HEF4104B-Q100

Quad low-to-high voltage translator with 3-state outputs

Rev. 1 — 24 March 2014 **Product data sheet**

1. General description

The HEF4104B-Q100 is a quad low voltage-to-high voltage translator with 3-state outputs. It provides the capability of interfacing low voltage circuits to high-voltage circuits. For example, low voltage Local Oxidation Complementary MOS (LOCMOS) and Transistor-Transistor Logic (TTL) to high-voltage LOCMOS. It has four data inputs (A0 to A3) and an active HIGH output enable input (OE). It also has four data outputs (B0 to B3) with their complements ($\overline{B0}$ to $\overline{B3}$).

With OE = HIGH, the outputs B0 to B3 and $\overline{B0}$ to $\overline{B3}$ are in the low impedance ON-state. The inputs A0 to A3 determine whether it is HIGH or LOW. With OE = LOW, the outputs B0 to B3 and $\overline{B0}$ to $\overline{B3}$ are in the high-impedance OFF-state.

It uses a common negative supply (V_{SS}) and separate positive supplies for the inputs ($V_{DD(A)}$) and the outputs ($V_{DD(B)}$). $V_{DD(A)}$ must always be less than or equal to $V_{DD(B)}$, even during power turn-on and turn-off. For the permissible operating range of $V_{DD(A)}$ and $V_{DD(B)}$, see Figure 4.

Each input protection circuit is terminated between $V_{DD(B)}$ and V_{SS}. It allows the input signals to be driven from any potential between $V_{DD(B)}$ and V_{SS}, without regard to current limiting. When driving from potentials greater than $V_{DD(B)}$ or less than V_{SS}, the current at each input must be limited to 10 mA.

It operates over a recommended V_{DD} power supply range of 3 V to 15 V referenced to V_{SS} (usually ground). Unused inputs must be connected to V_{DD}, V_{SS}, or another input.

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
- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Inputs and outputs are protected against electrostatic effects
- 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. Ordering information

Table 1. Ordering information

All types operate from –40 °C to +85 °C.

Type number	Package		
	Name	Description	Version
HEF4104BT-Q100	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

4. Functional diagram

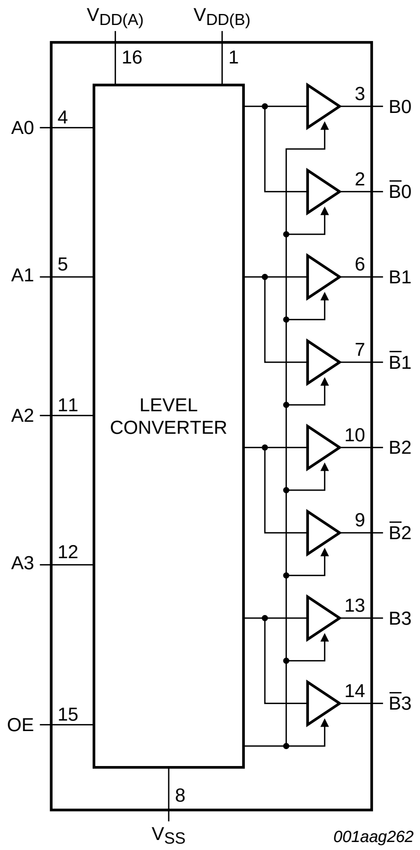


Fig 1. Logic symbol

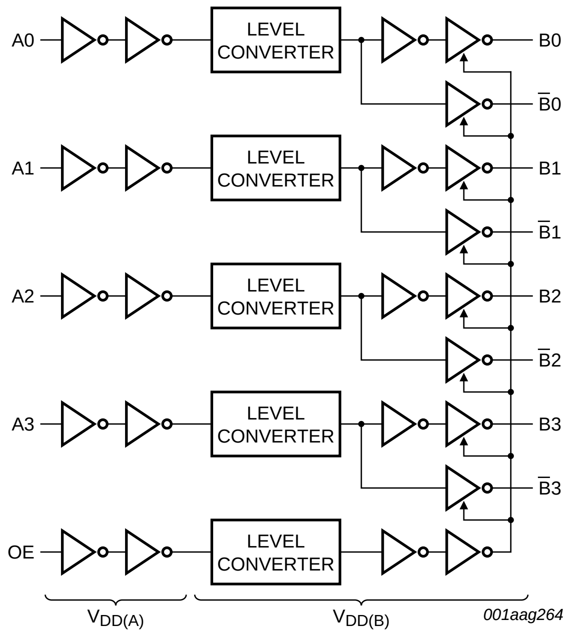


Fig 2. Logic diagram

5. Pinning information

5.1 Pinning

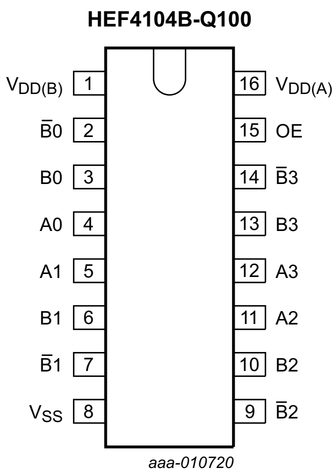


Fig 3. Pin configuration

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$V_{DD(B)}$	1	supply voltage port B
$\overline{B}0$ to $\overline{B}3$	2, 7, 9, 14	complementary data output
B0 to B3	3, 6, 10, 13	data output
A0 to A3	4, 5, 11, 12	data input
V_{SS}	8	common negative supply voltage (0 V)
OE	15	output enable input
$V_{DD(A)}$	16	supply voltage port A

6. Functional description

Table 3. Function table[1]

Control	Output	
OE	**Bn**	**$\overline{B}n$**
H	An	$\overline{A}n$
L	Z	Z

[1] H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

7. 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
$V_{DD(A)}$	supply voltage A	port A; $V_{DD(A)} \leq V_{DD(B)}$	−0.5	+18	V
$V_{DD(B)}$	supply voltage B	port B; $V_{DD(B)} \geq V_{DD(A)}$	−0.5	+18	V
I_{IK}	input clamping current	$V_I < -0.5$ V or $V_I > V_{DD(A)} + 0.5$ V	-	±10	mA
V_I	input voltage		−0.5	$V_{DD(A)} + 0.5$	V
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{DD(B)} + 0.5$ V	-	±10	mA
$I_{I/O}$	input/output current		-	±10	mA
I_{DD}	supply current	[1]	-	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 [2]	-	500	mW
P	power dissipation	per output	-	100	mW

[1] I_{DD} is the combined current of $I_{DD(A)}$ and $I_{DD(B)}$.

[2] For SO16 packages: above T_{amb} = 70 °C, P_{tot} derates linearly at 8 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DD(A)}$	supply voltage A		3	-	$\leq V_{DD(B)}$	V
$V_{DD(B)}$	supply voltage B		$\geq V_{DD(A)}$	-	15	V
V_I	input voltage		0	-	$V_{DD(A)}$	V
T_{amb}	ambient temperature	in free air	−40	-	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{DD(A)}$ = 5 V	-	-	3.75	μs/V
		$V_{DD(A)}$ = 10 V	-	-	0.5	μs/V
		$V_{DD(A)}$ = 15 V	-	-	0.08	μs/V

9. Static characteristics

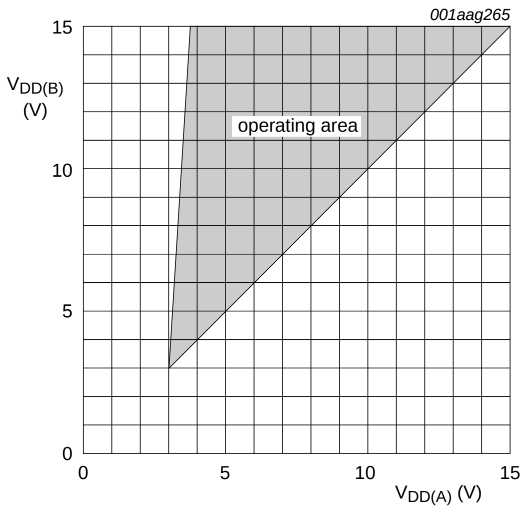
Table 6. Static characteristics

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

Symbol	Parameter	Conditions	V_{DD} [1]	T_{amb} = −40 °C		T_{amb} = +25 °C		T_{amb} = +85 °C		Unit
				Min	Max	Min	Max	Min	Max	
V_{IH}	HIGH-level input voltage	$\|I_O\|$ < 1 μA	5 V	3.5	-	3.5	-	3.5	-	V
			10 V	7.0	-	7.0	-	7.0	-	V
			15 V	11.0	-	11.0	-	11.0	-	V
V_{IL}	LOW-level input voltage	$\|I_O\|$ < 1 μA	5 V	-	1.5	-	1.5	-	1.5	V
			10 V	-	3.0	-	3.0	-	3.0	V
			15 V	-	4.0	-	4.0	-	4.0	V
V_{OH}	HIGH-level output voltage	$\|I_O\|$ < 1 μA	5 V	4.95	-	4.95	-	4.95	-	V
			10 V	9.95	-	9.95	-	9.95	-	V
			15 V	14.95	-	14.95	-	14.95	-	V
V_{OL}	LOW-level output voltage	$\|I_O\|$ < 1 μA	5 V	-	0.05	-	0.05	-	0.05	V
			10 V	-	0.05	-	0.05	-	0.05	V
			15 V	-	0.05	-	0.05	-	0.05	V
I_{OH}	HIGH-level output current	V_O = 2.5 V	5 V	-	−1.7	-	−1.4	-	−1.1	mA
		V_O = 4.6 V	5 V	-	−0.52	-	−0.44	-	−0.36	mA
		V_O = 9.5 V	10 V	-	−1.3	-	−1.1	-	−0.9	mA
		V_O = 13.5 V	15 V	-	−3.6	-	−3.0	-	−2.4	mA
I_{OL}	LOW-level output current	V_O = 0.4 V	5 V	0.52	-	0.44	-	0.36	-	mA
		V_O = 0.5 V	10 V	1.3	-	1.1	-	0.9	-	mA
		V_O = 1.5 V	15 V	3.6	-	3.0	-	2.4	-	mA
I_I	input leakage current		15 V	-	±0.3	-	±0.3	-	±1.0	μA
I_{DD}	supply current	all valid input combinations; I_O = 0 A	5 V [2]	-	20	-	20	-	150	μA
			10 V	-	40	-	40	-	300	μA
			15 V	-	80	-	80	-	600	μA
I_{OZ}	OFF-state output current	HIGH level; $V_O = V_{DD(B)}$	15 V	-	1.6	-	1.6	-	12.0	μA
		LOW level; $V_O = V_{SS}$	15 V	-	−1.6	-	−1.6	-	−12.0	μA
C_I	input capacitance	digital inputs	-	-	-	-	7.5	-	-	pF

[1] V_{DD} is the same as $V_{DD(A)}$ and $V_{DD(B)}$.

[2] I_{DD} is the combined current of $I_{DD(A)}$ and $I_{DD(B)}$.



The shaded area shows the permissible operating range.

Fig 4. **$V_{DD(B)}$ as a function of $V_{DD(A)}$**

10. Dynamic characteristics

Table 7. Dynamic characteristics

T_{amb} = 25 °C, unless otherwise specified. For test circuit, see Figure 7.

Symbol	Parameter	Conditions	Extrapolation formula[1]	Min	Typ	Max	Unit
t_{PHL}	HIGH to LOW propagation delay	An to Bn, $\overline{Bn}$; see Figure 5					
		$V_{DD(A)}$ = $V_{DD(B)}$ = 5 V	143 ns + (0.55 ns/pF)C_L	-	170	340	ns
		$V_{DD(A)}$ = $V_{DD(B)}$ = 10 V	69 ns + (0.23 ns/pF)C_L	-	80	160	ns
		$V_{DD(A)}$ = $V_{DD(B)}$ = 15 V	57 ns + (0.16 ns/pF)C_L	-	65	135	ns
t_{PLH}	LOW to HIGH propagation delay	An to Bn, $\overline{Bn}$; see Figure 5					
		$V_{DD(A)}$ = $V_{DD(B)}$ = 5 V	143 ns + (0.55 ns/pF)C_L	-	170	340	ns
		$V_{DD(A)}$ = $V_{DD(B)}$ = 10 V	69 ns + (0.23 ns/pF)C_L	-	80	160	ns
		$V_{DD(A)}$ = $V_{DD(B)}$ = 15 V	62 ns + (0.16 ns/pF)C_L	-	70	140	ns
t_{THL}	HIGH to LOW output transition time	Bn or $\overline{Bn}$; see Figure 6					
		$V_{DD(A)}$ = $V_{DD(B)}$ = 5 V	10 ns + (1.00 ns/pF)C_L	-	60	120	ns
		$V_{DD(A)}$ = $V_{DD(B)}$ = 10 V	9 ns + (0.42 ns/pF)C_L	-	30	60	ns
		$V_{DD(A)}$ = $V_{DD(B)}$ = 15 V	6 ns + (0.28 ns/pF)C_L	-	20	40	ns
t_{TLH}	LOW to HIGH output transition time	Bn or $\overline{Bn}$; see Figure 6					
		$V_{DD(A)}$ = $V_{DD(B)}$ = 5 V	10 ns + (1.00 ns/pF)C_L	-	60	120	ns
		$V_{DD(A)}$ = $V_{DD(B)}$ = 10 V	9 ns + (0.42 ns/pF)C_L	-	30	60	ns
		$V_{DD(A)}$ = $V_{DD(B)}$ = 15 V	6 ns + (0.28 ns/pF)C_L	-	20	40	ns
t_{PHZ}	HIGH to OFF-state propagation delay	OE to Bn, $\overline{Bn}$; see Figure 6					
		$V_{DD(A)}$ = $V_{DD(B)}$ = 5 V		-	70	135	ns
		$V_{DD(A)}$ = $V_{DD(B)}$ = 10 V		-	55	110	ns
		$V_{DD(A)}$ = $V_{DD(B)}$ = 15 V		-	60	120	ns

Table 7. Dynamic characteristics *...continued*

T_{amb} = 25 °C, unless otherwise specified. For test circuit, see Figure 7.

Symbol	Parameter	Conditions	Extrapolation formula[1]	Min	Typ	Max	Unit
t_{PLZ}	LOW to OFF-state propagation delay	OE to Bn, $\overline{B}$n; see Figure 6					
		$V_{DD(A)} = V_{DD(B)}$ = 5 V		-	70	135	ns
		$V_{DD(A)} = V_{DD(B)}$ = 10 V		-	55	105	ns
		$V_{DD(A)} = V_{DD(B)}$ = 15 V		-	55	110	ns
t_{PZH}	OFF-state to HIGH propagation delay	OE to Bn, $\overline{B}$n; see Figure 6					
		$V_{DD(A)} = V_{DD(B)}$ = 5 V		-	195	395	ns
		$V_{DD(A)} = V_{DD(B)}$ = 10 V		-	95	195	ns
		$V_{DD(A)} = V_{DD(B)}$ = 15 V		-	80	165	ns
t_{PZL}	OFF-state to LOW propagation delay	OE to Bn, $\overline{B}$n; see Figure 6					
		$V_{DD(A)} = V_{DD(B)}$ = 5 V		-	195	395	ns
		$V_{DD(A)} = V_{DD(B)}$ = 10 V		-	95	190	ns
		$V_{DD(A)} = V_{DD(B)}$ = 15 V		-	80	160	ns

[1] Typical value of the propagation delay and output transition time can be calculated with the extrapolation formula (C_L in pF).

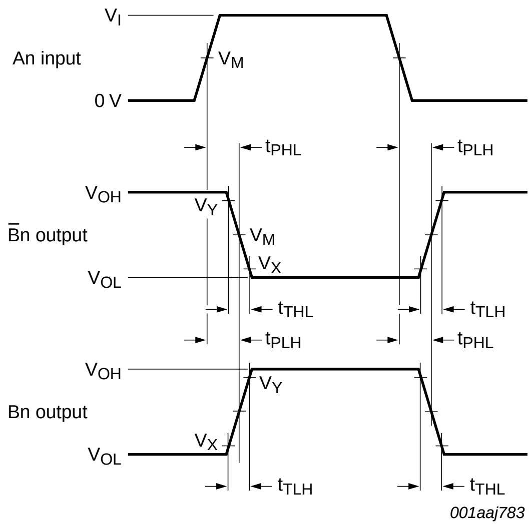
Table 8. Dynamic power dissipation

$V_{DD(A)} = V_{DD(B)}$; V_{SS} = 0 V; $t_r = t_f \leq$ 20 ns; T_{amb} = 25 °C.

Symbol	Parameter	V_{DD}[1]	Typical formula (µW)	where
P_D	dynamic power dissipation	5 V	$P_D = 3000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f_i = input frequency in MHz;
		10 V	$P_D = 12200 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f_o = output frequency in MHz;
		15 V	$P_D = 31000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	C_L = output load capacitance in pF;
				$\Sigma(f_o \times C_L)$ = sum of the outputs;
				V_{DD} = supply voltage in V.

[1] V_{DD} is the same as $V_{DD(A)}$ and $V_{DD(B)}$.

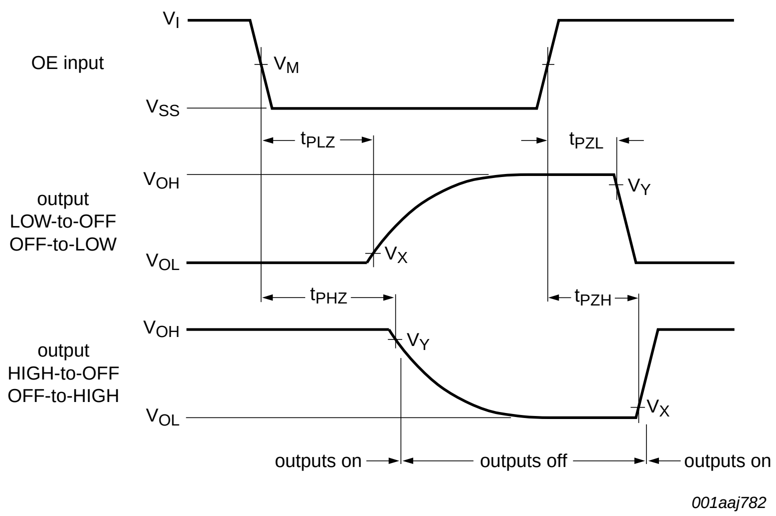
11. Waveforms



Measurement points are given in Table 9.

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

Fig 5. Data input (An) to data output (Bn, $\overline{\text{Bn}}$) propagation delays and output transition times



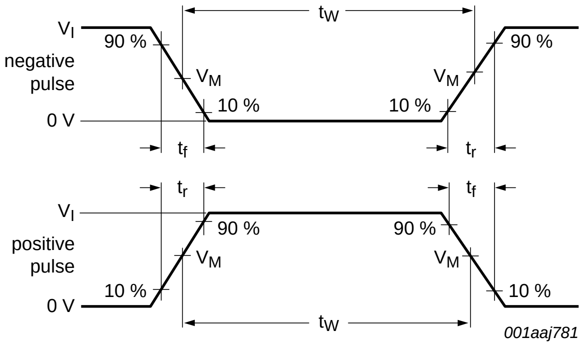
Measurement points are given in Table 9.

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

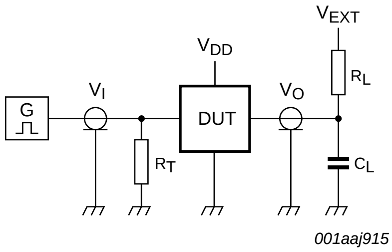
Fig 6. Enable and disable times

Table 9. Measurement points

Input		Output		
V_I	V_M	V_M	V_X	V_Y
V_{SS} or $V_{DD(A)}$	$0.5V_{DD(A)}$	$0.5V_{DD(B)}$	$0.1V_{DD(B)}$	$0.9V_{DD(B)}$



a. Input waveforms



b. Test circuit

Test data given in Table 10.

Definitions for test circuit:

DUT = Device Under Test.

C_L = load capacitance including jig and probe capacitance.

R_L = load resistance.

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

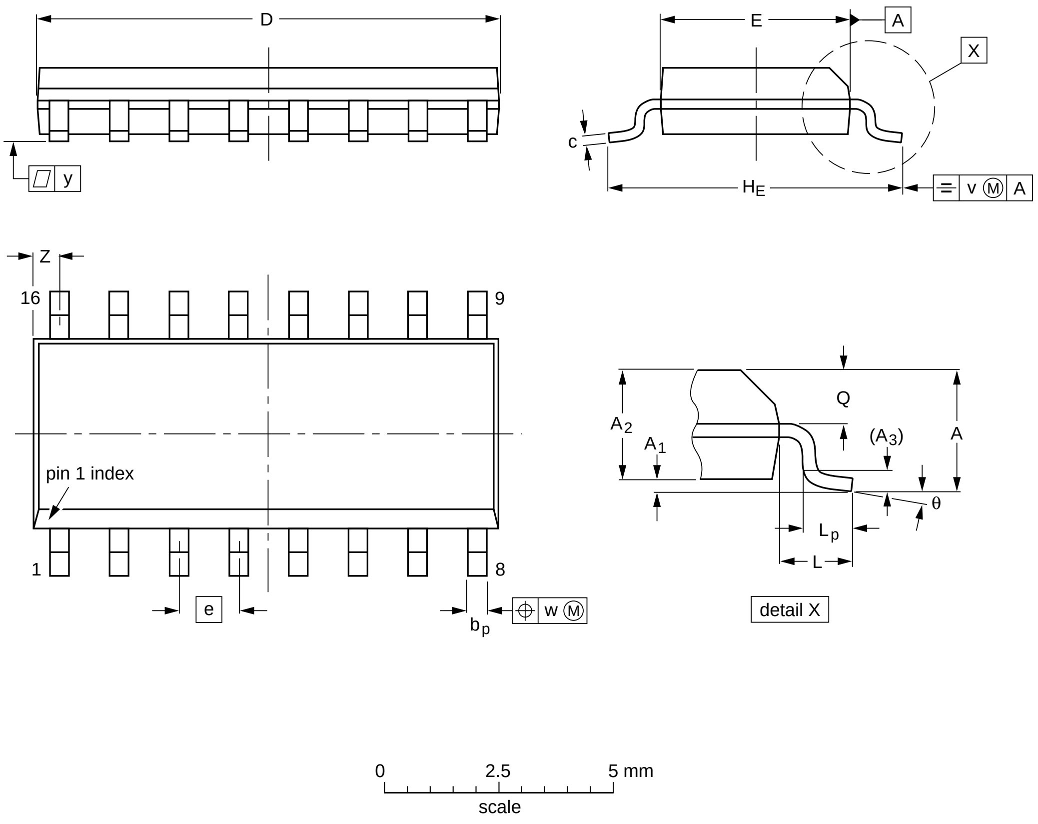
Fig 7. Test circuit for measuring switching times

Table 10. Test data

Supplies	Input	Load		V_{EXT}		
$V_{DD(A)} = V_{DD(B)}$	t_r, t_f	R_L	C_L	t_{PHL}, t_{PLH}	t_{PZL}, t_{PLZ}	t_{PZH}, t_{PHZ}
5 V to 15 V	≤ 20 ns	1 kΩ	50 pF	open	$V_{DD(B)}$	V_{SS}

12. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm **SOT109-1**



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	10.0 9.8	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	0.39 0.38	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.020	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			
SOT109-1	076E07	MS-012				~~99-12-27~~ 03-02-19

Fig 8. Package outline SOT109-1 (SO16)

13. Abbreviations

Table 11. Abbreviations

Acronym	Description
HBM	Human Body Model
ESD	ElectroStatic Discharge
MM	Machine Model
MIL	Military

14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4104B_Q100 v.1	20140324	Product data sheet	-	-

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".

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OCEAN CHIPS

Океан Электроники

Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
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- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения **«JONHON»**, а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов **«FORSTAR»**.

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