

# CBTD3861

## 10-bit level shifting bus switch with output enable

Rev. 3 — 6 March 2019

Product data sheet

### 1. General description

The CBTD3861 provides ten bits of high-speed TTL-compatible bus switching. The low ON resistance of the switch allows connections to be made with minimal propagation delay.

The CBTD3861 device is organized as one 10-bit bus switches with one output enable ( $\overline{OE}$ ) input. When  $\overline{OE}$  is LOW, the switch is on and port A is connected to the B port. When  $\overline{OE}$  is HIGH, each switch is disabled.

The CBTD3861 is characterized for operation from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$ .

### 2. Features and benefits

- Designed to be used in 5 V to 3.3 V level shifting applications with internal diode
- $5\ \Omega$  switch connection between two ports
- TTL-compatible control input levels
- Latch-up protection exceeds 100 mA per JESD78
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - CDM JESD22-C101C exceeds 1000 V

### 3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
CBTD3861PW	$-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$	TSSOP24	plastic thin shrink small outline package; 24 leads; body width 4.4 mm	SOT355-1
CBTD3861BQ	$-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$	DHVQFN24	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 24 terminals; body 3.5 x 5.5 x 0.85 mm	SOT815-1

### 4. Functional diagram

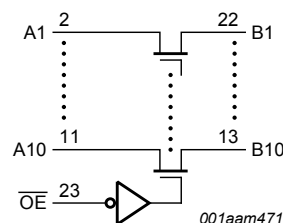


Fig. 1. Logic diagram

## 5. Pinning information

### 5.1. Pinning

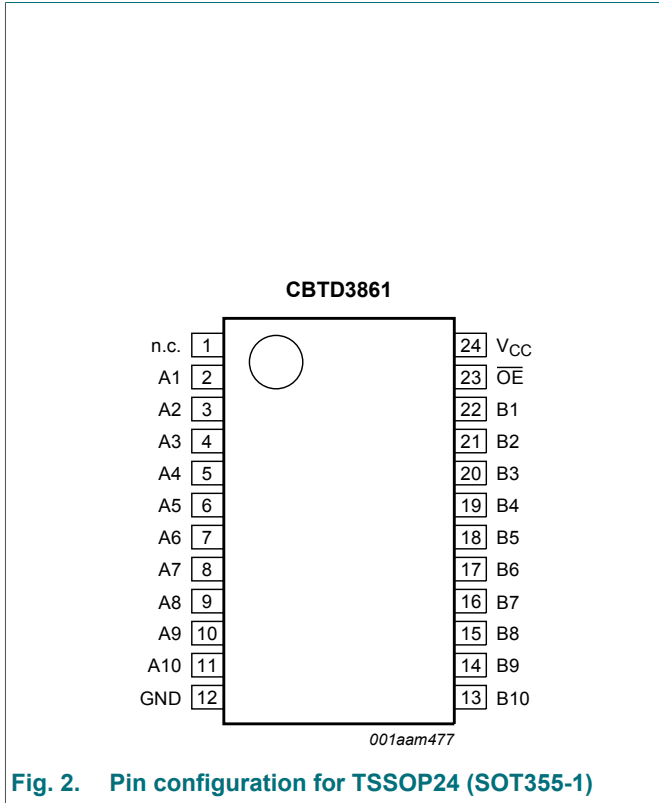


Fig. 2. Pin configuration for TSSOP24 (SOT355-1)

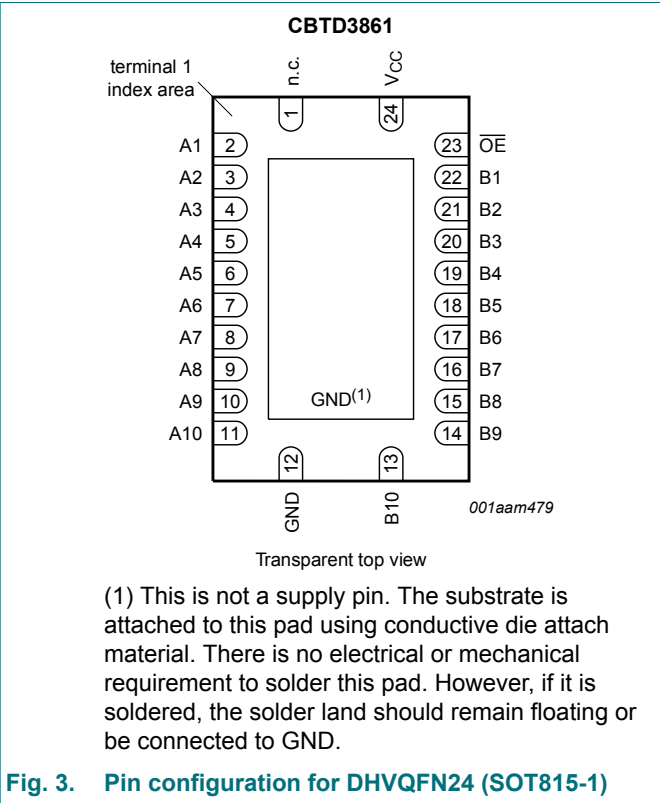


Fig. 3. Pin configuration for DHVQFN24 (SOT815-1)

### 5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
n.c.	1	not connected
A1 to A10	2, 3, 4, 5, 6, 7, 8, 9, 10, 11	data input/output (A port)
GND	12	ground (0 V)
B1 to B10	22, 21, 20, 19, 18, 17, 16, 15, 14, 13	data input/output (B port)
OE	23	output enable input (active LOW)
V <sub>CC</sub>	24	positive supply voltage

## 6. Functional description

Table 3. Function selection

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

Input	Input/output
OE	An, Bn
L	An = Bn
H	Z

## 7. Limiting values

**Table 4. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

$T_{amb} = -40\text{ °C}$  to  $+85\text{ °C}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{CC}$	supply voltage		-0.5	+7.0	V
$V_I$	input voltage	[1]	-0.5	+7.0	V
$I_O$	output current	$V_O < 0\text{ V}$	-	±128	mA
$I_{IK}$	input clamping current	$V_{IO} = 0\text{ V}$	-50	-	mA
$T_{stg}$	storage temperature		-65	+150	°C

[1] The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

## 8. Recommended operating conditions

**Table 5. Operating conditions**

All unused control inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage		4.5	-	5.5	V
$V_{IH}$	HIGH-state input voltage		2.0	-	-	V
$V_{IL}$	LOW-state input voltage		-	-	0.8	V
$T_{amb}$	ambient temperature	operating in free air	-40	-	+85	°C

## 9. Static characteristics

**Table 6. Static characteristics**

Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ °C}$ to $+85\text{ °C}$			Unit
			Min	Typ[1]	Max	
$V_{IK}$	input clamping voltage	$V_{CC} = 4.5\text{ V}$ ; $I_I = -18\text{ mA}$	-	-	-1.2	V
$I_I$	input leakage current	$V_{CC} = 5.5\text{ V}$ ; $V_I = \text{GND}$ or $5.5\text{ V}$	-	-	±1	µA
$I_{CC}$	supply current	$V_{CC} = 5.5\text{ V}$ ; $I_O = 0\text{ mA}$ ; $V_I = V_{CC}$ or GND	-	-	1.5	mA
$\Delta I_{CC}$	additional supply current	per input pin; $V_{CC} = 5.5\text{ V}$ ; one input at 3.4 V, other inputs at $V_{CC}$ or GND [2]	-	-	2.5	mA
$V_{pass}$	pass voltage	see Fig. 4 to Fig. 8	-	-	-	V
$C_I$	input capacitance	control pins; $V_I = 3\text{ V}$ or $0\text{ V}$	-	2.5	-	pF
$C_{io(off)}$	off-state input/output capacitance	port off; $V_I = 3\text{ V}$ or $0\text{ V}$ ; $\overline{OE} = V_{CC}$	-	4.0	-	pF
$R_{ON}$	ON resistance	$V_{CC} = 4.5\text{ V}$ ; $V_I = 0\text{ V}$ ; $I_I = 64\text{ mA}$ [3]	-	5	7	Ω
		$V_{CC} = 4.5\text{ V}$ ; $V_I = 0\text{ V}$ ; $I_I = 30\text{ mA}$ [3]	-	5	7	Ω
		$V_{CC} = 4.5\text{ V}$ ; $V_I = 2.4\text{ V}$ ; $I_I = -15\text{ mA}$ [3]	-	17	50	Ω

[1] All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_{amb} = 25\text{ °C}$ .

[2] This is the increase in supply current for each input that is at the specified TTL voltage level rather than  $V_{CC}$  or GND.

[3] Measured by the voltage drop between the An and the Bn terminals at the indicated current through the switch. ON resistance is determined by the lowest voltage of the two (An or Bn) terminals.

9.1. Typical pass voltage graphs

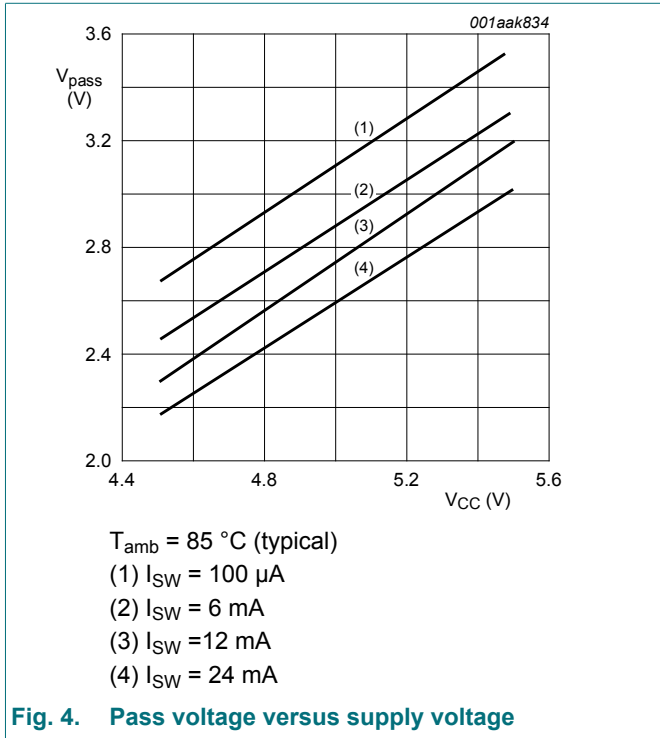


Fig. 4. Pass voltage versus supply voltage

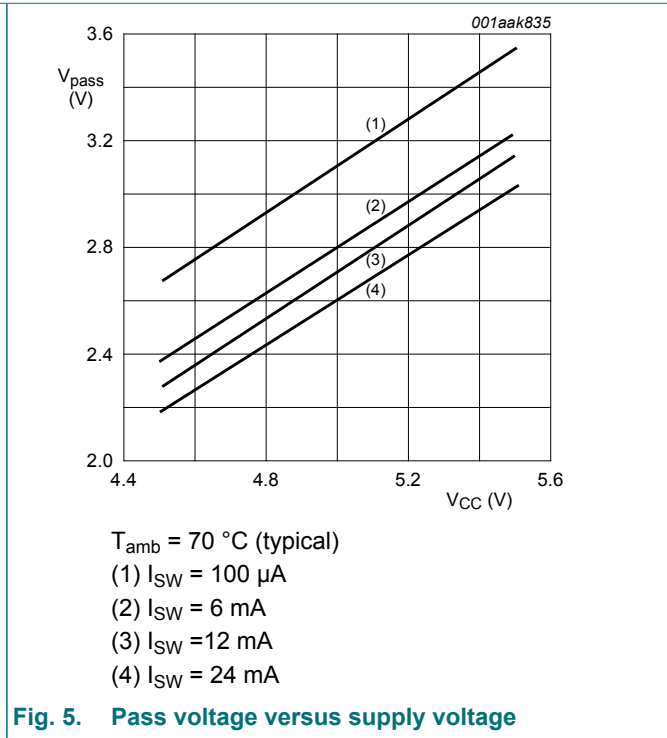


Fig. 5. Pass voltage versus supply voltage

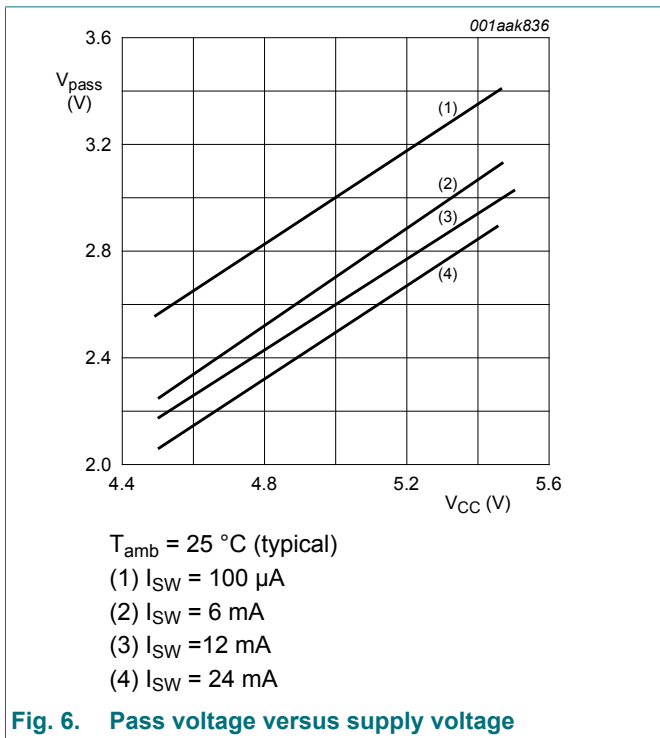


Fig. 6. Pass voltage versus supply voltage

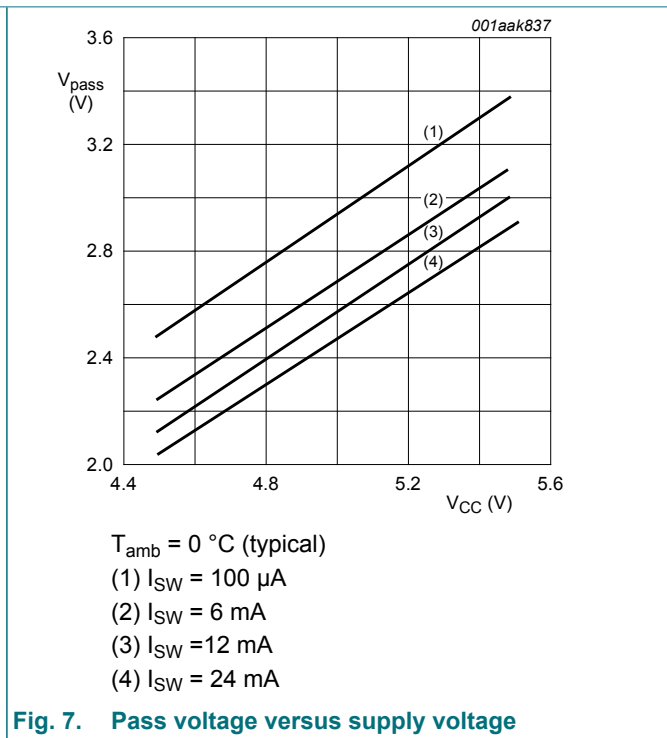
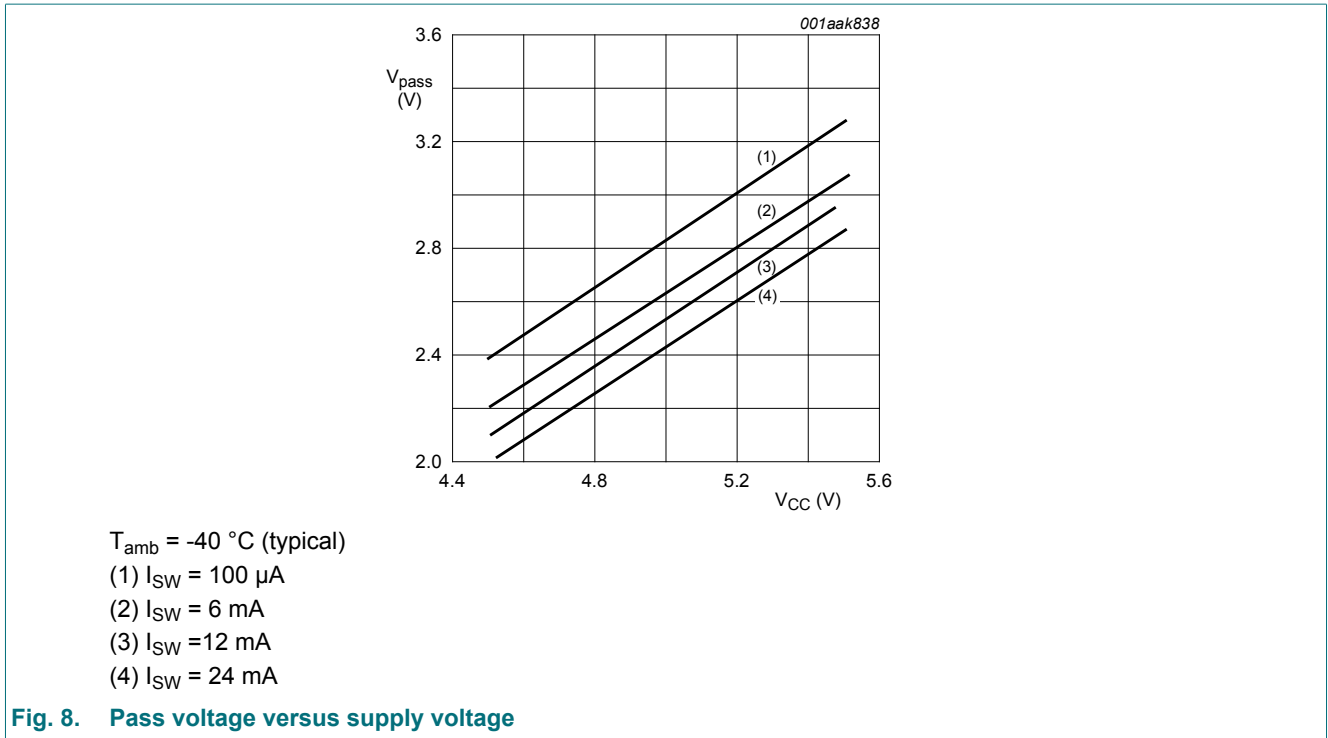


Fig. 7. Pass voltage versus supply voltage



## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

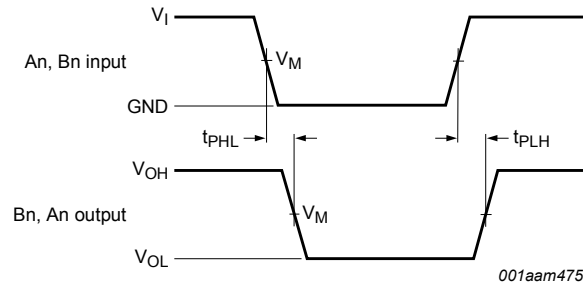
Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 11.

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$			Unit
			Min	Typ	Max	
$t_{pd}$	propagation delay	An, Bn to Bn, An; see Fig. 9 [1][2]				
		$V_{CC} = 5.0\text{ V} \pm 0.5\text{ V}$	-	-	0.25	ns
$t_{en}$	enable time	$\overline{OE}$ to An or Bn; see Fig. 10 [2]				
		$V_{CC} = 5.0\text{ V} \pm 0.5\text{ V}$	1.8	4.3	10.0	ns
$t_{dis}$	disable time	$\overline{OE}$ to An or Bn; see Fig. 10 [2]				
		$V_{CC} = 5.0\text{ V} \pm 0.5\text{ V}$	1.0	3.0	6.0	ns

[1] The propagation delay is the calculated RC time constant of the typical ON resistance of the switch and the specified load capacitance, when driven by an ideal voltage source (zero output impedance).

[2]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .  
 $t_{en}$  is the same as  $t_{PZL}$  and  $t_{PZH}$ .  
 $t_{dis}$  is the same as  $t_{PLZ}$  and  $t_{PHZ}$ .

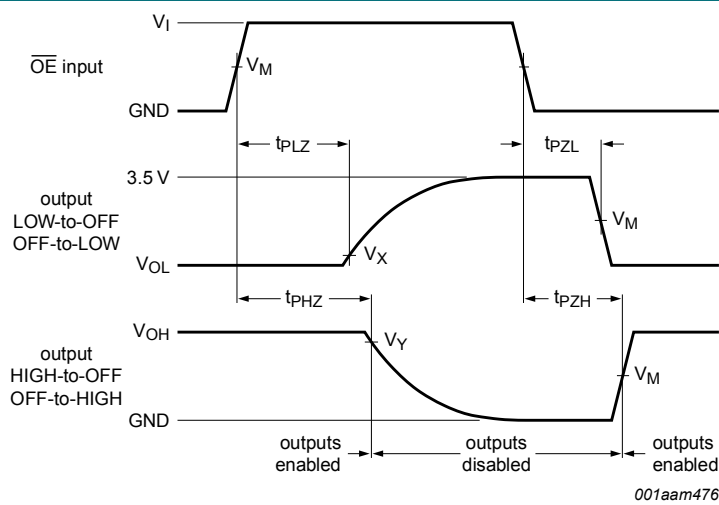
10.1. Waveforms and test circuit



Measurement points are given in [Table 8](#).

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

Fig. 9. The data input (An, Bn) to output (Bn, An) propagation delay times



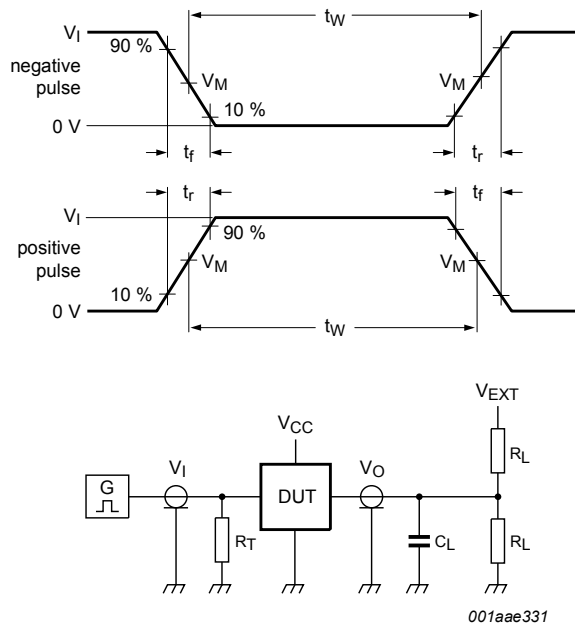
Measurement points are given in [Table 8](#).

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

Fig. 10. Enable and disable times

Table 8. Measurement points

Supply voltage	Input		Output		
$V_{CC}$	$V_I$	$V_M$	$V_M$	$V_X$	$V_Y$
$V_{CC} = 5.0\text{ V} \pm 0.5\text{ V}$	GND to 3.0 V	1.5 V	1.5 V	$V_{OL} + 0.3\text{ V}$	$V_{OH} - 0.3\text{ V}$



Test data is given in [Table 9](#).

All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz; Z<sub>o</sub> = 50 Ω.

The outputs are measured one at a time with one transition per measurement.

Definitions for test circuit:

R<sub>L</sub> = Load resistance.

C<sub>L</sub> = Load capacitance including jig and probe capacitance.

R<sub>T</sub> = Termination resistance should be equal to output impedance Z<sub>o</sub> of the pulse generator.

V<sub>EXT</sub> = External voltage for measuring switching times.

**Fig. 11. Test circuit for measuring switching times**

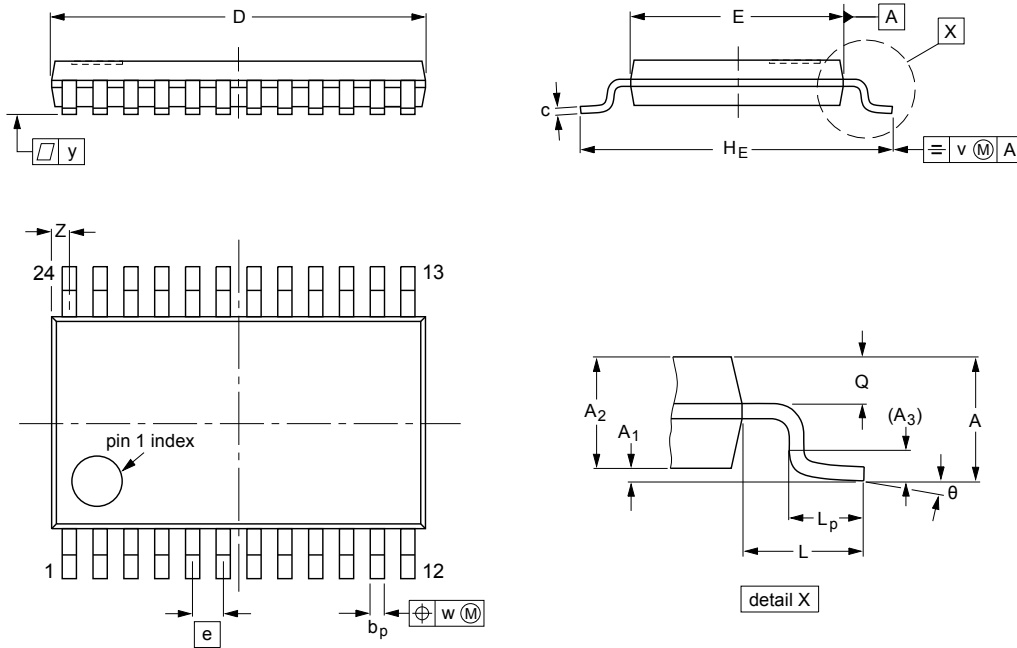
**Table 9. Test data**

Supply voltage	Input		Load		V <sub>EXT</sub>		
	V <sub>I</sub>	t <sub>r</sub> , t <sub>f</sub>	C <sub>L</sub>	R <sub>L</sub>	t <sub>PLH</sub> , t <sub>PHL</sub>	t <sub>PLZ</sub> , t <sub>PZL</sub>	t <sub>PHZ</sub> , t <sub>PZH</sub>
V <sub>CC</sub> = 5.0 V ± 0.5 V	GND to 3.0 V	≤ 2.5 ns	50 pF	500 Ω	open	7.0 V	open

### 11. Package outline

TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm

SOT355-1



**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	7.9 7.7	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	0.5 0.2	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.

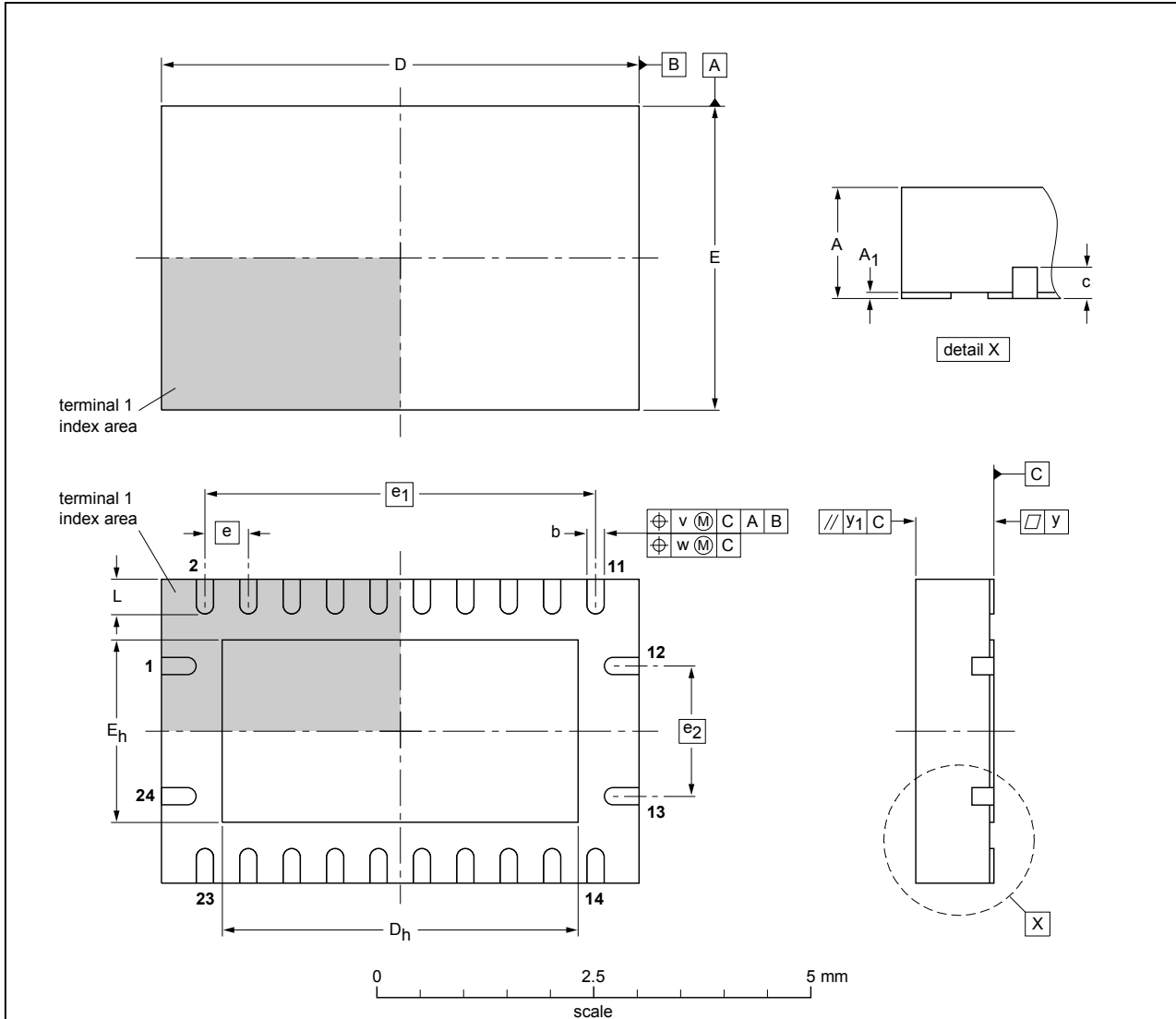
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT355-1		MO-153				99-12-27 03-02-19

Fig. 12. Package outline SOT355-1 (TSSOP24)



DHVQFN24: plastic dual in-line compatible thermal enhanced very thin quad flat package;  
no leads; 24 terminals; body 3.5 x 5.5 x 0.85 mm

SOT815-1



**DIMENSIONS (mm are the original dimensions)**

UNIT	A <sup>(1)</sup> max.	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>	e <sub>2</sub>	L	v	w	y	y <sub>1</sub>
mm	1	0.05 0.00	0.30 0.18	0.2	5.6 5.4	4.25 3.95	3.6 3.4	2.25 1.95	0.5	4.5	1.5	0.5 0.3	0.1	0.05	0.05	0.1

**Note**

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT815-1	---	---	---			03-04-29

Fig. 13. Package outline SOT815-1 (DHVQFN24)

## 12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CDM	Charged Device Model
ESD	ElectroStatic Discharge
HBM	Human Body Model
PRR	Pulse Rate Repetition
TTL	Transistor-Transistor Logic

## 13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
CBTD3861 v.3	20190306	Product data sheet	-	CBTD3861 v.2
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> <li>Type number CBTD3861DK (SOT556-1) removed.</li> </ul>			
CBTD3861 v.2	20111121	Product data sheet	-	CBTD3861 v.1
Modifications:	<ul style="list-style-type: none"> <li>Legal pages updated.</li> </ul>			
CBTD3861 v.1	20100819	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.
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