74CBTLVD3384

10-bit level-shifting bus switch with 5-bit output enables

Rev. 3 — 17 April 2019 Product data sheet

1. General description

The 74CBTLVD3384 is a dual 5-pole, single-throw bus switch. The device features two output enable inputs ($n\overline{OE}$) that each control five switch channels. The switches are disabled when the associated $n\overline{OE}$ input is HIGH. Schmitt-trigger action at control inputs makes the circuit tolerant of slower input rise and fall times. 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.

2. Features and benefits

- Supply voltage range from 3.0 V to 3.6 V
- High noise immunity
- Complies with JEDEC standard:
  - JESD8-B/JESD36 (3.0 V to 3.6 V)
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - CDM AEC-Q100-011 revision B exceeds 1000 V
- 5 Ω switch connection between two ports
- -3 dB bandwidth at 600 MHz
- 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
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	**Name**	**Description**	**Version**
74CBTLVD3384PW	-40 °C to +125 °C	TSSOP24	plastic thin shrink small outline package; 24 leads; body width 4.4 mm	SOT355-1
74CBTLVD3384BQ	-40 °C to +125 °C	DHVQFN24	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 24 terminals; body 3.5 × 5.5 × 0.85 mm	SOT815-1

nexperia

4. Functional diagram

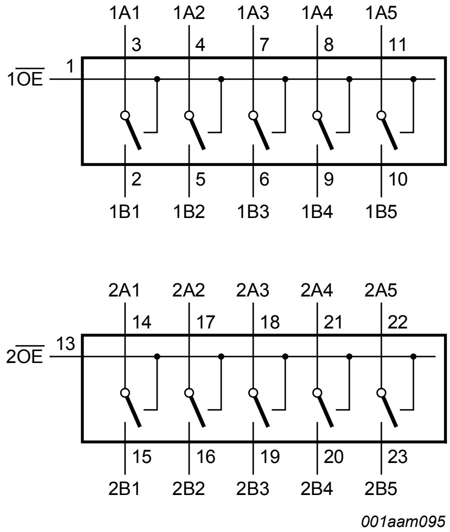


Fig. 1. Logic symbol

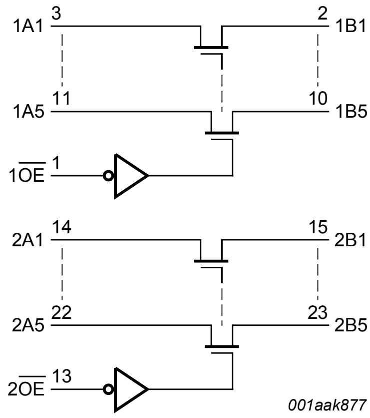


Fig. 2. Logic diagram

5. Pinning information

5.1. Pinning

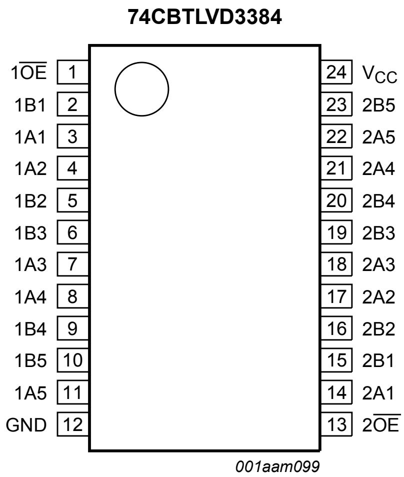
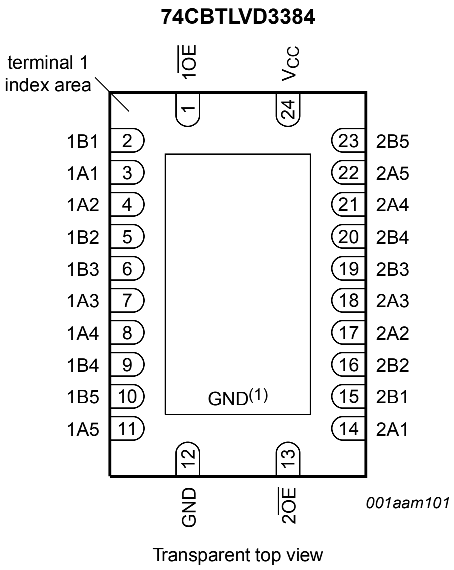


Fig. 3. Pin configuration SOT355-1 (TSSOP24)



(1) This is not a supply pin, the substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However if it is soldered the solder land should remain floating or be connected to GND.

Fig. 4. Pin configuration SOT815-1 (DHVQFN24)

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
$1\overline{OE}$, $2\overline{OE}$	1, 13	output enable input (active LOW)
1A1 to 1A5	3, 4, 7, 8, 11	data input/output (A port)
2A1 to 2A5	14, 17, 18, 21, 22	data input/output (A port)
1B1 to 1B5	2, 5, 6, 9, 10	data input/output (B port)
2B1 to 2B5	15, 16, 19, 20, 23	data input/output (B port)
GND	12	ground (0 V)
V_{CC}	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	
$1\overline{OE}$	$2\overline{OE}$	1An, 1Bn	2An, 2Bn
L	L	1An = 1Bn	2An = 2Bn
L	H	1An = 1Bn	Z
H	L	Z	2An = 2Bn
H	H	Z	Z

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_{CC}	supply voltage			-0.5	+4.6	V
V_I	input voltage		[1]	-0.5	+4.6	V
V_{SW}	switch voltage	enable and disable mode	[1]	-0.5	V_{CC} + 0.5	V
I_{IK}	input clamping current	$V_{I/O}$ < -0.5 V		-50	-	mA
I_{SK}	switch clamping current	V_I < -0.5 V		-50	-	mA
I_{SW}	switch current	V_{SW} = 0 V to V_{CC}		-	±128	mA
I_{CC}	supply current			-	+100	mA
I_{GND}	ground current			-100	-	mA
T_{stg}	storage temperature			-65	+150	°C
P_{tot}	total power dissipation	T_{amb} = -40 °C to +125 °C	[2]	-	500	mW

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

[2] For TSSOP24 packages: P_{tot} derates linearly with 5.5 mW/K above 60 °C.
For DHVQFN24 package: P_{tot} derates linearly at 4.5 mW/K above 60 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		3.0	3.6	V
V_I	input voltage		0	3.6	V
V_{SW}	switch voltage	enable and disable mode	0	V_{CC}	V
T_{amb}	ambient temperature		-40	+125	°C
Δt/ΔV	input transition rise and fall rate	V_{CC} = 3.0 V to 3.6 V [1]	0	200	ns/V

[1] Applies to control signal levels.

9. Static characteristics

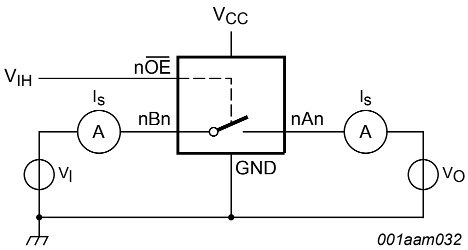
Table 6. Static characteristics

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
V_{IH}	HIGH-level input voltage	V_{CC} = 3.0 V to 3.6 V	2.0	-	-	2.0	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 3.0 V to 3.6 V	-	-	0.9	-	0.9	V
I_I	input leakage current	pin n$\overline{OE}$; V_I = GND to V_{CC}; V_{CC} = 3.6 V	-	-	±1	-	±20	μA
V_{pass}	pass voltage	V_I = V_{CC}; see Fig. 7 to Fig. 11	-	-	-	-	-	V
$I_{S(OFF)}$	OFF-state leakage current	V_{CC} = 3.6 V; see Fig. 5	-	-	±1	-	±20	μA
$I_{S(ON)}$	ON-state leakage current	V_{CC} = 3.6 V; see Fig. 6	-	-	±1	-	±20	μA
I_{OFF}	power-off leakage current	V_I or V_O = 0 V to 3.6 V; V_{CC} = 0 V	-	-	±10	-	±50	μA
I_{CC}	supply current	V_I = V_{CC}; I_O = 0 A; V_{CC} = 3.6 V; V_{SW} = GND or V_{CC}	-	-	20	-	50	μA
		V_I = GND; I_O = 0 A; V_{CC} = 3.6 V; V_{SW} = GND or V_{CC}	-	-	100	-	150	μA
ΔI_{CC}	additional supply current	pin n$\overline{OE}$; V_I = V_{CC} - 0.6 V; V_{SW} = GND or V_{CC}; V_{CC} = 3.6 V [2]	-	-	300	-	2000	μA
C_I	input capacitance	pin n$\overline{OE}$; 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	-	2.5	-	-	-	pF
$C_{S(ON)}$	ON-state capacitance	V_{CC} = 3.3 V; V_I = 0 V to 3.3 V	-	9.0	-	-	-	pF

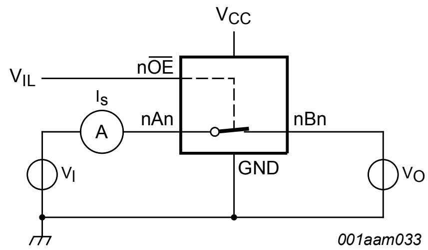
[1] All typical values are measured at T_{amb} = 25 °C.
[2] One input at 3 V, other inputs at V_{CC} or GND.

9.1. Test circuits



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

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



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

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

9.2. Typical pass voltage graphs

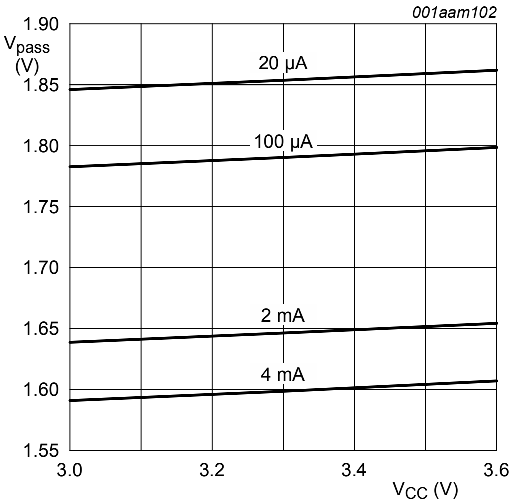


Fig. 7. Pass voltage versus supply voltage; T_{amb} = 125 °C (typical)

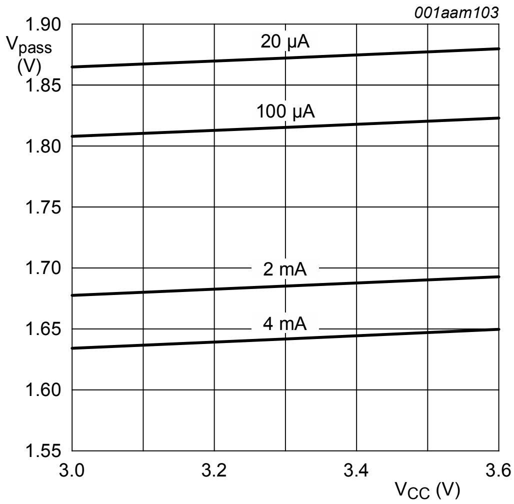


Fig. 8. Pass voltage versus supply voltage; T_{amb} = 85 °C (typical)

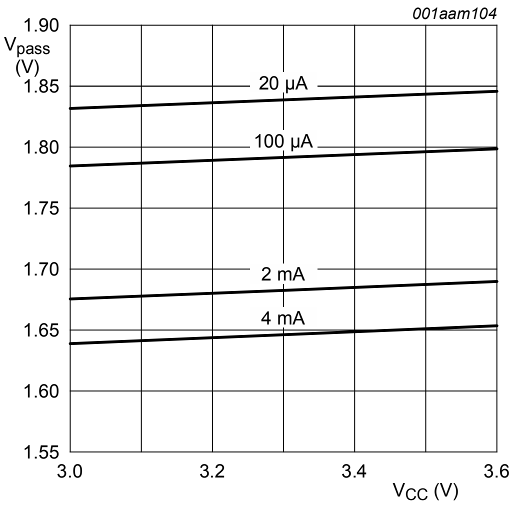


Fig. 9. Pass voltage versus supply voltage; T_{amb} = 25 °C (typical)

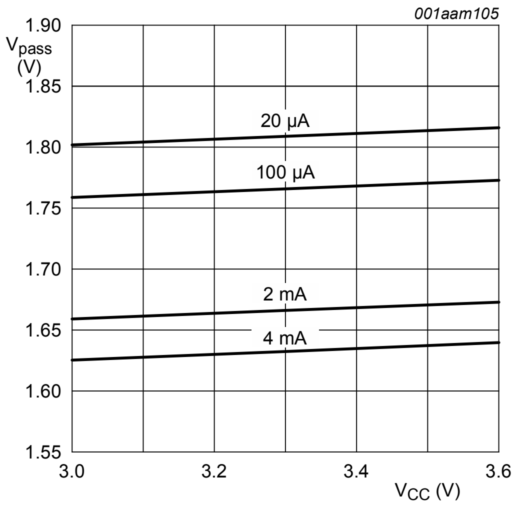


Fig. 10. Pass voltage versus supply voltage; T_{amb} = 0 °C (typical)

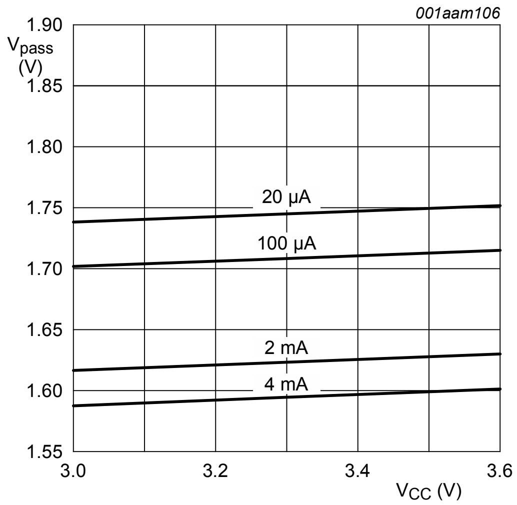


Fig. 11. Pass voltage versus supply voltage; T_{amb} = -40 °C (typical)

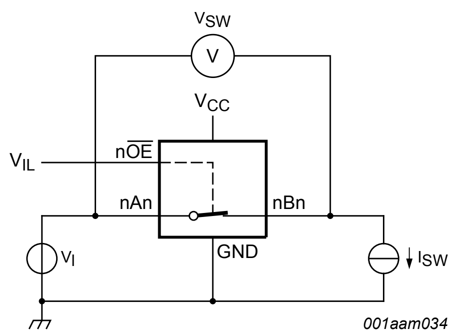
9.3. ON resistance

Table 7. Resistance R_{ON}

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 12.

Symbol	Parameter	Conditions		-40 °C to +85 °C			-40 °C to +125 °C		Unit
				Min	Typ [1]	Max	Min	Max	
R_{ON}	ON resistance	V_{CC} = 3.0 V to 3.6 V	[2]						
		I_{SW} = 64 mA; V_I = 0 V		-	3.7	7.0	-	10.0	Ω
		I_{SW} = 24 mA; V_I = 0 V		-	3.7	7.0	-	10.0	Ω
		I_{SW} = 15 mA; V_I = 1.2 V		-	4.7	10.0	-	12.0	Ω

[1] Typical values are measured at T_{amb} = 25 °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.



$R_{ON} = V_{SW} / I_{SW}$.

Fig. 12. Test circuit for measuring ON resistance (one switch)

10. Dynamic characteristics

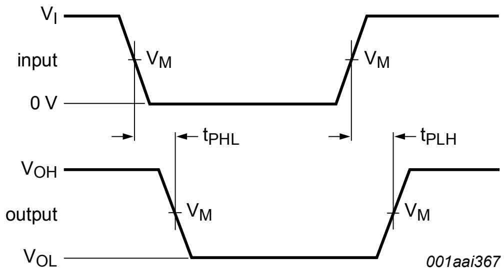
Table 8. Dynamic characteristics

GND = 0 V; for test circuit see Fig. 15

Symbol	Parameter	Conditions		-40 °C to +85 °C			-40 °C to +125 °C		Unit
				Min	Typ [1]	Max	Min	Max	
t_{pd}	propagation delay	nAn to nBn or nBn to nAn; V_{CC} = 3.0 V to 3.6 V; see Fig. 13	[2][3]	-	-	0.11	-	0.22	ns
t_{en}	enable time	n$\overline{OE}$ to nAn or nBn; V_{CC} = 3.0 V to 3.6 V; see Fig. 14	[4]	1.5	2.8	5.0	1.5	6.0	ns
t_{dis}	disable time	n$\overline{OE}$ to nAn or nBn; V_{CC} = 3.0 V to 3.6 V; see Fig. 14	[5]	0.8	3.2	7.0	0.8	8.0	ns

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

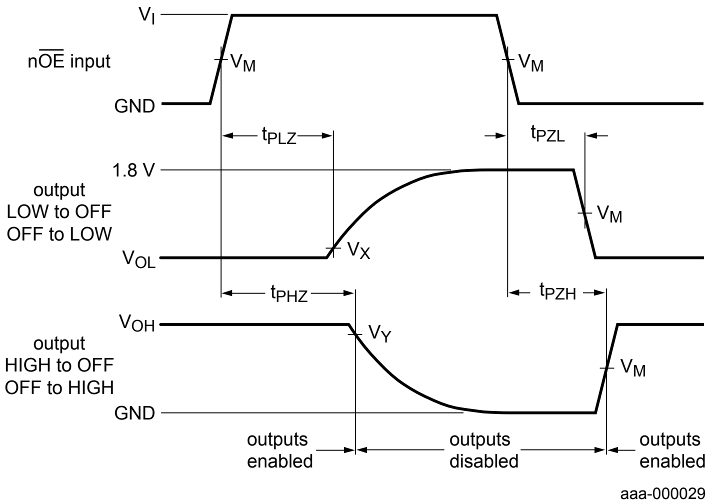
10.1. Waveforms and test circuit



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. 13. The data input (nAn, nBn) to output (nBn, nAn) propagation delay times



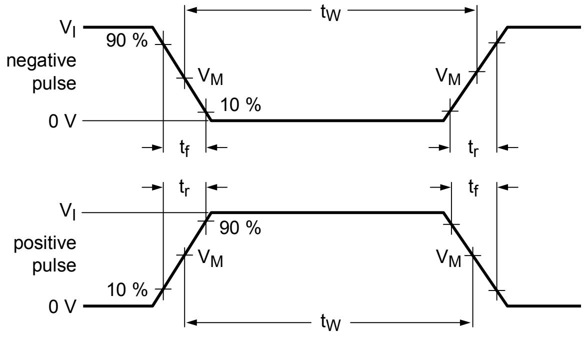
Measurement points are given in Table 9.

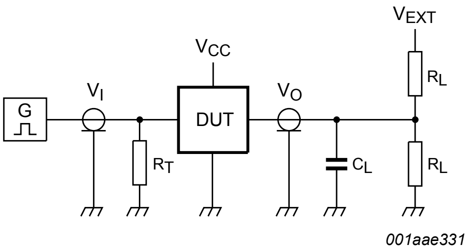
Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 14. Enable and disable times

Table 9. Measurement points

Supply voltage	Input			Output		
V_{CC}	V_M	V_I	$t_r = t_f$	V_M	V_X	V_Y
3.0 V to 3.6 V	$0.5V_{CC}$	V_{CC}	≤ 2.0 ns	0.9 V	V_{OL} + 0.15 V	V_{OH} - 0.15 V





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. 15. 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}
3.0 V to 3.6 V	30 pF	1 kΩ	open	GND	3.6 V

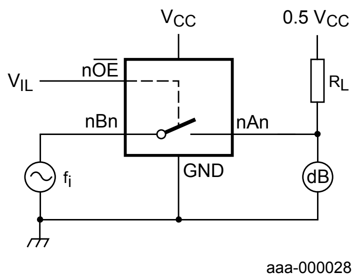
10.2. Additional dynamic characteristics

Table 11. Additional dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); V_I = GND or V_{CC} (unless otherwise specified); $t_r = t_f \leq 2.5$ ns.

Symbol	Parameter	Conditions		T_{amb} = 25 °C			Unit
				Min	Typ [1]	Max	
$f_{(-3dB)}$	-3 dB frequency response	V_{CC} = 3.3 V; R_L = 50 Ω; see Fig. 16	[2]	-	575	-	MHz

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 3.3 V.
[2] f_i is biased at $0.5V_{CC}$.

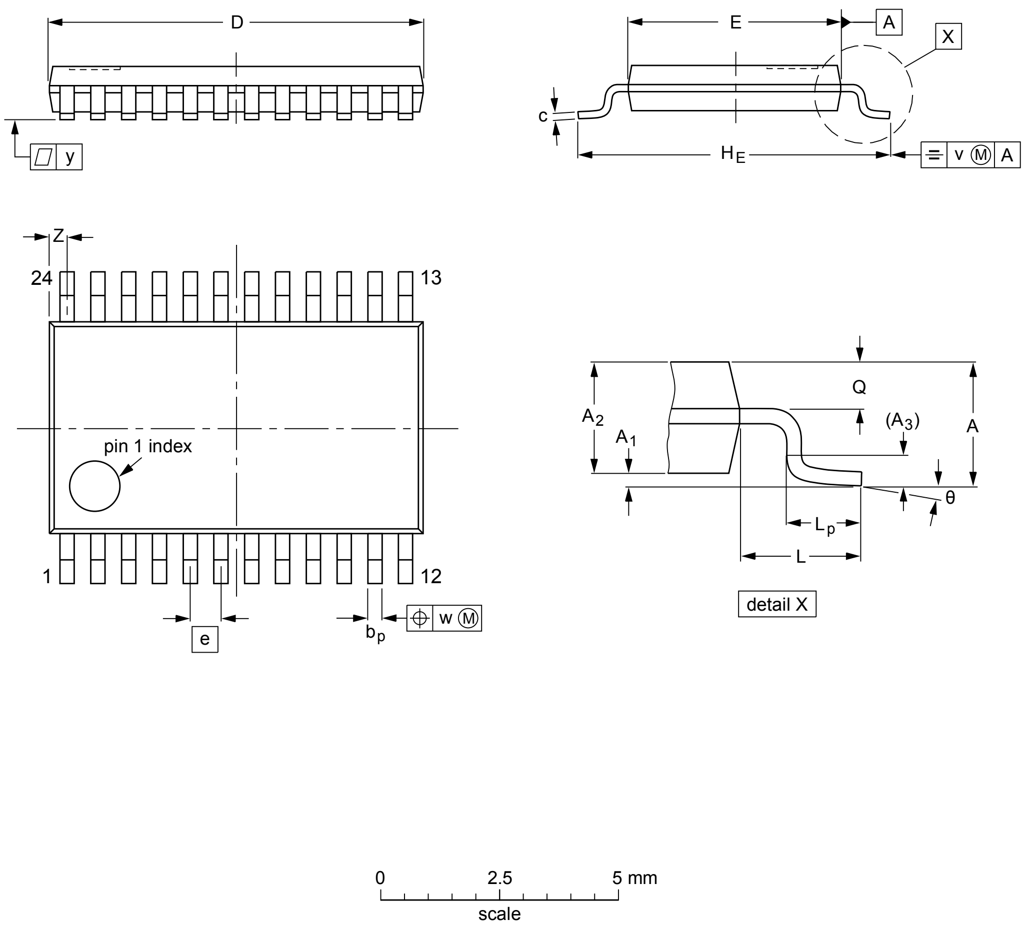


nOE connected to GND; Adjust f_i voltage to obtain 0 dBm level at output.
Increase f_i frequency until dB meter reads -3 dB.

Fig. 16. Test circuit for measuring the frequency response when channel is in ON-state

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_1	A_2	A_3	b_p	c	D[1]	E[2]	e	H_E	L	L_p	Q	v	w	y	Z[1]	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°

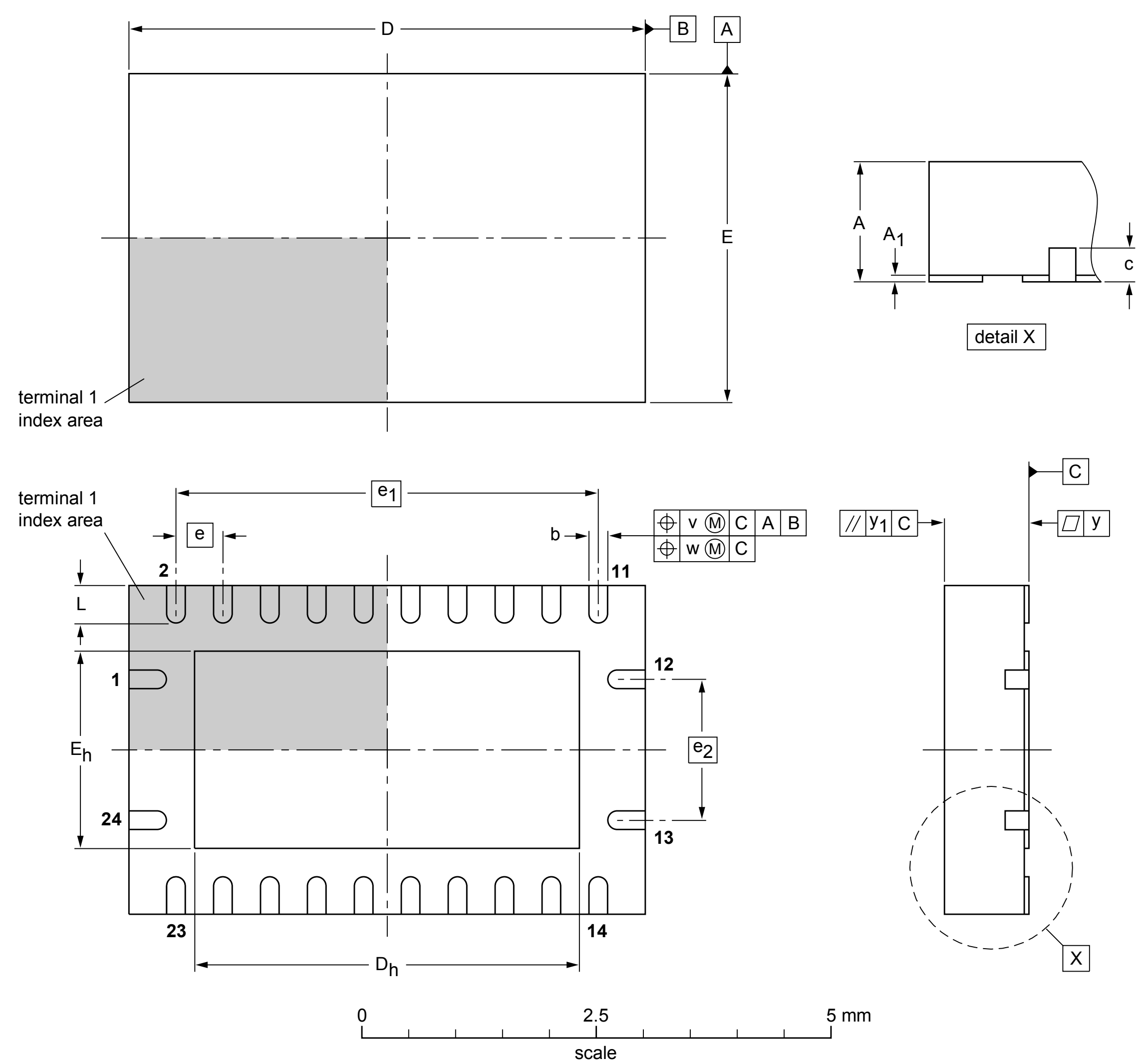
Notes

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. 17. 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(1) max.	A_1	b	c	D (1)	D_h	E (1)	E_h	e	e_1	e_2	L	v	w	y	y_1
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. 18. Package outline SOT815-1 (DHVQFN24)

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

13. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74CBTLVD3384 v.3	20190417	Product data sheet	-	74CBTLVD3384 v.2
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. • Type number 74CBTLVD3384DK (SOT556-1) removed.			
74CBTLVD3384 v.2	20111216	Product data sheet	-	74CBTLVD3384 v.1
Modifications:	• Legal pages updated.			
74CBTLVD3384 v.1	20110719	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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