HEF4066B-Q100

Quad single-pole single-throw analog switch

Rev. 4 — 21 December 2021 Product data sheet

1. General description

The HEF4066B-Q100 is a quad single pole, single throw analog switch. Each switch features two input/output terminals (nY and nZ) and an active HIGH enable input (nE). When nE is LOW, the analog switch is 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 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from -40 °C to +85 °C and from -40 °C to +125 °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-833, 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

- Industrial and automotive
- 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
HEF4066BT-Q100	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1

5. Functional diagram

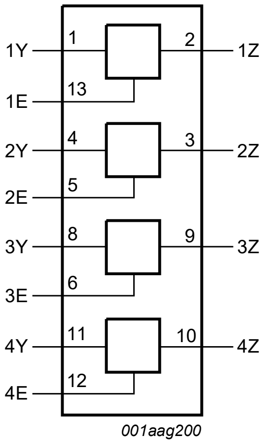


Fig. 1. Functional diagram

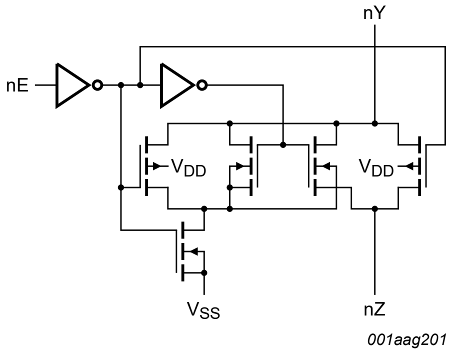


Fig. 2. Logic diagram (one switch)

6. Pinning information

6.1. Pinning

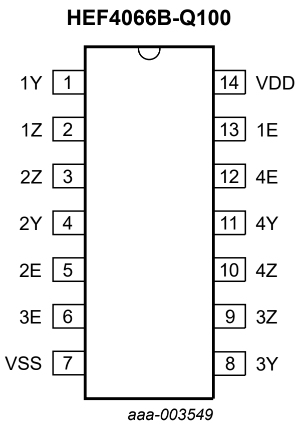


Fig. 3. Pin configuration

6.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1Y, 2Y, 3Y, 4Y	1, 4, 8, 11	independent input or output
1Z, 2Z, 3Z, 4Z	2, 3, 9, 10	independent input or output
1E, 2E, 3E, 4E	13, 5, 6, 12	enable input (active HIGH)
V_{SS}	7	ground (0 V)
V_{DD}	14	supply voltage

7. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level.

Input nE	Switch
H	ON
L	OFF

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	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
T_{stg}	storage temperature		-65	+150	°C
T_{amb}	ambient temperature		-40	+125	°C
P_{tot}	total power dissipation	T_{amb} = -40 °C to +125 °C [2]	-	500	mW
P	power dissipation	per switch	-	100	mW

[1] To avoid drawing V_{DD} current out of terminal nZ, when switch current flows into terminals nY, the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal nZ, no V_{DD} current will flow out of terminals nY, in this case there is no limit for the voltage drop across the switch, but the voltages at nY and nZ may not exceed V_{DD} or V_{SS}.

[2] For SOT108-1 (SO14) package: P_{tot} derates linearly with 10.1 mW/K above 100 °C.

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	-	+125	°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		T_{amb} = +125 °C		Unit
				Min	Max	Min	Max	Min	Max	Min	Max	
V_{IH}	HIGH-level input voltage	$\lvert I_O \rvert$ < 1 μA	5 V	3.5	-	3.5	-	3.5	-	3.5	-	V
			10 V	7.0	-	7.0	-	7.0	-	7.0	-	V
			15 V	11.0	-	11.0	-	11.0	-	11.0	-	V
V_{IL}	LOW-level input voltage	$\lvert I_O \rvert$ < 1 μA	5 V	-	1.5	-	1.5	-	1.5	-	1.5	V
			10 V	-	3.0	-	3.0	-	3.0	-	3.0	V
			15 V	-	4.0	-	4.0	-	4.0	-	4.0	V
I_I	input leakage current		15 V	-	±0.1	-	±0.1	-	±1.0	-	±1.0	μA
$I_{S(OFF)}$	OFF-state leakage current	per channel; see Fig. 4	15 V	-	-	-	200	-	-	-	-	nA
I_{DD}	supply current	all valid input combinations	5 V	-	1.0	-	1.0	-	7.5	-	7.5	μA
			10 V	-	2.0	-	2.0	-	15.0	-	15.0	μA
			15 V	-	4.0	-	4.0	-	30.0	-	30.0	μA
C_I	input capacitance	nE input	-	-	-	-	7.5	-	-	-	-	pF

10.1. Test circuit

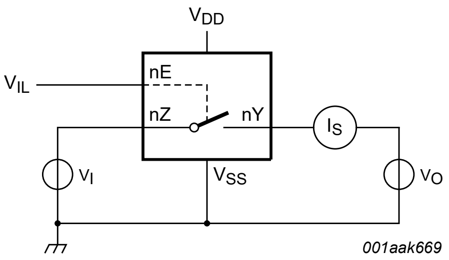


Fig. 4. Test circuit for measuring OFF-state leakage current

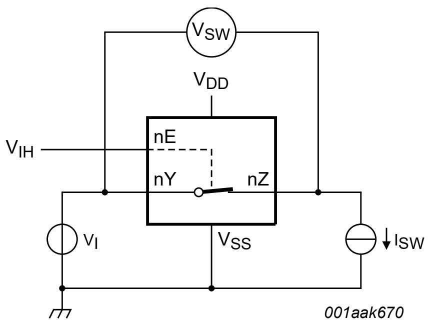
10.2. ON resistance

Table 7. ON resistance

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

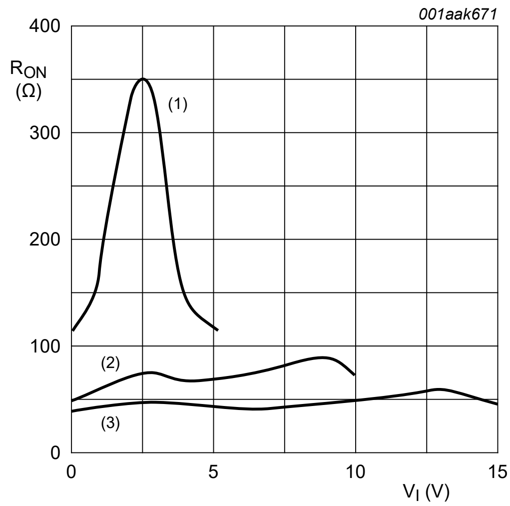
Symbol	Parameter	Conditions	V_{DD}	Typ	Max	Unit
$R_{ON(peak)}$	ON resistance (peak)	V_I = 0 V to V_{DD}; see Fig. 5 and Fig. 6.	5 V	350	2500	Ω
			10 V	80	245	Ω
			15 V	60	175	Ω
$R_{ON(rail)}$	ON resistance (rail)	V_I = 0 V; see Fig. 5 and Fig. 6.	5 V	115	340	Ω
			10 V	50	160	Ω
			15 V	40	115	Ω
		V_I = V_{DD}; see Fig. 5 and Fig. 6.	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. 5	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. 5. Test circuit for measuring R_{ON}



I_{SW} = 200 μA.

(1) V_{DD} = 5 V

(2) V_{DD} = 10 V

(3) V_{DD} = 15 V

Fig. 6. 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. 9.

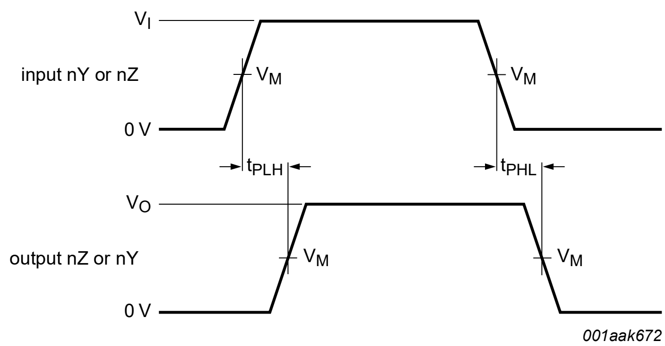
Symbol	Parameter	Conditions	V_{DD}	Typ	Max	Unit
t_{PHL}	HIGH to LOW propagation delay	nY, nZ to nZ, nY; see Fig. 7	5 V	10	20	ns
			10 V	5	10	ns
			15 V	5	10	ns
		nY, nZ to nZ, nY; see Fig. 7	5 V	10	20	ns
			10 V	5	10	ns
			15 V	5	10	ns
t_{PHZ}	HIGH to OFF-state propagation delay	nE to nY, nZ; see Fig. 8	5 V	80	160	ns
			10 V	65	130	ns
			15 V	60	120	ns
t_{PZH}	OFF-state to HIGH propagation delay	nE to nY, nZ; see Fig. 8	5 V	40	80	ns
			10 V	20	40	ns
			15 V	15	30	ns
t_{PLZ}	LOW to OFF-state propagation delay	nE to nY, nZ; see Fig. 8	5 V	80	160	ns
			10 V	70	140	ns
			15 V	70	140	ns
t_{PZL}	OFF-state to LOW propagation delay	nE to nY, nZ; see Fig. 8	5 V	45	90	ns
			10 V	20	40	ns
			15 V	15	30	ns

Table 9. Dynamic power dissipation

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

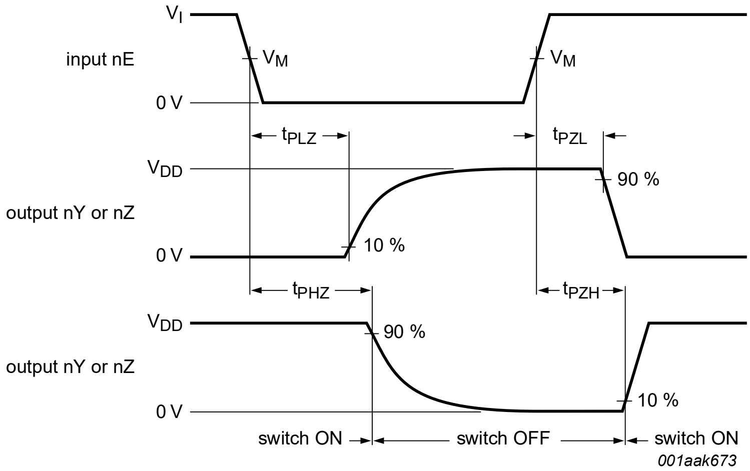
Symbol	Parameter	V_{DD}	Typical formula for P_D (μW)	where:
P_D	dynamic power dissipation	5 V	$P_D = 2500 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f_i = input frequency in MHz; f_o = output frequency in MHz; C_L = output load capacitance in pF; V_{DD} = supply voltage in V; $\Sigma(C_L \times f_o)$ = sum of the outputs.
		10 V	$P_D = 11500 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	
		15 V	$P_D = 29000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	

11.1. Waveforms and test circuit



Measurement points are given in Table 10.

Fig. 7. nY or nZ to nZ or nY propagation delays

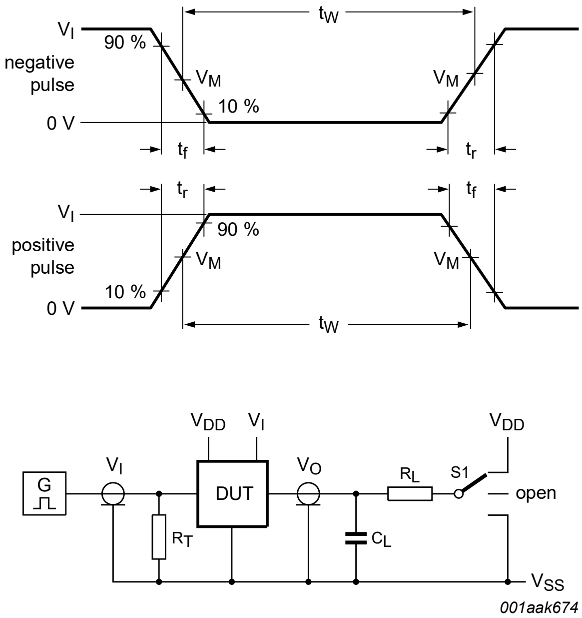


Measurement points are given in Table 10.

Fig. 8. Enable and disable times

Table 10. Measurement points

Supply voltage	Input	Output
V_{DD}	V_M	V_M
5 V to 15 V	$0.5V_{DD}$	$0.5V_{DD}$



Test data is given in Table 11.

Definitions:

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator.

C_L = Load capacitance including test jig and probe.

R_L = Load resistance.

Fig. 9. Test circuit for measuring switching times

Table 11. Test data

Supply voltage	Input		Load		S1 position		
V_{DD}	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
5 V to 15 V	0 V or V_{DD}	≤ 20 ns	50 pF	10 kΩ	V_{SS}	V_{SS}	V_{DD}

11.2. Additional dynamic parameters

Table 12. 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. 10; R_L = 10 kΩ; C_L = 15 pF; channel ON; V_I = 0.5V_{DD} (p-p); f_i = 1 kHz	[1]	5 V	0.25	-	%
				10 V	0.04	-	%
				15 V	0.04	-	%
V_{ct}	crosstalk voltage	nE input to switch; see Fig. 11; R_L = 10 kΩ; C_L = 15 pF; nE = V_{DD} (square-wave)		10 V	50	-	mV
Xtalk	crosstalk	between switches; see Fig. 12; f_i = 1 MHz; R_L = 1 kΩ; V_I = 0.5V_{DD} (p-p)	[1]	10 V	-50	-	dB
α_{iso}	isolation (OFF-state)	see Fig. 13; f_i = 1 MHz; R_L = 1 kΩ; C_L = 5 pF; V_I = 0.5V_{DD} (p-p)	[1]	10 V	-50	-	dB
$f_{(-3dB)}$	-3 dB frequency response	see Fig. 14; R_L = 1 kΩ; C_L = 5 pF; V_I = 0.5V_{DD} (p-p)	[1]	10 V	90	-	MHz

[1] f_i is biased at 0.5V_{DD}.

11.2.1. Test circuits

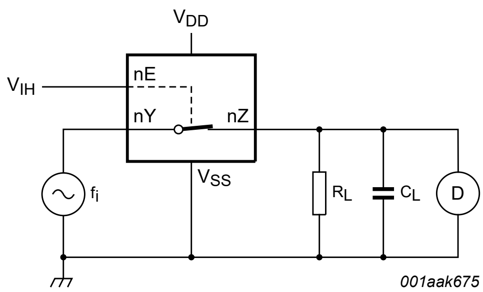
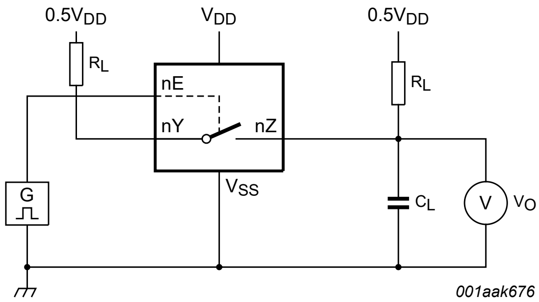
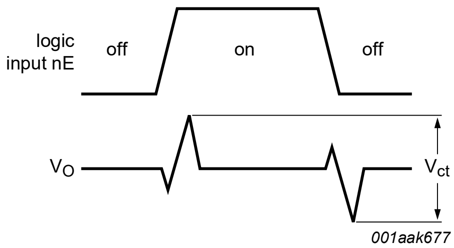


Fig. 10. Test circuit for measuring total harmonic distortion

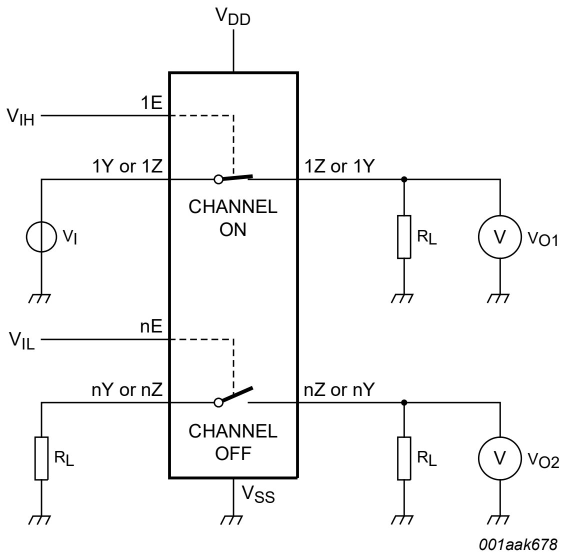


a. Test circuit



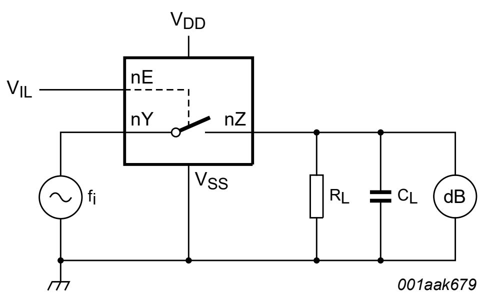
b. Input and output pulse definitions

Fig. 11. Test circuit for measuring crosstalk voltage between digital input and switch



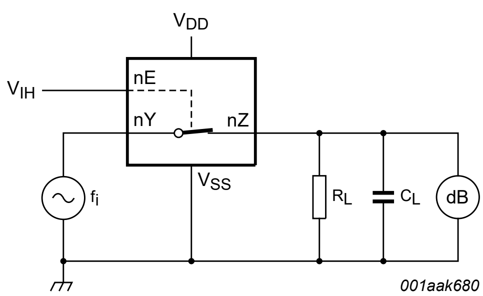
$20 \log_{10} (V_{O2} / V_{O1})$ or $20 \log_{10} (V_{O1} / V_{O2})$.

Fig. 12. Test circuit for measuring crosstalk between switches



Adjust f_i voltage to obtain 0 dBm level at input.

Fig. 13. Test circuit for measuring isolation (OFF-state)

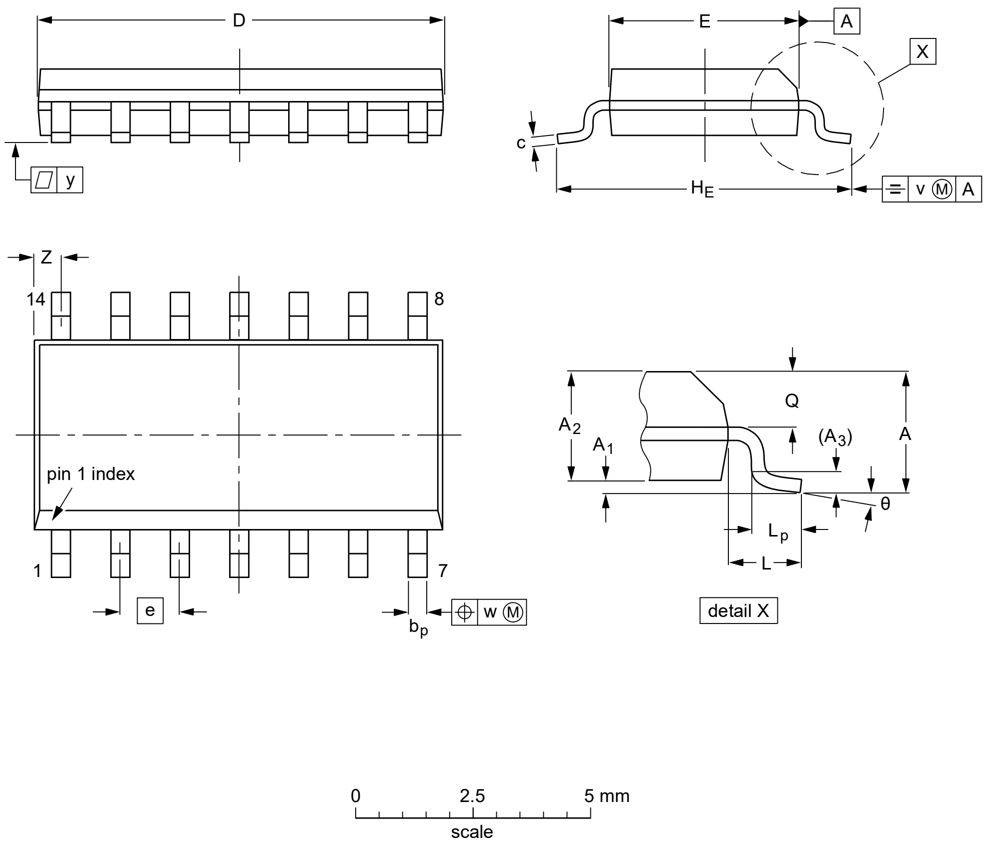


Adjust f_i voltage to obtain 0 dBm level at output.
Increase f_i frequency until dB meter reads -3 dB.

Fig. 14. Test circuit for measuring frequency response

12. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm **SOT108-1**



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	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.35 0.34	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

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			
SOT108-1	076E06	MS-012				~~99-12-27~~ 03-02-19

Fig. 15. Package outline SOT108-1 (SO14)

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
HEF4066B_Q100 v.4	20211221	Product data sheet	-	HEF4066B_Q100 v.3
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. • Table 4: Derating values for P_{tot} total power dissipation updated.			
HEF4066B_Q100 v.3	20160419	Product data sheet	-	HEF4066B_Q100 v.2
Modifications:	• Table 4: Condition for total power dissipation changed (errata). • Table 4: Maximum ambient temperature changed (errata).			
HEF4066B_Q100 v.2	20140911	Product data sheet	-	HEF4066B_Q100 v.1
Modifications:	• Fig. 11: Test circuit modified.			
HEF4066B_Q100 v.1	20120807	Product specification	-	-

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.

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