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Team Nexperia

74CBTLV16211

24-bit bus switch

Rev. 7 — 9 November 2016 Product data sheet

1. General description

The 74CBTLV16211 provides a dual 12-bit high-speed bus switch with separate output enable inputs ($1\overline{OE}$, $2\overline{OE}$). 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, $1\overline{OE}$ and $2\overline{OE}$ 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.

2. Features and benefits

- Supply voltage range from 2.3 V to 3.6 V
- 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:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
  - CDM AEC-Q100-011 revision B exceeds 1000 V
- 5 Ω 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
- TSSOP56 packages: SOT364-1 and SOT481-2
- 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
74CBTLV16211DGG	−40 °C to +125 °C	TSSOP56	plastic thin shrink small outline package; 56 leads; body width 6.1 mm	SOT364-1
74CBTLV16211DGV	−40 °C to +125 °C	TSSOP56	plastic thin shrink small outline package; 56 leads; body width 4.4 mm	SOT481-2

4. Functional diagram

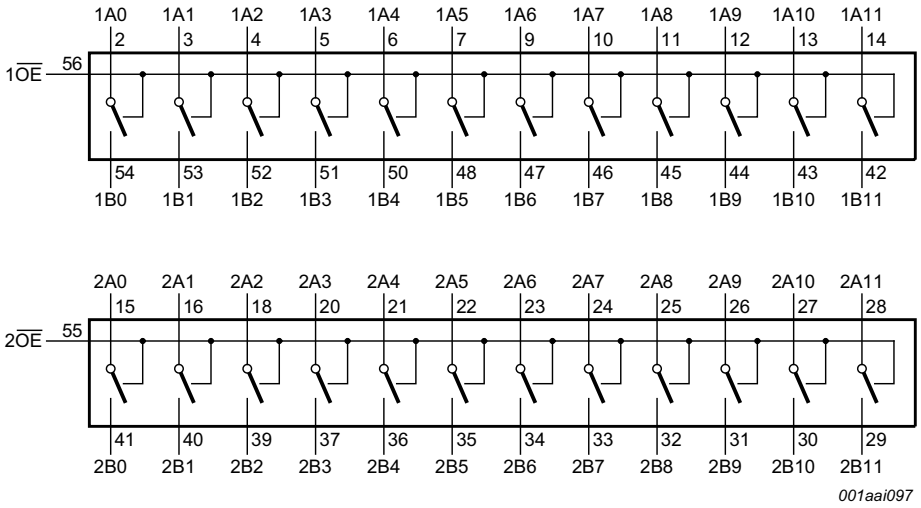


Fig 1. Logic symbol

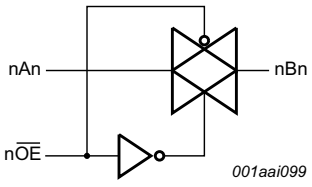


Fig 2. Logic diagram (one switch)

5. Pinning information

5.1 Pinning

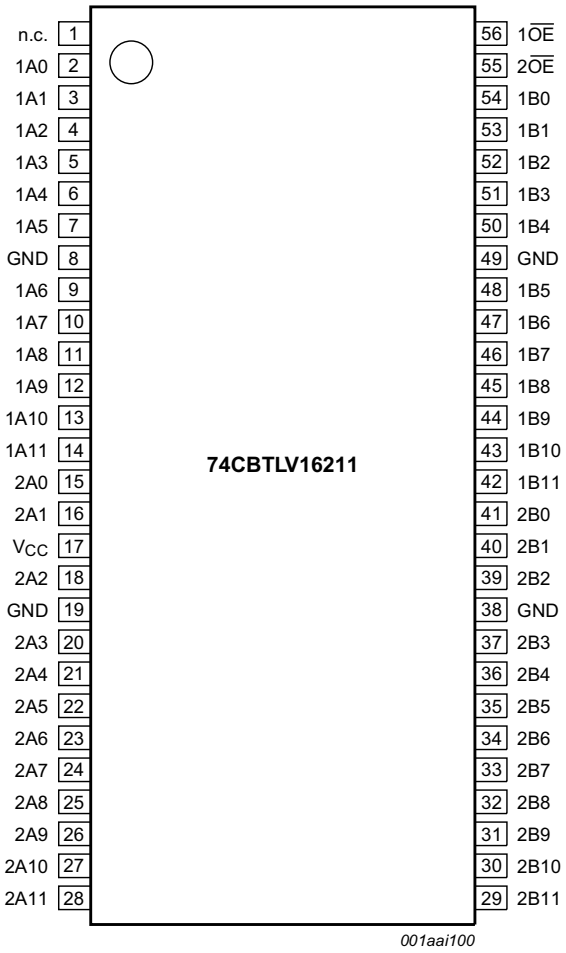


Fig 3. Pin configuration (SOT364-1 and SOT481-2)

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
n.c.	1	not connected
1A0 to 1A11	2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14	independent input or output
2A0 to 2A11	15, 16, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28	independent input or output
GND	8, 19, 38, 49	ground (0 V)
V_{CC}	17	supply voltage
2B0 to 2B11	41, 40, 39, 37, 36, 35, 34, 33, 32, 31, 30, 29	independent input or output

Table 2. Pin description *...continued*

Symbol	Pin	Description
1B0 to 1B11	54, 53, 52, 51, 50, 48, 47, 46, 45, 44, 43, 42	independent input or output
$2\overline{OE}$	55	output enable input (active-LOW)
$1\overline{OE}$	56	output enable input (active-LOW)

6. Functional description

Table 3. Function table[1]

Output enable input $\overline{OE}$	Function switch
L	ON-state
H	OFF-state

[1] H = HIGH voltage level; L = LOW voltage level.

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 < −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]	-	600	mW

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

[2] For TSSOP56 packages: above 55 °C the value of P_{tot} derates linearly with 8.0 mW/K.

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		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	V_{CC} = 2.3 V to 3.6 V [1]	0	200	ns/V

[1] Applies to control signal levels.

9. Static characteristics

Table 6. Static characteristics

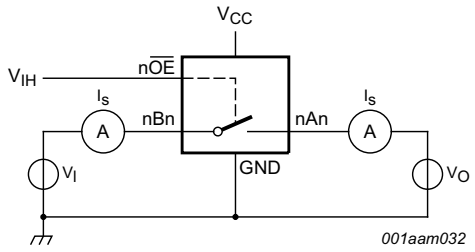
At recommended operating conditions voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	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 $n\overline{OE}$; V_I = GND to V_{CC}; V_{CC} = 3.6 V	-	-	±1.0	-	±20	µA
$I_{S(OFF)}$	OFF-state leakage current	V_{CC} = 3.6 V; see Figure 4	-	-	±1	-	±20	µA
$I_{S(ON)}$	ON-state leakage current	V_{CC} = 3.6 V; see Figure 5	-	-	±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 = GND or V_{CC}; I_O = 0 A; V_{SW} = GND or V_{CC}; V_{CC} = 3.6 V	-	-	10	-	50	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	-	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.

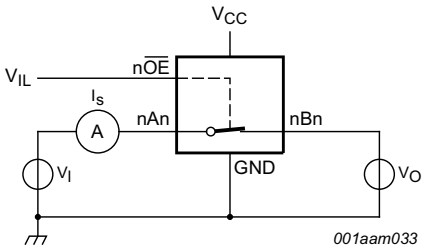
[2] One input at 3 V, other inputs at V_{CC} or GND.

9.1 Test circuits



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

Fig 4. Test circuit for measuring OFF-state leakage current (one channel)



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

Fig 5. Test circuit for measuring ON-state leakage current (one channel)

9.2 ON resistance

Table 7. Resistance R_{ON}

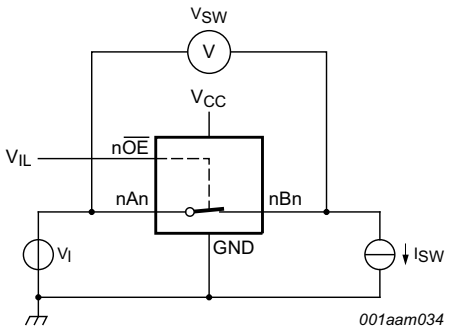
At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see Figure 6.

Symbol	Parameter	Conditions		T_{amb} = –40 °C to +85 °C			T_{amb} = –40 °C to +125 °C		Unit
				Min	Typ[1]	Max	Min	Max	
R_{ON}	ON resistance	V_{CC} = 2.3 V to 2.7 V; see Figure 7 to Figure 9	[2]						
		I_{SW} = 64 mA; V_I = 0 V		-	4.2	8.0	-	15.0	Ω
		I_{SW} = 24 mA; V_I = 0 V		-	4.2	8.0	-	15.0	Ω
		I_{SW} = 15 mA; V_I = 1.7 V		-	8.4	40	-	60.0	Ω
		V_{CC} = 3.0 V to 3.6 V; see Figure 10 to Figure 12							
		I_{SW} = 64 mA; V_I = 0 V		-	4.0	7.0	-	11.0	Ω
		I_{SW} = 24 mA; V_I = 0 V		-	4.0	7.0	-	11.0	Ω
		I_{SW} = 15 mA; V_I = 2.4 V		-	6.2	15	-	25.5	Ω

[1] Typical values are measured at T_{amb} = 25 °C and nominal V_{CC}.

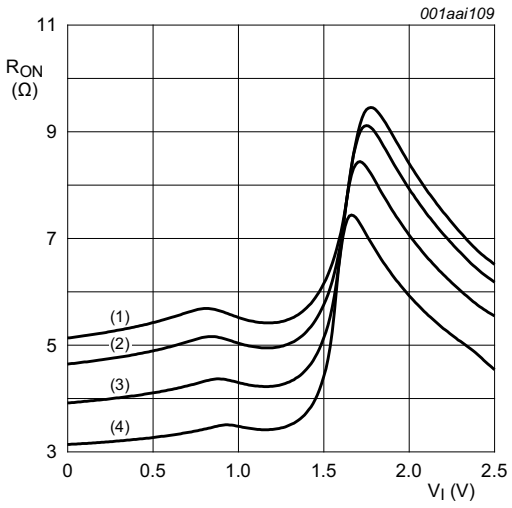
[2] Measured by the voltage drop between the A and B terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two (A or B) terminals.

9.3 ON resistance test circuit and graphs



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

Fig 6. Test circuit for measuring ON resistance (one channel)



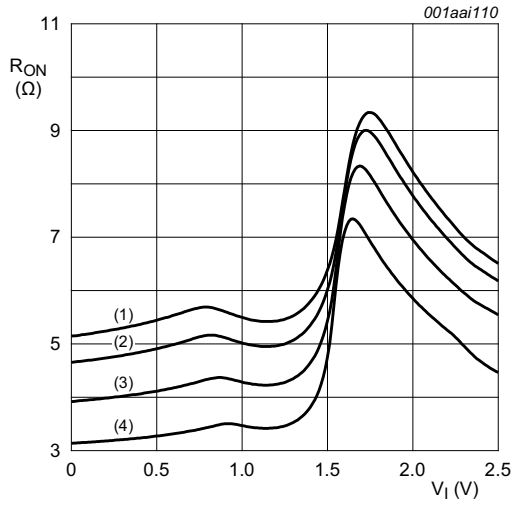
(1) T_{amb} = 125 °C.

(2) T_{amb} = 85 °C.

(3) T_{amb} = 25 °C.

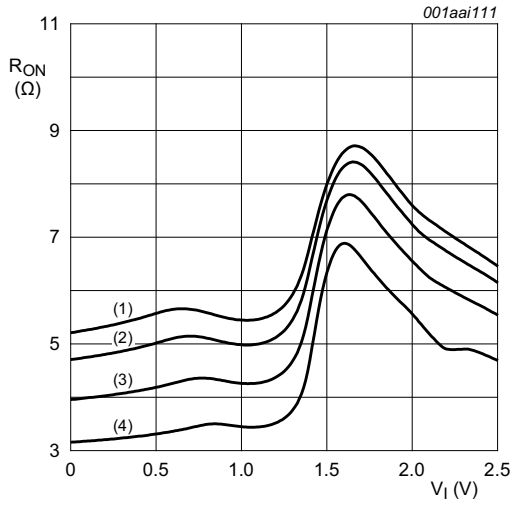
(4) T_{amb} = –40 °C.

Fig 7. ON resistance as a function of input voltage; V_{CC} = 2.5 V; I_{SW} = 15 mA



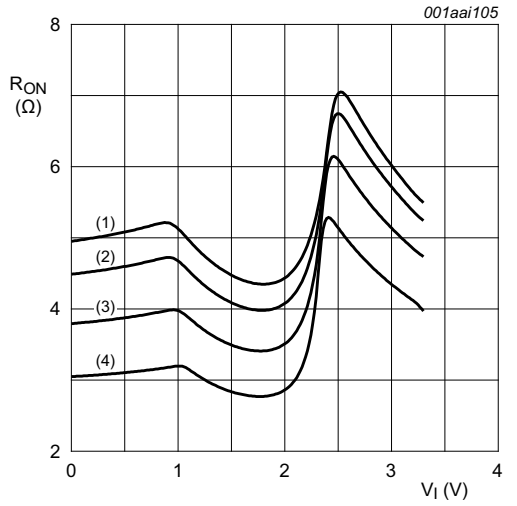
(1) T_{amb} = 125 °C.
(2) T_{amb} = 85 °C.
(3) T_{amb} = 25 °C.
(4) T_{amb} = −40 °C.

Fig 8. ON resistance as a function of input voltage; V_{CC} = 2.5 V; I_{SW} = 24 mA



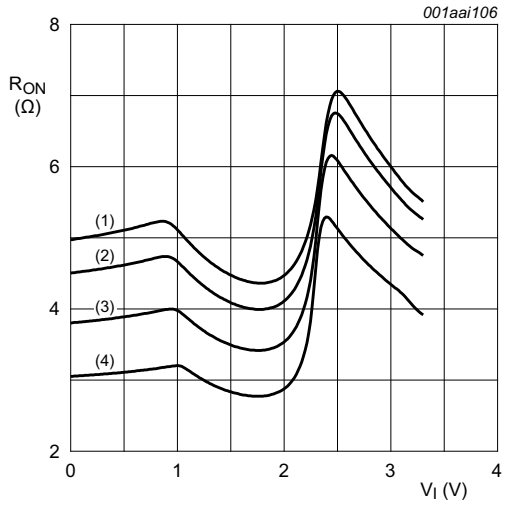
(1) T_{amb} = 125 °C.
(2) T_{amb} = 85 °C.
(3) T_{amb} = 25 °C.
(4) T_{amb} = −40 °C.

Fig 9. ON resistance as a function of input voltage; V_{CC} = 2.5 V; I_{SW} = 64 mA



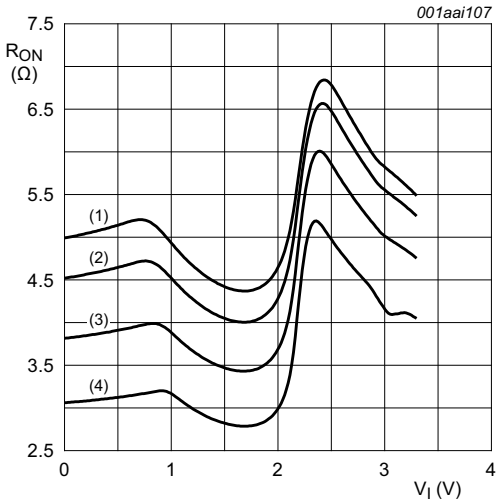
(1) T_{amb} = 125 °C.
(2) T_{amb} = 85 °C.
(3) T_{amb} = 25 °C.
(4) T_{amb} = −40 °C.

Fig 10. ON resistance as a function of input voltage; V_{CC} = 3.3 V; I_{SW} = 15 mA



(1) T_{amb} = 125 °C.
(2) T_{amb} = 85 °C.
(3) T_{amb} = 25 °C.
(4) T_{amb} = −40 °C.

Fig 11. ON resistance as a function of input voltage; V_{CC} = 3.3 V; I_{SW} = 24 mA



(1) T_{amb} = 125 °C.

(2) T_{amb} = 85 °C.

(3) T_{amb} = 25 °C.

(4) T_{amb} = −40 °C.

Fig 12. ON resistance as a function of input voltage; V_{CC} = 3.3 V; I_{SW} = 64 mA

10. Dynamic characteristics

Table 8. Dynamic characteristics

GND = 0 V; for test circuit see Figure 15

Symbol	Parameter	Conditions	T_{amb} = –40 °C to +85 °C			T_{amb} = –40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
t_{pd}	propagation delay	nAn to nBn or nBn to nAn; see Figure 13 [2][3]						
		V_{CC} = 2.3 V to 2.7 V	-	-	0.13	-	0.2	ns
		V_{CC} = 3.0 V to 3.6 V	-	-	0.2	-	0.31	ns
t_{en}	enable time	$n\overline{OE}$ to nAn or nBn; see Figure 14 [4]						
		V_{CC} = 2.3 V to 2.7 V	1.0	2.0	7.0	1.0	7.8	ns
		V_{CC} = 3.0 V to 3.6 V	1.0	1.7	6.2	1.0	6.8	ns
t_{dis}	disable time	$n\overline{OE}$ to nAn or nBn; see Figure 14 [5]						
		V_{CC} = 2.3 V to 2.7 V	1.0	2.6	7.2	1.0	8.1	ns
		V_{CC} = 3.0 V to 3.6 V	1.0	3.0	7.7	1.0	8.8	ns

[1] All typical values are measured at T_{amb} = 25 °C and at nominal V_{CC}.

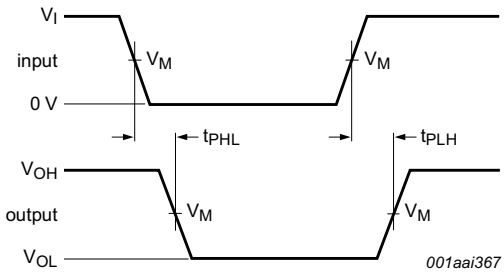
[2] The propagation delay is the calculated RC time constant of the typical on-state resistance of the switch and the load capacitance, when driven by an ideal voltage source (zero output impedance).

[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}.

11. Waveforms



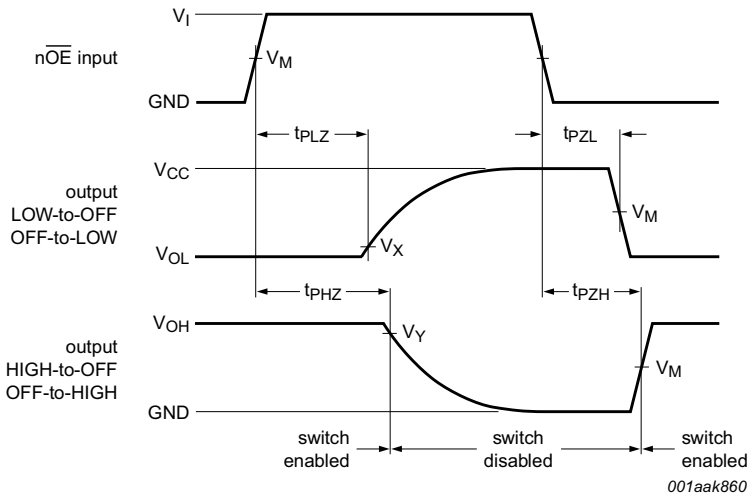
Measurement points are given in Table 9.

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

Fig 13. The data input (nAn or nBn) to output (nBn or nAn) propagation delays

Table 9. Measurement points

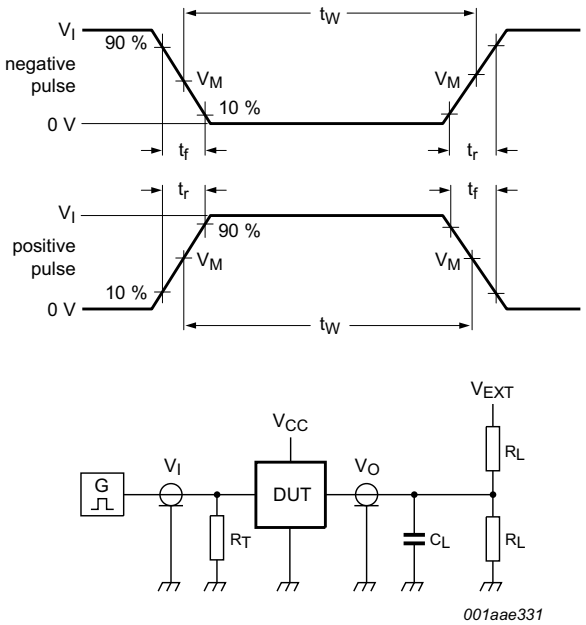
Supply voltage	Input			Output		
V_{CC}	V_M	V_I	$t_r = t_f$	V_M	V_X	V_Y
2.3 V to 2.7 V	$0.5V_{CC}$	V_{CC}	≤ 2.0 ns	$0.5V_{CC}$	V_{OL} + 0.15 V	V_{OH} − 0.15 V
3.0 V to 3.6 V	$0.5V_{CC}$	V_{CC}	≤ 2.0 ns	$0.5V_{CC}$	V_{OL} + 0.3 V	V_{OH} − 0.3 V



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 14. 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 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}
2.3 V to 2.7 V	30 pF	500 Ω	open	GND	$2V_{CC}$
3.0 V to 3.6 V	50 pF	500 Ω	open	GND	$2V_{CC}$

11.1 Additional dynamic characteristics

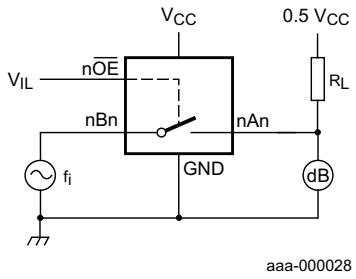
Table 11. Additional dynamic characteristics

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	Max	
$f_{(-3dB)}$	−3 dB frequency response	V_{CC} = 3.3 V; R_L = 50 Ω; see Figure 16 [1]	-	458	-	MHz

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

11.2 Test circuits

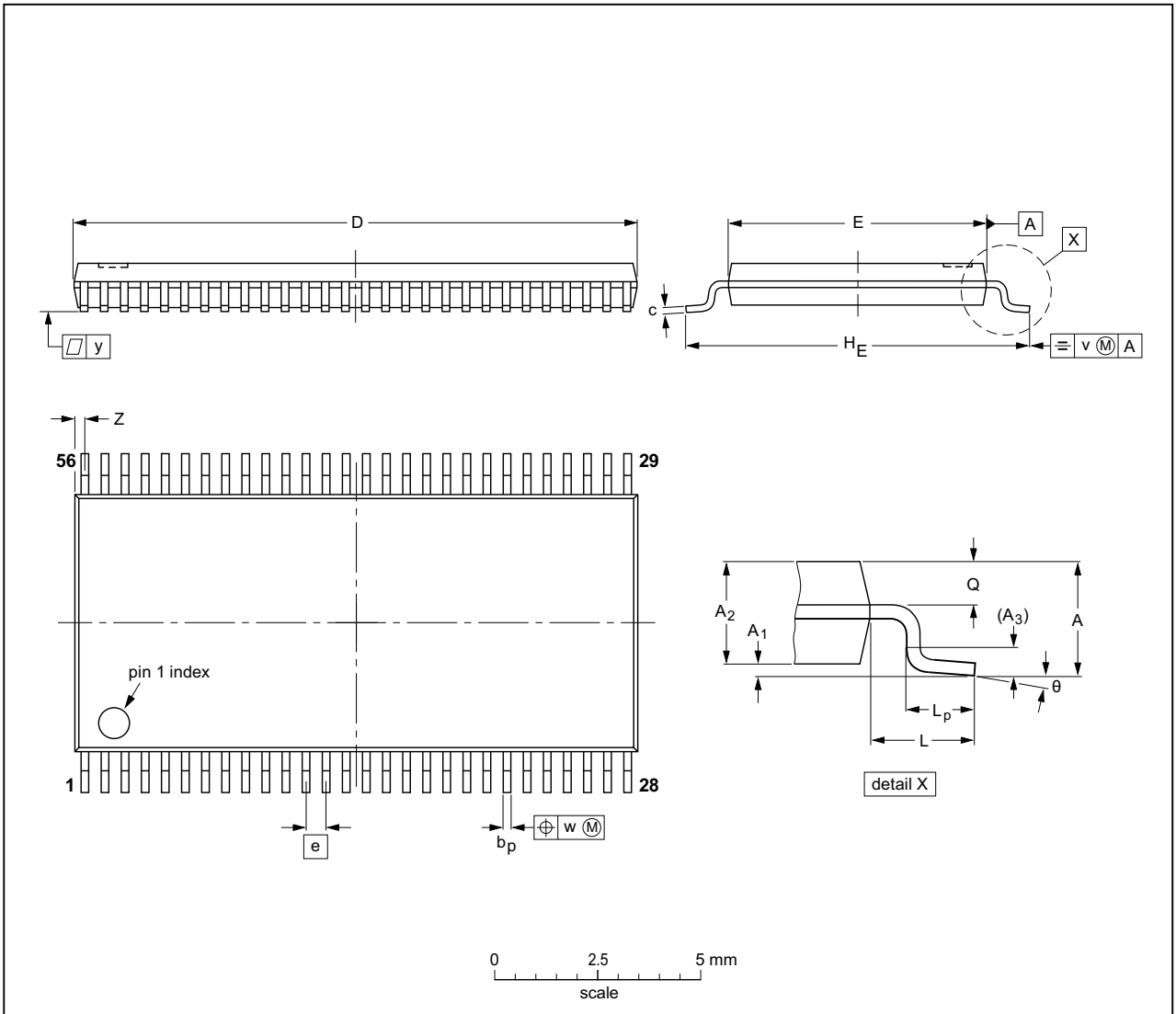


nOE connected to GND; Adjust f_i voltage to obtain 0 dBm level at output. Increase f_i frequency until dB meter reads −3 dB.

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

12. Package outline

TSSOP56: plastic thin shrink small outline package; 56 leads; body width 6.1 mm **SOT364-1**



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	θ
mm	1.2	0.15 0.05	1.05 0.85	0.25	0.28 0.17	**0.2** **0.1**	14.1 13.9	6.2 6.0	0.5	8.3 7.9	1	0.8 0.4	0.50 0.35	0.25	0.08	0.1	0.5 0.1	8^o 0^o

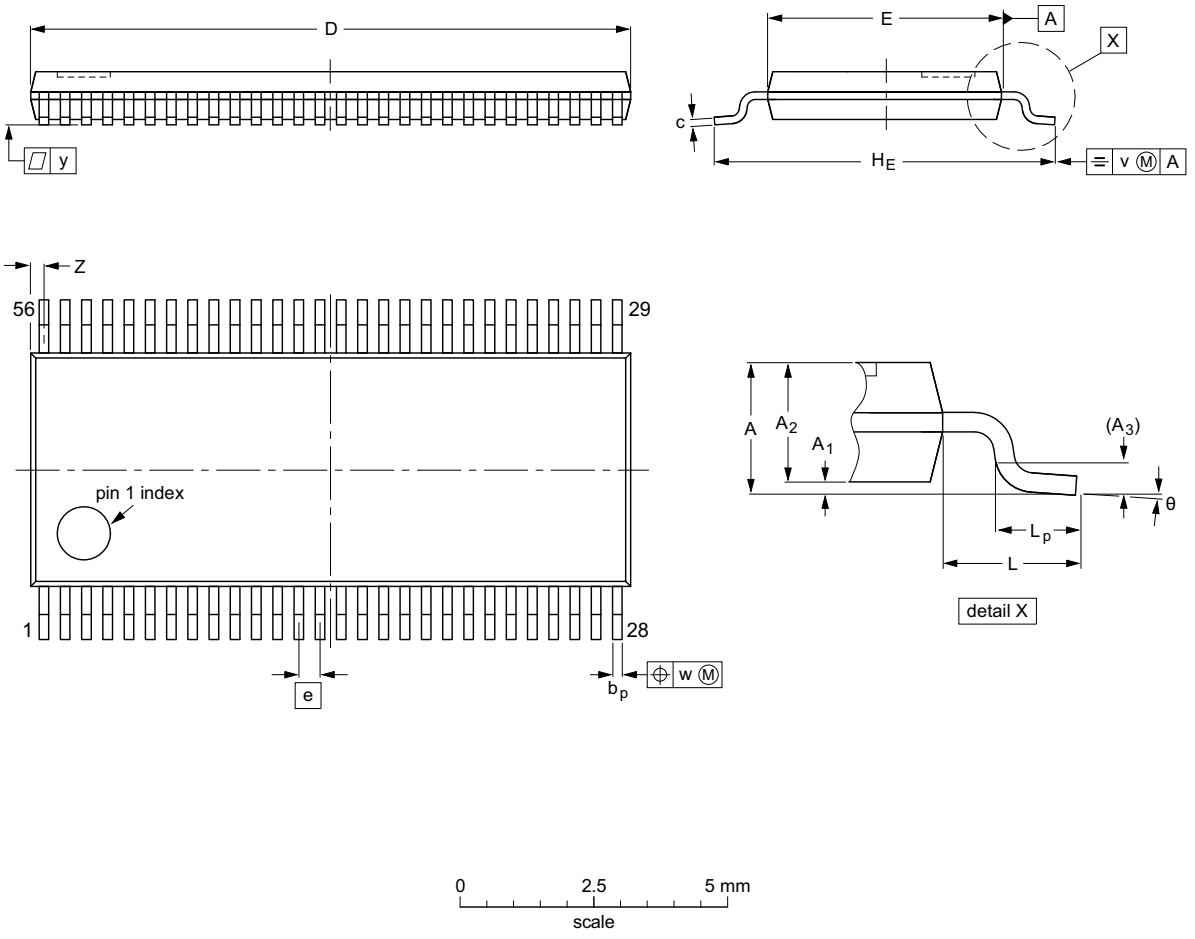
Notes

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			
SOT364-1		MO-153				~~99-12-27~~ 03-02-19

Fig 17. Package outline SOT364-1 (TSSOP56)

TSSOP56: plastic thin shrink small outline package; 56 leads; body width 4.4 mm **SOT481-2**



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	v	w	y	Z (1)	θ
mm	1.2	0.15 0.05	1.05 0.80	0.25	0.23 0.13	0.20 0.09	11.4 11.2	4.5 4.3	0.4	6.6 6.2	1	0.75 0.45	0.2	0.07	0.08	0.4 0.1	8° 0°

Notes

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT481-2	- - -	MO-194	- - -			01-11-24

Fig 18. Package outline SOT481-2 (TSSOP56)

13. 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
MM	Machine Model

14. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74CBTLV16211 v.7	20161109	Product data sheet	-	74CBTLV16211 v.6
Modifications:	• Section 11.1 and Section 11.2 added.			
74CBTLV16211 v.6	20111215	Product data sheet	-	74CBTLV16211 v.5
Modifications:	• Legal pages updated.			
74CBTLV16211 v.5	20101230	Product data sheet	-	74CBTLV16211 v.4
74CBTLV16211 v.4	20100816	Product data sheet	-	74CBTLV16211 v.3
74CBTLV16211 v.3	20100112	Product data sheet	-	74CBTLV16211 v.2
74CBTLV16211 v.2	20090826	Product data sheet	-	74CBTLV16211 v.1
74CBTLV16211 v.1	20080620	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".

[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 URL http://www.nxp.com.

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17. Contents

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