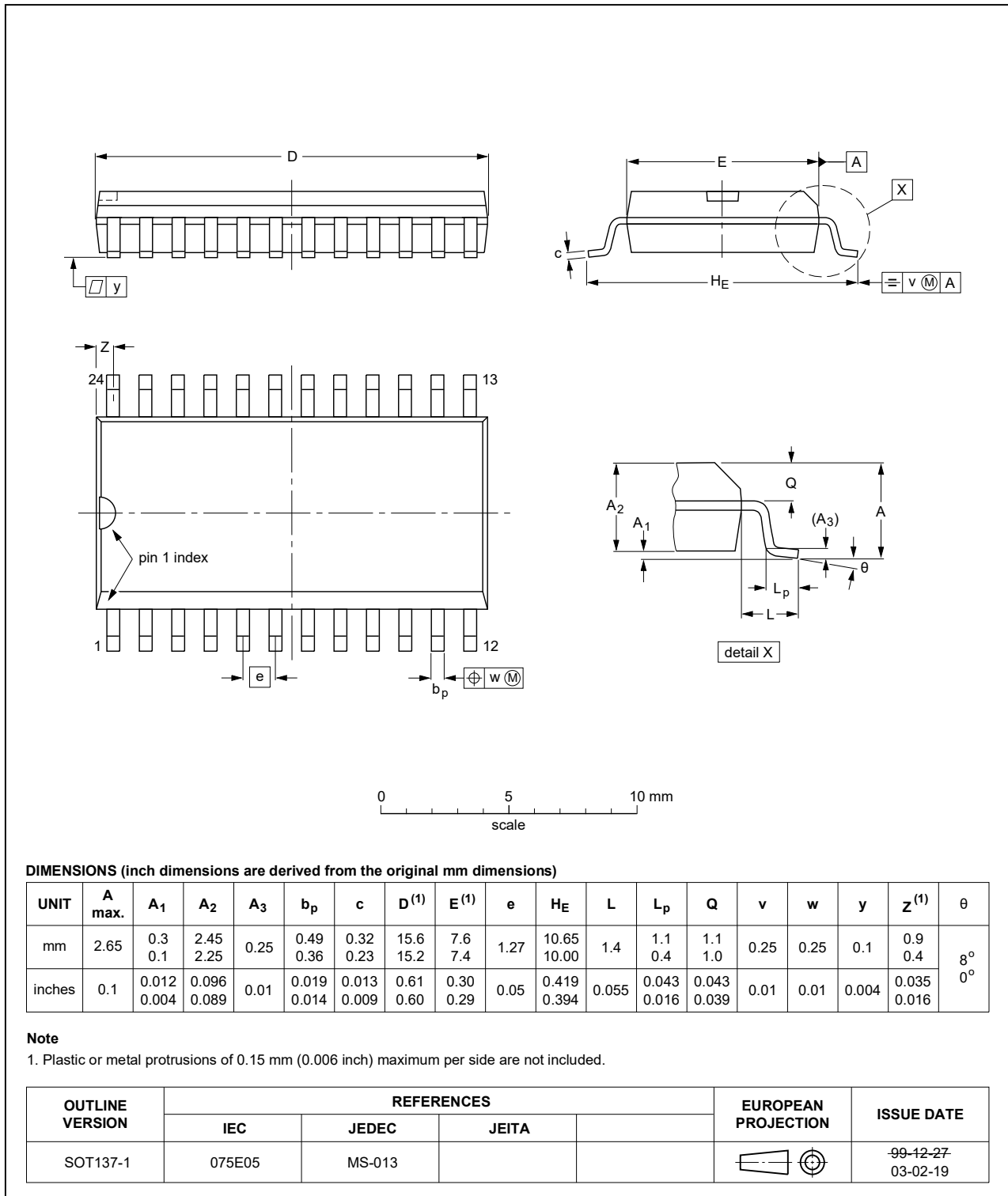


Fig. 18. Package outline SOT137-1 (SO24)

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:	<ul style="list-style-type: none"> 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:	<ul style="list-style-type: none"> 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.

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