

# 74CBTLV3125-Q100

## 4-bit bus switch

Rev. 3 — 23 October 2019

Product data sheet

## 1. General description

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The 74CBTLV3125-Q100 provides a 4-bit high-speed bus switch with separate output enable inputs (1 $\overline{OE}$  to 4 $\overline{OE}$ ). The low on-state resistance of the switch allows connections to be made with minimal propagation delay. The switch is disabled (high-impedance OFF-state) when the output enable (n $\overline{OE}$ ) input is HIGH.

To ensure the high-impedance OFF-state during power-up or power-down, n $\overline{OE}$  should be tied to the  $V_{CC}$  through a pull-up resistor. The minimum value of the resistor is determined by the current-sinking capability of the driver.

Schmitt trigger action at control input makes the circuit tolerant to slower input rise and fall times across the entire  $V_{CC}$  range from 2.3 V to 3.6 V.

This device is fully specified for partial power-down applications using  $I_{OFF}$ . The  $I_{OFF}$  circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

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

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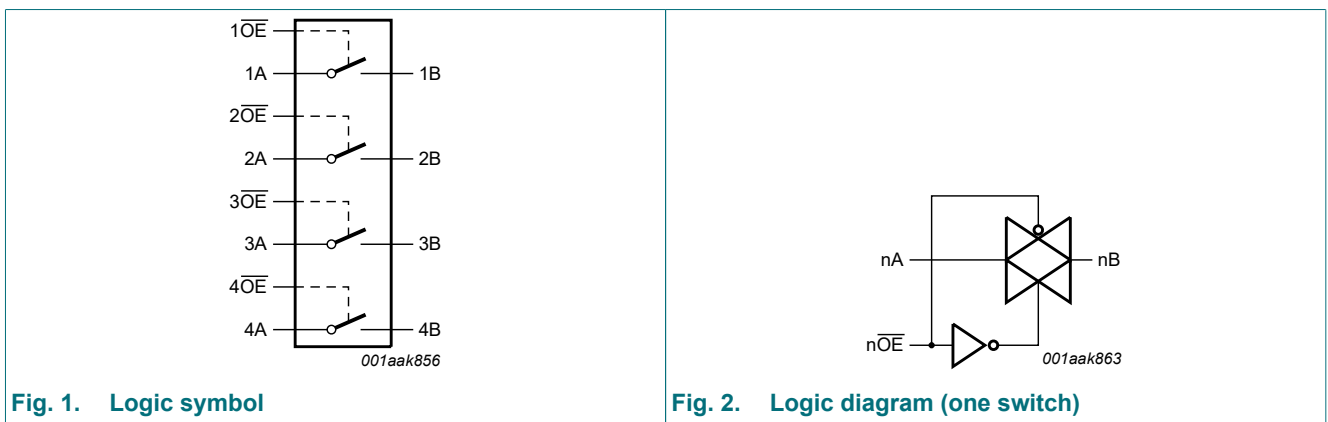
- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Supply voltage range from 2.3 V to 3.6 V
- Standard '125'-type pinout
- High noise immunity
- Complies with JEDEC standard:
  - JESD8-5 (2.3 V to 2.7 V)
  - JESD8-B/JESD36 (2.7 V to 3.6 V)
- ESD protection:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F: exceeds 2000 V
  - CDM AEC-Q100-011 revision B exceeds 1000 V
- 5  $\Omega$  switch connection between two ports
- Rail to rail switching on data I/O ports
- CMOS low power consumption
- Latch-up performance exceeds 250 mA per JESD78B Class I level A
- $I_{OFF}$  circuitry provides partial Power-down mode operation

### 3. Ordering information

Table 1. Ordering information

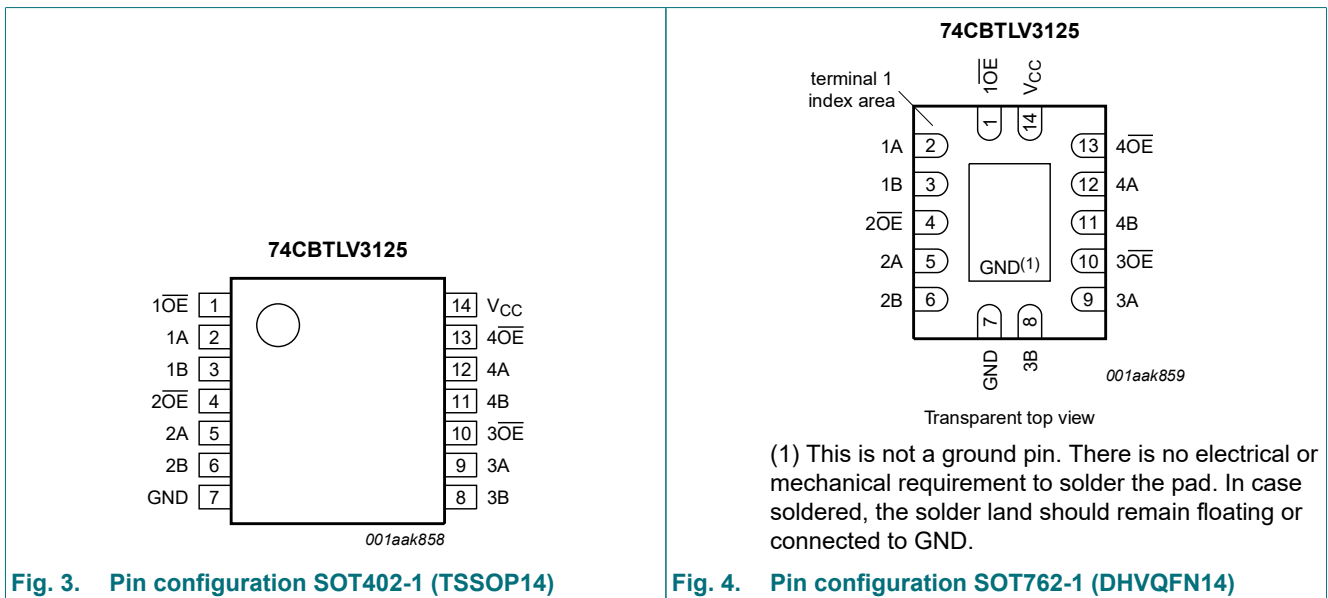
Type number	Package			Version
	Temperature range	Name	Description	
74CBTLV3125PW-Q100	-40 °C to +125 °C	TSSOP14	plastic thin shrink small outline package; 14 leads; body width 4.4 mm	SOT402-1
74CBTLV3125BQ-Q100	-40 °C to +125 °C	DHVQFN14	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm	SOT762-1

### 4. Functional diagram



### 5. Pinning information

#### 5.1. Pinning



## 5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1OE, 2OE, 3OE, 4OE	1, 4, 10, 13	output enable input
1A, 2A, 3A, 4A,	2, 5, 9, 12	A input/output
1B, 2B, 3B, 4B	3, 6, 8, 11	B output/input
GND	7	ground (0 V)
V <sub>CC</sub>	14	positive supply voltage

## 6. Functional description

Table 3. Function table

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

Output enable input OE	Function switch
L	ON-state
H	OFF-state

## 7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>CC</sub>	supply voltage		-0.5	+4.6	V
V <sub>I</sub>	input voltage	control inputs [1]	-0.5	+4.6	V
V <sub>SW</sub>	switch voltage	enable and disable mode [2]	-0.5	V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V	-50	-	mA
I <sub>SK</sub>	switch clamping current	V <sub>I</sub> < -0.5 V	-50	-	mA
I <sub>SW</sub>	switch current	V <sub>SW</sub> = 0 V to V <sub>CC</sub>	-	±128	mA
I <sub>CC</sub>	supply current		-	+100	mA
I <sub>GND</sub>	ground current		-100	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C [3]	-	500	mW

[1] The minimum input voltage rating may be exceeded if the input clamping current ratings are observed.

[2] The switch voltage ratings may be exceeded if switch clamping current ratings are observed

[3] For SOT402-1 (TSSOP14) package: P<sub>tot</sub> derates linearly with 7.3 mW/K above 81 °C.

For SOT762-1 (DHVQFN14) package: P<sub>tot</sub> derates linearly with 9.6 mW/K above 98 °C.

## 8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		2.3	3.6	V
$V_I$	input voltage	control inputs	0	3.6	V
$V_{SW}$	switch voltage	enable and disable mode	0	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	pin $\overline{nOE}$ ; $V_{CC} = 2.3$ V to 3.6 V	0	200	ns/V

## 9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	$T_{amb} = -40$ °C to +85 °C			$T_{amb} = -40$ °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 2.3$ V to 2.7 V	1.7	-	-	1.7	-	V
		$V_{CC} = 3.0$ V to 3.6 V	2.0	-	-	2.0	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 2.3$ V to 2.7 V	-	-	0.7	-	0.7	V
		$V_{CC} = 3.0$ V to 3.6 V	-	-	0.9	-	0.9	V
$I_I$	input leakage current	pin $\overline{nOE}$ ; $V_I = GND$ to $V_{CC}$ ; $V_{CC} = 3.6$ V	-	-	$\pm 1.0$	-	$\pm 20$	$\mu A$
$I_{S(OFF)}$	OFF-state leakage current	$V_{CC} = 3.6$ V; see Fig. 5	-	-	$\pm 1$	-	$\pm 20$	$\mu A$
$I_{S(ON)}$	ON-state leakage current	$V_{CC} = 3.6$ V; see Fig. 6	-	-	$\pm 1$	-	$\pm 20$	$\mu A$
$I_{OFF}$	power-off leakage current	$V_I$ or $V_O = 0$ V to 3.6 V; $V_{CC} = 0$ V	-	-	$\pm 10$	-	$\pm 50$	$\mu A$
$I_{CC}$	supply current	$V_I = GND$ or $V_{CC}$ ; $I_O = 0$ A; $V_{SW} = GND$ or $V_{CC}$ ; $V_{CC} = 3.6$ V	-	-	10	-	50	$\mu A$
$\Delta I_{CC}$	additional supply current	pin $\overline{nOE}$ ; $V_I = V_{CC} - 0.6$ V; [2] $V_{SW} = GND$ or $V_{CC}$ ; $V_{CC} = 3.6$ V	-	-	300	-	2000	$\mu A$
$C_I$	input capacitance	pin $\overline{nOE}$ ; $V_{CC} = 3.3$ V; $V_I = 0$ V to 3.3 V	-	0.9	-	-	-	pF
$C_{S(OFF)}$	OFF-state capacitance	$V_{CC} = 3.3$ V; $V_I = 0$ V to 3.3 V	-	5.2	-	-	-	pF
$C_{S(ON)}$	ON-state capacitance	$V_{CC} = 3.3$ V; $V_I = 0$ V to 3.3 V	-	14.3	-	-	-	pF

[1] All typical values are measured at  $T_{amb} = 25$  °C.

[2] One input at 3 V, other inputs at  $V_{CC}$  or GND.

9.1. Test circuits

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$V_I = V_{CC}$  or GND and  $V_O =$  GND or  $V_{CC}$ .

**Fig. 5. Test circuit for measuring OFF-state leakage current (one switch)**

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$V_I = V_{CC}$  or GND and  $V_O =$  open circuit.

**Fig. 6. Test circuit for measuring ON-state leakage current (one switch)**

9.2. ON resistance

Table 7. Resistance  $R_{ON}$

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 7.

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			$T_{amb} = -40\text{ °C to }+125\text{ °C}$		Unit
			Min	Typ [1]	Max	Min	Max	
$R_{ON}$	ON resistance	$V_{CC} = 2.3\text{ V to }2.7\text{ V};$ see Fig. 8 to Fig. 10 [2]						
		$I_{SW} = 64\text{ mA}; V_I = 0\text{ V}$	-	4.2	8.0	-	15.0	$\Omega$
		$I_{SW} = 24\text{ mA}; V_I = 0\text{ V}$	-	4.2	8.0	-	15.0	$\Omega$
		$I_{SW} = 15\text{ mA}; V_I = 1.7\text{ V}$	-	8.4	40.0	-	60.0	$\Omega$
		$V_{CC} = 3.0\text{ V to }3.6\text{ V};$ see Fig. 11 to Fig. 13						
		$I_{SW} = 64\text{ mA}; V_I = 0\text{ V}$	-	4.0	7.0	-	11.0	$\Omega$
		$I_{SW} = 24\text{ mA}; V_I = 0\text{ V}$	-	4.0	7.0	-	11.0	$\Omega$
$I_{SW} = 15\text{ mA}; V_I = 2.4\text{ V}$	-	6.2	15.0	-	25.5	$\Omega$		

[1] Typical values are measured at  $T_{amb} = 25\text{ °C}$  and nominal  $V_{CC}$ .  
 [2] Measured by the voltage drop between the A and B terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two (A or B) terminals.

9.3. ON resistance test circuit and graphs

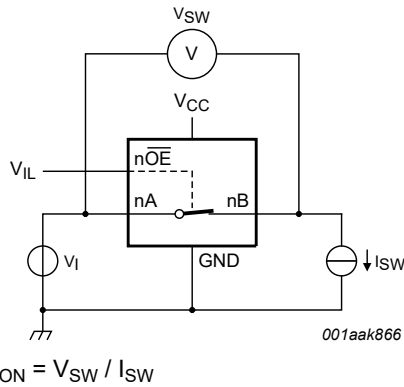
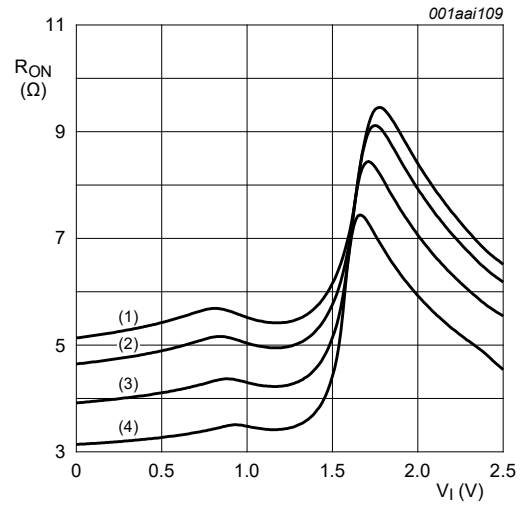
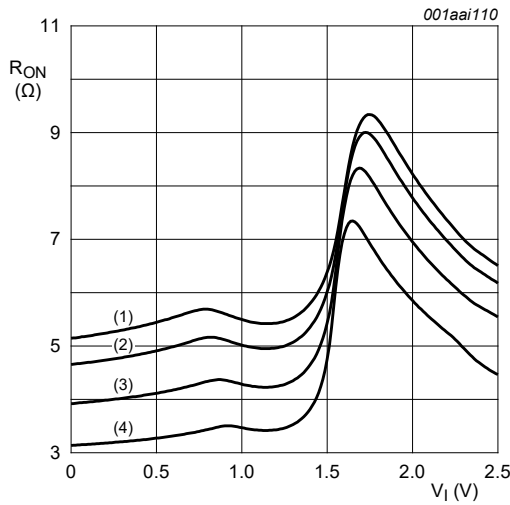


Fig. 7. Test circuit for measuring ON resistance (one switch)



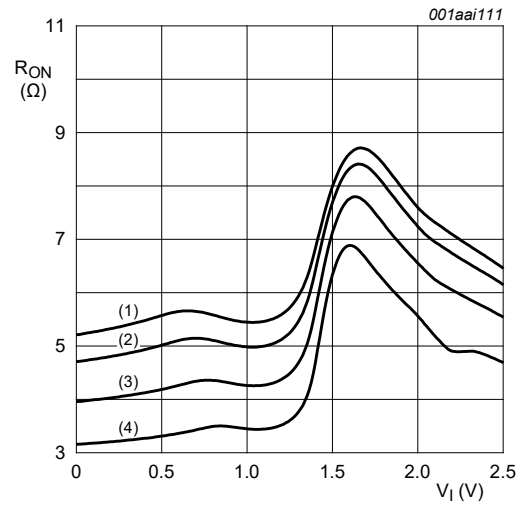
- (1)  $T_{amb} = 125\text{ }^{\circ}\text{C}$
- (2)  $T_{amb} = 85\text{ }^{\circ}\text{C}$
- (3)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
- (4)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig. 8. ON resistance as a function of input voltage;  $V_{CC} = 2.5\text{ V}$ ;  $I_{SW} = 15\text{ mA}$



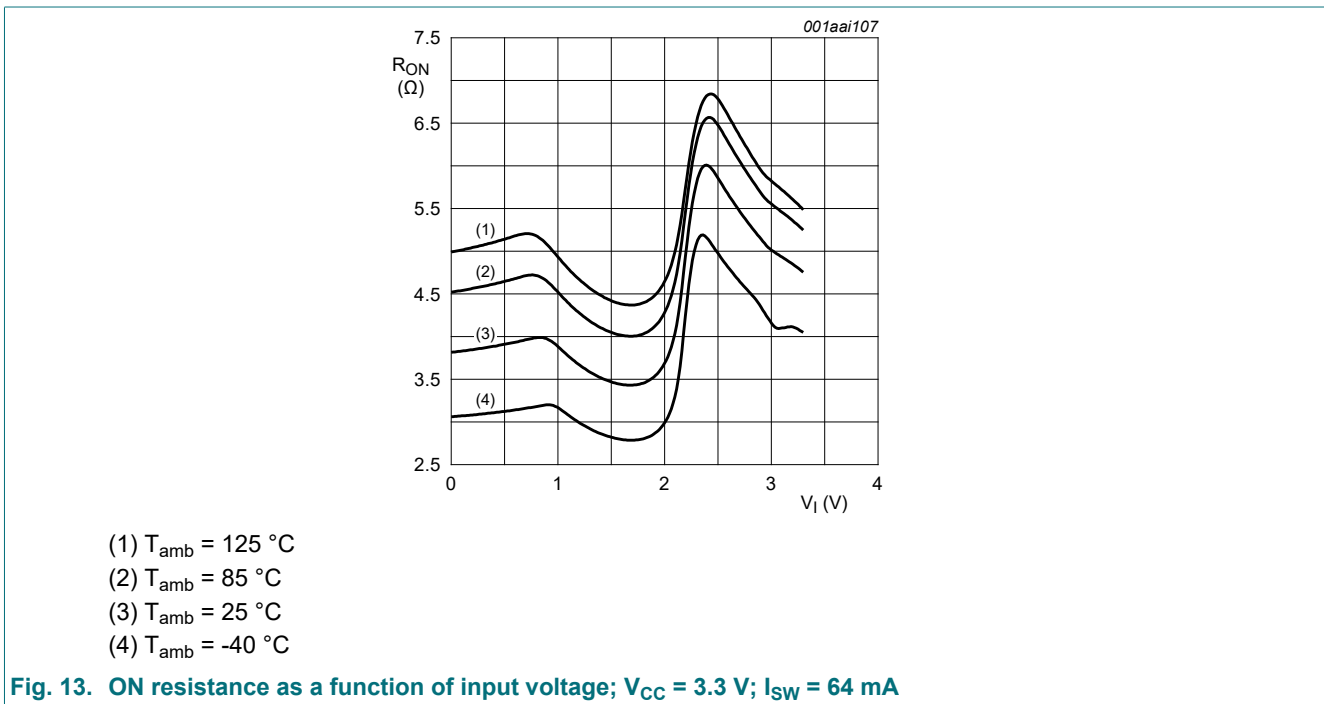
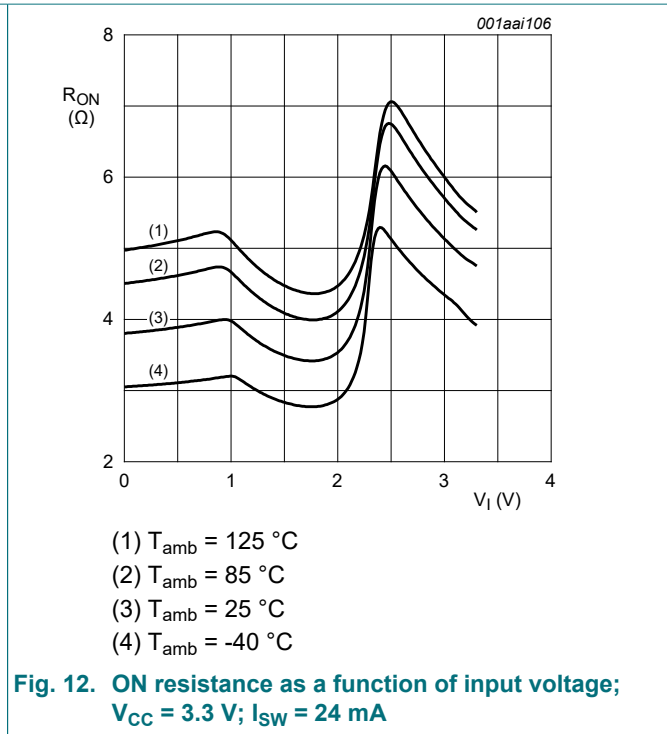
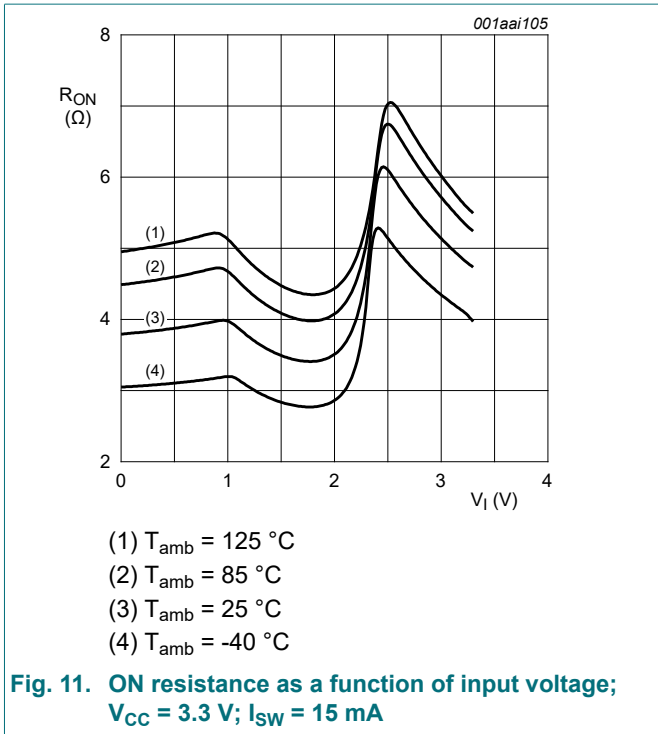
- (1)  $T_{amb} = 125\text{ }^{\circ}\text{C}$
- (2)  $T_{amb} = 85\text{ }^{\circ}\text{C}$
- (3)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
- (4)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig. 9. ON resistance as a function of input voltage;  $V_{CC} = 2.5\text{ V}$ ;  $I_{SW} = 24\text{ mA}$



- (1)  $T_{amb} = 125\text{ }^{\circ}\text{C}$
- (2)  $T_{amb} = 85\text{ }^{\circ}\text{C}$
- (3)  $T_{amb} = 25\text{ }^{\circ}\text{C}$
- (4)  $T_{amb} = -40\text{ }^{\circ}\text{C}$

Fig. 10. ON resistance as a function of input voltage;  $V_{CC} = 2.5\text{ V}$ ;  $I_{SW} = 64\text{ mA}$



## 10. Dynamic characteristics

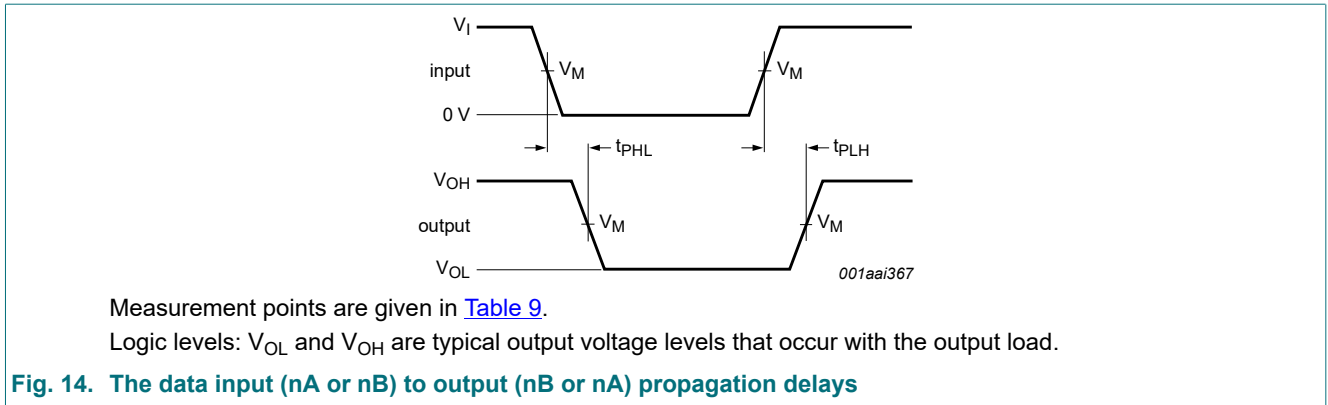
**Table 8. Dynamic characteristics**

$GND = 0\text{ V}$ ; for test circuit see Fig. 16

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			$T_{amb} = -40\text{ °C to }+125\text{ °C}$		Unit
			Min	Typ[1]	Max	Min	Max	
$t_{pd}$	propagation delay	nA to nB or nB to nA; see Fig. 14 [2] [3]						
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	-	0.13	-	0.20	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	-	0.20	-	0.31	ns
$t_{en}$	enable time	n $\overline{OE}$ to nA or nB; see Fig. 15 [4]						
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	2.7	4.6	1.0	6.0	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	2.4	4.4	1.0	6.0	ns
$t_{dis}$	disable time	n $\overline{OE}$ to nA or nB; see Fig. 15 [5]						
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	2.2	3.9	1.0	5.5	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	2.9	4.2	1.0	5.5	ns

- [1] All typical values are measured at  $T_{amb} = 25\text{ °C}$  and at nominal  $V_{CC}$ .
- [2] The propagation delay is the calculated RC time constant of the typical on-state resistance of the switch and the load capacitance, when driven by an ideal voltage source (zero output impedance).
- [3]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .
- [4]  $t_{en}$  is the same as  $t_{PZH}$  and  $t_{PZL}$ .
- [5]  $t_{dis}$  is the same as  $t_{PHZ}$  and  $t_{PLZ}$ .

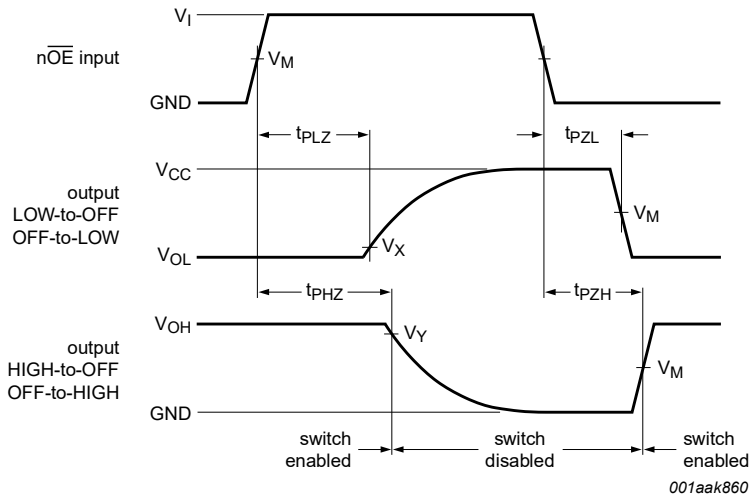
### 10.1. Waveforms and test circuit



**Table 9. Measurement points**

Supply voltage	Input			Output		
$V_{CC}$	$V_M$	$V_I$	$t_r = t_f$	$V_M$	$V_X$	$V_Y$
2.3 V to 2.7 V	$0.5V_{CC}$	$V_{CC}$	$\leq 2.0\text{ ns}$	$0.5V_{CC}$	$V_{OL} + 0.15\text{ V}$	$V_{OH} - 0.15\text{ V}$
3.0 V to 3.6 V	$0.5V_{CC}$	$V_{CC}$	$\leq 2.0\text{ ns}$	$0.5V_{CC}$	$V_{OL} + 0.3\text{ V}$	$V_{OH} - 0.3\text{ V}$

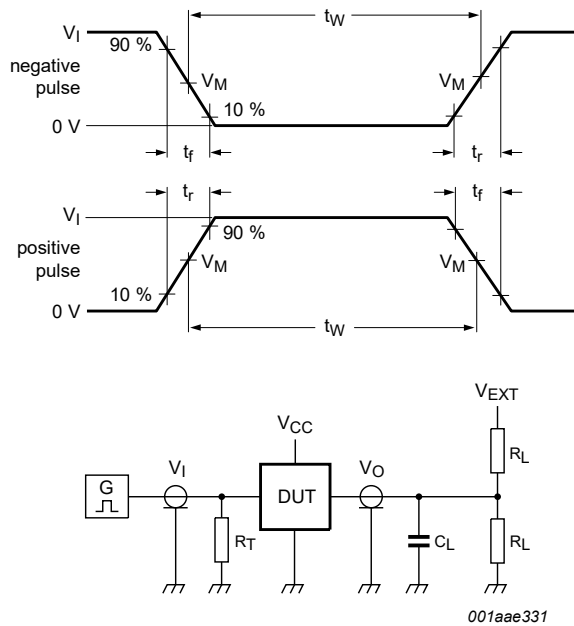




Measurement points are given in [Table 9](#).

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

**Fig. 15. Enable and disable times**



Test data is given in [Table 10](#).

Definitions for test circuit:

$R_L$  = Load resistance.

$C_L$  = Load capacitance including jig and probe capacitance.

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

$V_{EXT}$  = External voltage for measuring switching times.

**Fig. 16. Test circuit for measuring switching times**

**Table 10. Test data**

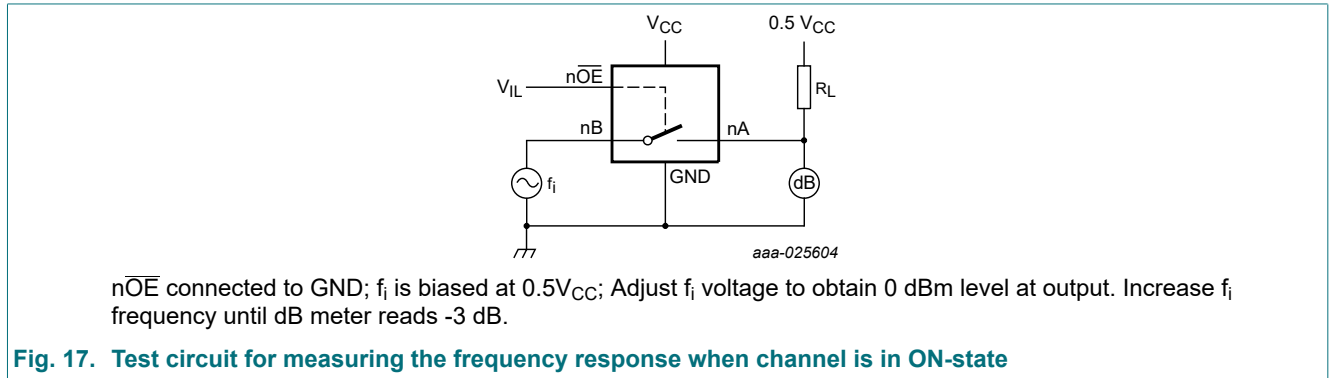
Supply voltage	Load		$V_{EXT}$
$V_{CC}$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$ $t_{PZH}, t_{PHZ}$ $t_{PZL}, t_{PLZ}$
2.3 V to 2.7 V	30 pF	500 $\Omega$	open    GND $2V_{CC}$
3.0 V to 3.6 V	50 pF	500 $\Omega$	open    GND $2V_{CC}$

10.2. Additional dynamic characteristics

Table 11. Additional dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

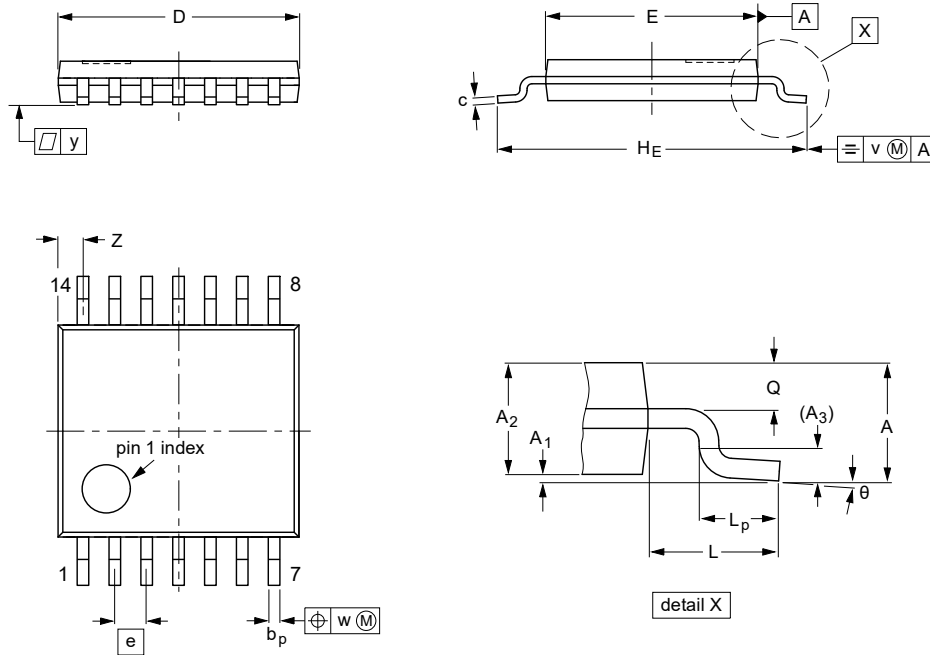
Symbol	Parameter	Conditions	T <sub>amb</sub> = 25 °C			Unit
			Min	Typ	Max	
f <sub>i(-3dB)</sub>	-3 dB frequency response	V <sub>I</sub> = GND or V <sub>CC</sub> ; t <sub>r</sub> = t <sub>f</sub> ≤ 2.5 ns; V <sub>CC</sub> = 3.3 V; R <sub>L</sub> = 50 Ω; see Fig. 17	-	406	-	MHz



11. Package outline

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(2)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.72 0.38	8° 0°

Notes

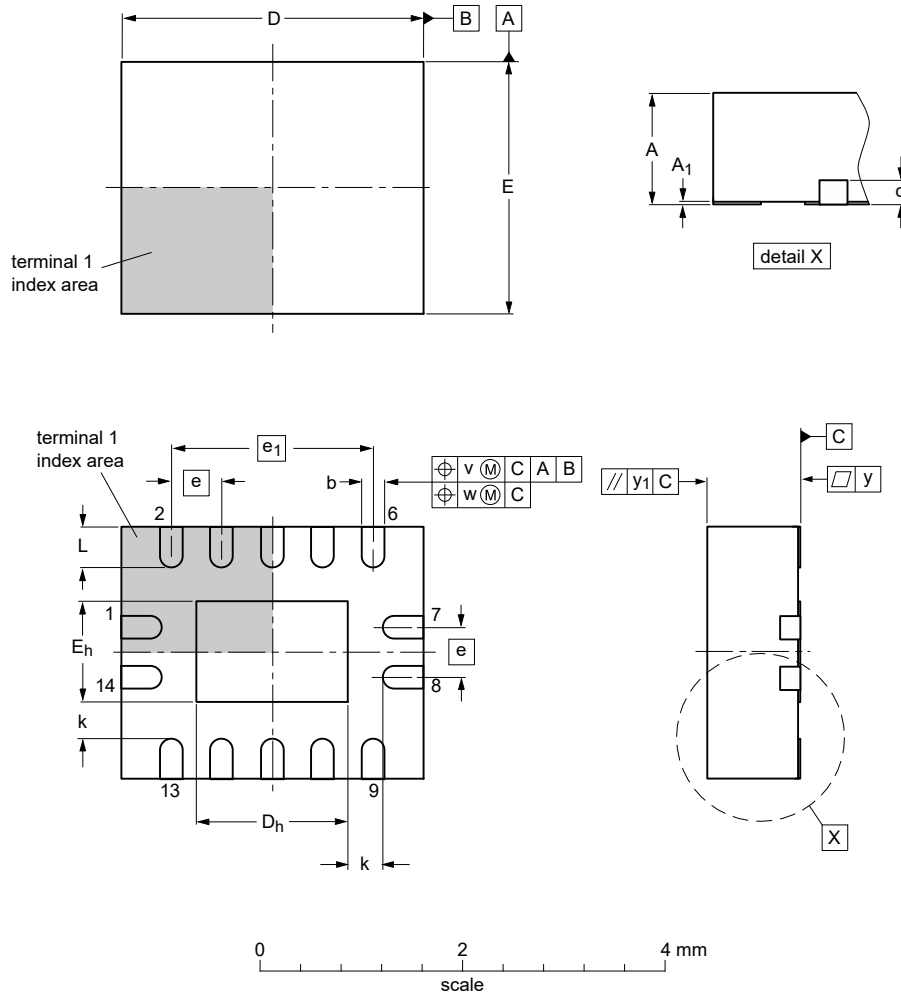
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT402-1		MO-153				99-12-27 03-02-18

Fig. 18. Package outline SOT402-1 (TSSOP14)

DHVQFN14: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 14 terminals; body 2.5 x 3 x 0.85 mm

SOT762-1



Dimensions (mm are the original dimensions)

Unit	A <sup>(1)</sup>	A <sub>1</sub>	b	c	D <sup>(1)</sup>	D <sub>h</sub>	E <sup>(1)</sup>	E <sub>h</sub>	e	e <sub>1</sub>	k	L	v	w	y	y <sub>1</sub>
max	1	0.05	0.30		3.1	1.65	2.6	1.15				0.5				
mm	nom	0.02	0.25	0.2	3.0	1.50	2.5	1.00	0.5	2		0.4	0.1	0.05	0.05	0.1
min		0.00	0.18		2.9	1.35	2.4	0.85			0.2	0.3				

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

sot762-1\_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT762-1		MO-241				-15-04-10- 15-05-05

Fig. 19. Package outline SOT762-1 (DHVQFN14)

## 12. Abbreviations

Table 12. Abbreviations

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

## 13. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74CBTLV3125_Q100 v.3	20191023	Product data sheet	-	74CBTLV3125_Q100 v.2
Modifications:	<ul style="list-style-type: none"> <li>Type number 74CBTLV3125BQ-Q100 (SOT762-1/DHVQFN14) added.</li> <li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> </ul>			
74CBTLV3125_Q100 v.2	20181008	Product data sheet	-	74CBTLV3125_Q100 v.1
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul>			
74CBTLV3125_Q100 v.1	20170105	Product data sheet	-	-

## 14. 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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Date of release: 23 October 2019

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