NTB0101

Dual supply translating transceiver; auto direction sensing; 3-state

Rev. 7 — 9 April 2018 Product data sheet

1. General description

The NTB0101 is a 1-bit, dual supply translating transceiver with auto direction sensing, that enables bidirectional voltage level translation. It features two 1-bit input-output ports (A and B), one output enable input (OE) and two supply pins ($V_{CC(A)}$ and $V_{CC(B)}$). $V_{CC(A)}$ can be supplied at any voltage between 1.2 V and 3.6 V and $V_{CC(B)}$ can be supplied at any voltage between 1.65 V and 5.5 V, making the device suitable for translating between any of the low voltage nodes (1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V and 5.0 V).

Pins A and OE are referenced to $V_{CC(A)}$ and pin B is referenced to $V_{CC(B)}$. A LOW level at pin OE causes the outputs to assume a high-impedance OFF-state. 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

- Wide supply voltage range:
  - $V_{CC(A)}$: 1.2 V to 3.6 V and $V_{CC(B)}$: 1.65 V to 5.5 V
- I_{OFF} circuitry provides partial Power-down mode operation
- Inputs accept voltages up to 5.5 V
- ESD protection:
  - HBM JESD22-A114E Class 2 exceeds 2500 V for A port
  - HBM JESD22-A114E Class 3B exceeds 15000 V for B port
  - MM JESD22-A115-A exceeds 200 V
  - CDM JESD22-C101E exceeds 1500 V
- Latch-up performance exceeds 100 mA per JESD 78B Class II
- Multiple package options
- Specified from −40 °C to +85 °C and −40 °C to +125 °C

3. Ordering information

Table 1. Device information

Type number	Topside marking[1]	Package		
		Name	Description	Version
NTB0101GW	t1	SC-88	plastic surface-mounted package; 6 leads	SOT363
NTB0101GM	t1	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; 1 × 1.45 × 0.5 mm body	SOT886
NTB0101GF	t1	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; 1 × 1 × 0.5 mm body	SOT891
NTB0101GS	t1	XSON6	extremely thin small outline package; no leads; 6 terminals; 1.0 × 1.0 × 0.35 mm body	SOT1202
NTB0101GS1	T1	X2SON6	plastic super thin small outline package; no leads; 6 terminals; 1.0 × 1.0 × 0.32 mm body	SOT1202-2
NTB0101GN	t1	XSON6	extremely thin small outline package; no leads; 6 terminals; 0.9 × 1.0 × 0.35 mm body	SOT1115

[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

3.1 Ordering options

Table 2. Ordering options

Type number	Orderable part number	Package	Packing method	Minimum order qty	Temperature
NTB0101GW[3]	NTB0101GW,125	SC-88	REEL 7" Q3/T4 *STANDARD MARK	3000	T_{amb} = –40 °C to +125 °C
NTB0101GM	NTB0101GM,115	XSON6	REEL 7" Q1/T1 *STANDARD MARK SMD	5000	T_{amb} = –40 °C to +125 °C
NTB0101GF[1]	NTB0101GF,132	XSON6	REEL 7" Q1/T1,Q3/T4 *STANDARD MARK SMD	5000	T_{amb} = –40 °C to +125 °C
NTB0101GS[2]	NTB0101GS,132	XSON6	REEL 7" Q1/T1,Q3/T4 *STANDARD MARK SMD	5000	T_{amb} = –40 °C to +125 °C
NTB0101GS1	NTB0101GS1Z	X2SON6	REEL 7" Q2/T3 *STANDARD MARK	10000	T_{amb} = –40 °C to +125 °C
NTB0101GN[1]	NTB0101GN,132	XSON6	REEL 7" Q1/T1,Q3/T4 *STANDARD MARK SMD	5000	T_{amb} = –40 °C to +125 °C

[1] Discontinued with 24 Apr 2018 Last Time Buy and 24 Jul 2018 Last Time Ship date.

[2] Discontinued with 31 Aug 2018 Last Time Buy and 30 Nov 2018 Last Time Ship date.

[3] Not recommend for new design.

4. Functional diagram

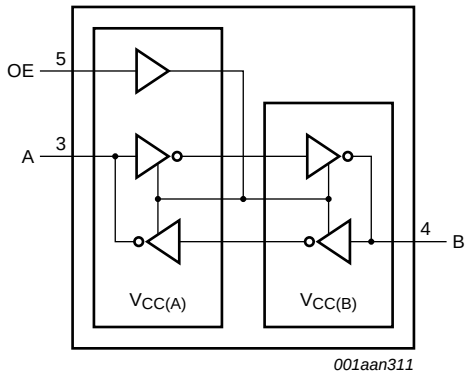


Fig 1. Logic symbol

5. Pinning information

5.1 Pinning

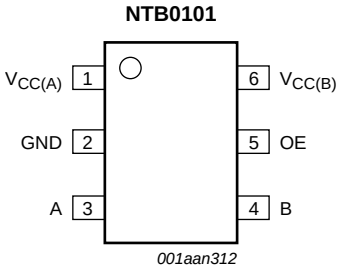
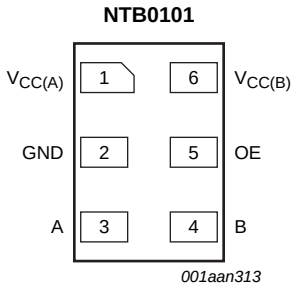
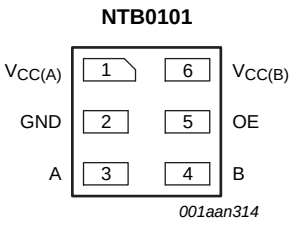


Fig 2. Pin configuration SOT363



Transparent top view

Fig 3. Pin configuration SOT886 and SOT1115



Transparent top view

Fig 4. Pin configuration SOT891, SOT1202 and SOT1202-2

5.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
$V_{CC(A)}$	1	supply voltage A
GND	2	ground (0 V)
A	3	data input or output (referenced to $V_{CC(A)}$)
B	4	data input or output (referenced to $V_{CC(B)}$)
OE	5	output enable input (active HIGH; referenced to $V_{CC(A)}$)
$V_{CC(B)}$	6	supply voltage B

6. Functional description

Table 4. Function table[1]

Supply voltage		Input	Input/output	
$V_{CC(A)}$	$V_{CC(B)}$	OE	A	B
1.2 V to $V_{CC(B)}$	1.65 V to 5.5 V	L	Z	Z
1.2 V to $V_{CC(B)}$	1.65 V to 5.5 V	H	input or output	output or input
GND[2]	GND[2]	X	Z	Z

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state.

[2] When either $V_{CC(A)}$ or $V_{CC(B)}$ is at GND level, the device goes into Power-down mode.

7. Limiting values

Table 5. 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
$V_{CC(A)}$	supply voltage A			–0.5	+6.5	V
$V_{CC(B)}$	supply voltage B			–0.5	+6.5	V
V_I	input voltage		[1]	–0.5	+6.5	V
V_O	output voltage	Active mode	[1][2][3]	–0.5	V_{CCO} + 0.5	V
		Power-down or 3-state mode	[1]	–0.5	+6.5	V
I_{IK}	input clamping current	V_I < 0 V		–50	-	mA
I_{OK}	output clamping current	V_O < 0 V		–50	-	mA
I_O	output current	V_O = 0 V to V_{CCO}	[2]	-	±50	mA
I_{CC}	supply current	$I_{CC(A)}$ or $I_{CC(B)}$		-	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	[4]	-	250	mW

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

[2] V_{CCO} is the supply voltage associated with the output.

[3] V_{CCO} + 0.5 V should not exceed 6.5 V.

[4] For SC-88 and SC-74A packages: above 87.5 °C the value of P_{tot} derates linearly with 4.0 mW/K.
For XSON6 packages: above 118 °C the value of P_{tot} derates linearly with 7.8 mW/K.

8. Recommended operating conditions

Table 6. Recommended operating conditions[1][2]

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{CC(A)}$	supply voltage A			1.2	3.6	V
$V_{CC(B)}$	supply voltage B			1.65	5.5	V
V_I	input voltage			0	5.5	V

Table 6. Recommended operating conditions[1][2] *…continued*

Symbol	Parameter	Conditions		Min	Max	Unit
V_O	output voltage	Power-down or 3-state mode; $V_{CC(A)}$ = 1.2 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V				
		A port		0	3.6	V
		B port		0	5.5	V
T_{amb}	ambient temperature			−40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC(A)}$ = 1.2 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	40	ns/V

[1] The A and B sides of an unused I/O pair must be held in the same state, both at V_{CCI} or both at GND.

[2] $V_{CC(A)}$ must be less than or equal to $V_{CC(B)}$.

9. Static characteristics

Table 7. Typical static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); T_{amb} = 25 °C.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{OH}	HIGH-level output voltage	A port; $V_{CC(A)}$ = 1.2 V; I_O = −20 μA		-	1.1	-	V
V_{OL}	LOW-level output voltage	A port; $V_{CC(A)}$ = 1.2 V; I_O = 20 μA		-	0.09	-	V
I_I	input leakage current	OE input; V_I = 0 V to 3.6 V; $V_{CC(A)}$ = 1.2 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	-	±1	μA
I_{OZ}	OFF-state output current	A or B port; V_O = 0 V to V_{CCO}; $V_{CC(A)}$ = 1.2 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V	[1]	-	-	±1	μA
I_{OFF}	power-off leakage current	A port; V_I or V_O = 0 V to 3.6 V; $V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 0 V to 5.5 V		-	-	±1	μA
		B port; V_I or V_O = 0 V to 5.5 V; $V_{CC(B)}$ = 0 V; $V_{CC(A)}$ = 0 V to 3.6 V		-	-	±1	μA
C_I	input capacitance	OE input; $V_{CC(A)}$ = 1.2 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	1.0	-	pF
$C_{I/O}$	input/output capacitance	A port; $V_{CC(A)}$ = 1.2 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	4.0	-	pF
		B port; $V_{CC(A)}$ = 1.2 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	7.5	-	pF

[1] V_{CCO} is the supply voltage associated with the output.

[2] V_{CCI} is the supply voltage associated with the input.

Table 8. Typical supply current

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); T_{amb} = 25 °C.

$V_{CC(A)}$	$V_{CC(B)}$								Unit
	1.8 V		2.5 V		3.3 V		5.0 V		
	$I_{CC(A)}$	$I_{CC(B)}$	$I_{CC(A)}$	$I_{CC(B)}$	$I_{CC(A)}$	$I_{CC(B)}$	$I_{CC(A)}$	$I_{CC(B)}$	
1.2 V	10	10	10	10	10	20	10	1050	nA
1.5 V	10	10	10	10	10	10	10	650	nA

Table 8. Typical *…continued* supply current *…continued*

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); T_{amb} = 25 °C.

$V_{CC(A)}$	$V_{CC(B)}$								Unit
	1.8 V		2.5 V		3.3 V		5.0 V		
	$I_{CC(A)}$	$I_{CC(B)}$	$I_{CC(A)}$	$I_{CC(B)}$	$I_{CC(A)}$	$I_{CC(B)}$	$I_{CC(A)}$	$I_{CC(B)}$	
1.8 V	10	10	10	10	10	10	10	350	nA
2.5 V	-	-	10	10	10	10	10	40	nA
3.3 V	-	-	-	-	10	10	10	10	nA

Table 9. 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	Max	Min	Max	
V_{IH}	HIGH-level input voltage	A or B port and OE input	[1]					
		$V_{CC(A)}$ = 1.2 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		$0.65V_{CCI}$	-	$0.65V_{CCI}$	-	V
V_{IL}	LOW-level input voltage	A or B port and OE input	[1]					
		$V_{CC(A)}$ = 1.2 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	$0.35V_{CCI}$	-	$0.35V_{CCI}$	V
V_{OH}	HIGH-level output voltage	I_O = −20 μA	[2]					
		A port; $V_{CC(A)}$ = 1.4 V to 3.6 V		$V_{CCO} - 0.4$	-	$V_{CCO} - 0.4$	-	V
		B port; $V_{CC(B)}$ = 1.65 V to 5.5 V		$V_{CCO} - 0.4$	-	$V_{CCO} - 0.4$	-	V
V_{OL}	LOW-level output voltage	I_O = 20 μA	[2]					
		A port; $V_{CC(A)}$ = 1.4 V to 3.6 V		-	0.4	-	0.4	V
		B port; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	0.4	-	0.4	V
I_I	input leakage current	OE input; V_I = 0 V to 3.6 V; $V_{CC(A)}$ = 1.2 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	±2	-	±5	μA
I_{OZ}	OFF-state output current	A or B port; V_O = 0 V or V_{CCO}; $V_{CC(A)}$ = 1.2 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V	[2]	-	±2	-	±10	μA
I_{OFF}	power-off leakage current	A port; V_I or V_O = 0 V to 3.6 V; $V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 0 V to 5.5 V		-	±2	-	±10	μA
		B port; V_I or V_O = 0 V to 5.5 V; $V_{CC(B)}$ = 0 V; $V_{CC(A)}$ = 0 V to 3.6 V		-	±2	-	±10	μA

Table 9. Static characteristics *…continued*

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	Max	Min	Max	
I_{CC}	supply current	V_I = 0 V or V_{CCI}; I_O = 0 A	[1]					
		$I_{CC(A)}$						
		OE = LOW; $V_{CC(A)}$ = 1.4 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	3	-	15	µA
		OE = HIGH; $V_{CC(A)}$ = 1.4 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	3	-	20	µA
		$V_{CC(A)}$ = 3.6 V; $V_{CC(B)}$ = 0 V		-	2	-	15	µA
		$V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 5.5 V		-	−2	-	−15	µA
		$I_{CC(B)}$						
		OE = LOW; $V_{CC(A)}$ = 1.4 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	5	-	15	µA
		OE = HIGH; $V_{CC(A)}$ = 1.4 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	5	-	20	µA
		$V_{CC(A)}$ = 3.6 V; $V_{CC(B)}$ = 0 V		-	−2	-	−15	µA
		$V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 5.5 V		-	2	-	15	µA
		$I_{CC(A)} + I_{CC(B)}$						
		$V_{CC(A)}$ = 1.4 V to 3.6 V; $V_{CC(B)}$ = 1.65 V to 5.5 V		-	8	-	40	µA

[1] V_{CCI} is the supply voltage associated with the input.

[2] V_{CCO} is the supply voltage associated with the output.

10. Dynamic characteristics

Table 10. Typical dynamic characteristics for temperature 25 °C[1]

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7; for waveforms see Figure 5 and Figure 6.

Symbol	Parameter	Conditions		$V_{CC(B)}$				Unit
				1.8 V	2.5 V	3.3 V	5.0 V	
$V_{CC(A)}$ = 1.2 V; T_{amb} = 25 °C								
t_{pd}	propagation delay	A to B		5.9	4.8	4.4	4.2	ns
		B to A		5.6	4.8	4.5	4.4	ns
t_{en}	enable time	OE to A, B		0.5	0.5	0.5	0.5	µs
t_{dis}	disable time	OE to A; no external load	[2]	6.9	6.9	6.9	6.9	ns
		OE to B; no external load	[2]	9.5	8.6	8.5	8.0	ns
		OE to A		81	69	83	68	ns
		OE to B		81	69	83	68	ns

Table 10. Typical dynamic characteristics for temperature 25 °C[1] *…continued*

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7; for waveforms see Figure 5 and Figure 6.

Symbol	Parameter	Conditions		$V_{CC(B)}$				Unit
				1.8 V	2.5 V	3.3 V	5.0 V	
t_t	transition time	A port		4.0	4.0	4.1	4.1	ns
		B port		2.6	2.0	1.7	1.4	ns
t_W	pulse width	data inputs		15	13	13	13	ns
f_{data}	data rate			70	80	80	80	Mbps

[1] 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}.
t_t is the same as t_{THL} and t_{TLH}

[2] Delay between OE going LOW and when the outputs are actually disabled.

Table 11. Dynamic characteristics for temperature range −40 °C to +85 °C[1]

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7; for wave forms see Figure 5 and Figure 6.

Symbol	Parameter	Conditions		$V_{CC(B)}$								Unit
				1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
				Min	Max	Min	Max	Min	Max	Min	Max	
$V_{CC(A)}$ = 1.5 V ± 0.1 V												
t_{pd}	propagation delay	A to B		1.4	12.9	1.2	10.1	1.1	10.0	0.8	9.9	ns
		B to A		0.9	14.2	0.7	12.0	0.4	11.7	0.3	13.7	ns
t_{en}	enable time	OE to A, B		-	1.0	-	1.0	-	1.0	-	1.0	µs
t_{dis}	disable time	OE to A; no external load	[2]	1.0	11.9	1.0	11.9	1.0	11.9	1.0	11.9	ns
		OE to B; no external load	[2]	1.0	16.9	1.0	15.2	1.0	14.1	1.0	13.8	ns
		OE to A		-	320	-	260	-	260	-	280	ns
		OE to B		-	200	-	200	-	200	-	200	ns
t_t	transition time	A port		0.9	5.1	0.9	5.1	0.9	5.1	0.9	5.1	ns
		B port		0.9	4.7	0.6	3.2	0.5	2.5	0.4	2.7	ns
t_W	pulse width	data inputs		25	-	25	-	25	-	25	-	ns
f_{data}	data rate			-	40	-	40	-	40	-	40	Mbps
$V_{CC(A)}$ = 1.8 V ± 0.15 V												
t_{pd}	propagation delay	A to B		1.6	11.0	1.4	7.7	1.3	6.8	1.2	6.5	ns
		B to A		1.5	12.0	1.3	8.4	1.0	7.6	0.9	7.1	ns
t_{en}	enable time	OE to A, B		-	1.0	-	1.0	-	1.0	-	1.0	µs
t_{dis}	disable time	OE to A; no external load	[2]	1.0	11.0	1.0	11.0	1.0	11.0	1.0	11.0	ns
		OE to B; no external load	[2]	1.0	15.4	1.0	13.5	1.0	12.4	1.0	12.1	ns
		OE to A		-	260	-	230	-	230	-	230	ns
		OE to B		-	200	-	200	-	200	-	200	ns
t_t	transition time	A port		0.8	4.1	0.8	4.1	0.8	4.1	0.8	4.1	ns
		B port		0.9	4.7	0.6	3.2	0.5	2.5	0.4	2.7	ns
t_W	pulse width	data inputs		20	-	17	-	17	-	17	-	ns
f_{data}	data rate			-	49	-	60	-	60	-	60	Mbps

Table 11. Dynamic characteristics for temperature range −40 °C to +85 °C[1] *…continued*

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7; for wave forms see Figure 5 and Figure 6.

Symbol	Parameter	Conditions		$V_{CC(B)}$								Unit
				1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
				Min	Max	Min	Max	Min	Max	Min	Max	
$V_{CC(A)}$ = 2.5 V ± 0.2 V												
t_{pd}	propagation delay	A to B		-	-	1.1	6.3	1.0	5.2	0.9	4.7	ns
		B to A		-	-	1.2	6.6	1.1	5.1	0.9	4.4	ns
t_{en}	enable time	OE to A, B		-	-	-	1.0	-	1.0	-	1.0	µs
t_{dis}	disable time	OE to A; no external load	[2]	-	-	1.0	9.2	1.0	9.2	1.0	9.2	ns
		OE to B; no external load	[2]	-	-	1.0	11.9	1.0	10.7	1.0	10.2	ns
		OE to A		-	-	-	200	-	200	-	200	ns
		OE to B		-	-	-	200	-	200	-	200	ns
t_t	transition time	A port		-	-	0.7	3.0	0.7	3.0	0.7	3.0	ns
		B port		-	-	0.7	3.2	0.5	2.5	0.4	2.7	ns
t_W	pulse width	data inputs		-	-	12	-	10	-	10	-	ns
f_{data}	data rate			-	-	-	85	-	100	-	100	Mbps
$V_{CC(A)}$ = 3.3 V ± 0.3 V												
t_{pd}	propagation delay	A to B		-	-	-	-	0.9	4.7	0.8	4.0	ns
		B to A		-	-	-	-	1.0	4.9	0.9	3.8	ns
t_{en}	enable time	OE to A, B		-	-	-	-	-	1.0	-	1.0	µs
t_{dis}	disable time	OE to A; no external load	[2]	-	-	-	-	1.0	9.2	1.0	9.2	ns
		OE to B; no external load	[2]	-	-	-	-	1.0	10.1	1.0	9.6	ns
		OE to A		-	-	-	-	-	260	-	260	ns
		OE to B		-	-	-	-	-	200	-	200	ns
t_t	transition time	A port		-	-	-	-	0.7	2.5	0.7	2.5	ns
		B port		-	-	-	-	0.5	2.5	0.4	2.7	ns
t_W	pulse width	data inputs		-	-	-	-	10	-	10	-	ns
f_{data}	data rate			-	-	-	-	-	100	-	100	Mbps

[1] 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}.
t_t is the same as t_{THL} and t_{TLH}.

[2] Delay between OE going LOW and when the outputs are actually disabled.

Table 12. Dynamic characteristics for temperature range −40 °C to +125 °C[1]

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7; for wave forms see Figure 5 and Figure 6.

Symbol	Parameter	Conditions		$V_{CC(B)}$								Unit
				1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
				Min	Max	Min	Max	Min	Max	Min	Max	
$V_{CC(A)}$ = 1.5 V ± 0.1 V												
t_{pd}	propagation delay	A to B		1.4	15.9	1.2	13.1	1.1	13.0	0.8	12.9	ns
		B to A		0.9	17.2	0.7	15.0	0.4	14.7	0.3	16.7	ns
t_{en}	enable time	OE to A, B		-	1.0	-	1.0	-	1.0	-	1.0	µs
t_{dis}	disable time	OE to A; no external load	[2]	1.0	12.5	1.0	12.5	1.0	12.5	1.0	12.5	ns
		OE to B; no external load	[2]	1.0	18.1	1.0	16.2	1.0	14.9	1.0	14.6	ns
		OE to A		-	340	-	280	-	280	-	300	ns
		OE to B		-	220	-	220	-	220	-	220	ns
t_t	transition time	A port		0.9	7.1	0.9	7.1	0.9	7.1	0.9	7.1	ns
		B port		0.9	6.5	0.6	5.2	0.5	4.8	0.4	4.7	ns
t_W	pulse width	data inputs		25	-	25	-	25	-	25	-	ns
f_{data}	data rate			-	40	-	40	-	40	-	40	Mbps
$V_{CC(A)}$ = 1.8 V ± 0.15 V												
t_{pd}	propagation delay	A to B		1.6	14.0	1.4	10.7	1.3	9.8	1.2	9.5	ns
		B to A		1.5	15.0	1.3	11.4	1.0	10.6	0.9	10.1	ns
t_{en}	enable time	OE to A, B		-	1.0	-	1.0	-	1.0	-	1.0	µs
t_{dis}	disable time	OE to A; no external load	[2]	1.0	11.5	1.0	11.5	1.0	11.5	1.0	11.5	ns
		OE to B; no external load	[2]	1.0	16.5	1.0	14.5	1.0	13.3	1.0	12.7	ns
		OE to A		-	280	-	250	-	250	-	250	ns
		OE to B		-	220	-	220	-	220	-	220	ns
t_t	transition time	A port		0.8	6.2	0.8	6.1	0.8	6.1	0.8	6.1	ns
		B port		0.9	5.8	0.6	5.2	0.5	4.8	0.4	4.7	ns
t_W	pulse width	data inputs		22	-	19	-	19	-	19	-	ns
f_{data}	data rate			-	45	-	55	-	55	-	55	Mbps
$V_{CC(A)}$ = 2.5 V ± 0.2 V												
t_{pd}	propagation delay	A to B		-	-	1.1	9.3	1.0	8.2	0.9	7.7	ns
		B to A		-	-	1.2	9.6	1.1	8.1	0.9	7.4	ns
t_{en}	enable time	OE to A, B		-	-	-	1.0	-	1.0	-	1.0	µs
t_{dis}	disable time	OE to A; no external load	[2]	-	-	1.0	9.6	1.0	9.6	1.0	9.6	ns
		OE to B; no external load	[2]	-	-	1.0	12.6	1.0	11.4	1.0	10.8	ns
		OE to A		-	-	-	220	-	220	-	220	ns
		OE to B		-	-	-	220	-	220	-	220	ns
t_t	transition time	A port		-	-	0.7	5.0	0.7	5.0	0.7	5.0	ns
		B port		-	-	0.7	4.6	0.5	4.8	0.4	4.7	ns
t_W	pulse width	data inputs;		-	-	14	-	13	-	10	-	ns
f_{data}	data rate			-	-	-	75	-	80	-	100	Mbps

Table 12. Dynamic characteristics for temperature range −40 °C to +125 °C[1] *...continued*

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7; for wave forms see Figure 5 and Figure 6.

Symbol	Parameter	Conditions		$V_{CC(B)}$								Unit
				1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		5.0 V ± 0.5 V		
				Min	Max	Min	Max	Min	Max	Min	Max	
$V_{CC(A)}$ = 3.3 V ± 0.3 V												
t_{pd}	propagation delay	A to B		-	-	-	-	0.9	7.7	0.8	7.0	ns
		B to A		-	-	-	-	1.0	7.9	0.9	6.8	ns
t_{en}	enable time	OE to A, B		-	-	-	-	-	1.0	-	1.0	µs
t_{dis}	disable time	OE to A; no external load	[2]	-	-	-	-	1.0	9.5	1.0	9.5	ns
		OE to B; no external load	[2]	-	-	-	-	1.0	10.7	1.0	9.6	ns
		OE to A		-	-	-	-	-	280	-	280	ns
		OE to B		-	-	-	-	-	220	-	220	ns
t_t	transition time	A port		-	-	-	-	0.7	4.5	0.7	4.5	ns
		B port		-	-	-	-	0.5	4.1	0.4	4.7	ns
t_W	pulse width	data inputs		-	-	-	-	10	-	10	-	ns
f_{data}	data rate			-	-	-	-	-	100	-	100	Mbps

[1] 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}.
t_t is the same as t_{THL} and t_{TLH}.

[2] Delay between OE going LOW and when the outputs are actually disabled.

Table 13. Typical power dissipation capacitance

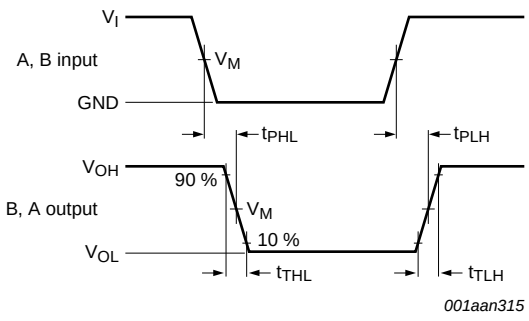
Voltages are referenced to GND (ground = 0 V).[1][2]

Symbol	Parameter	Conditions	$V_{CC(A)}$							Unit
			1.2 V	1.2 V	1.5 V	1.8 V	2.5 V	2.5 V	3.3 V	
			$V_{CC(B)}$							
			1.8 V	5.0 V	1.8 V	1.8 V	2.5 V	5.0 V	3.3 V to 5.0 V	
T_{amb} = 25 °C										
C_{PD}	power dissipation capacitance	outputs enabled; OE = $V_{CC(A)}$								
		A port: (direction A to B)	5	5	5	5	5	5	5	pF
		A port: (direction B to A)	8	8	8	8	8	8	8	pF
		B port: (direction A to B)	18	18	18	18	18	18	18	pF
		B port: (direction B to A)	13	16	12	12	12	12	13	pF
		outputs disabled; OE = GND								
		A port: (direction A to B)	0.12	0.12	0.04	0.05	0.08	0.08	0.07	pF
		A port: (direction B to A)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	pF
		B port: (direction A to B)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	pF
		B port: (direction B to A)	0.07	0.09	0.07	0.07	0.05	0.09	0.09	pF

[1] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
f_i = input frequency in MHz;
f_o = output frequency in MHz;
C_L = load capacitance in pF;
V_{CC} = supply voltage in V;
N = number of inputs switching;
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

[2] f_i = 10 MHz; V_I = GND to V_{CC}; $t_r = t_f$ = 1 ns; C_L = 0 pF; $R_L = \infty\ \Omega$.

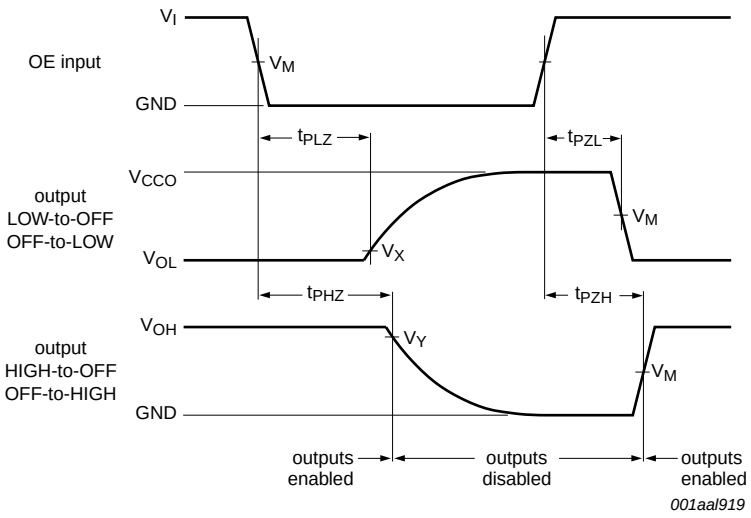
11. Waveforms



Measurement points are given in Table 14.

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

Fig 5. Data input (A, B) to data output (B, A) propagation delay times



Measurement points are given in Table 14.

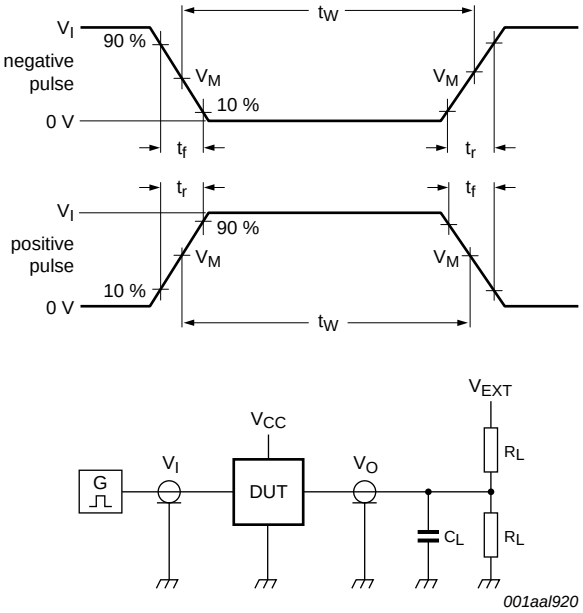
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 6. Enable and disable times

Table 14. Measurement points[1]

Supply voltage	Input	Output		
V_{CCO}	V_M	V_M	V_X	V_Y
1.2 V	$0.5V_{CCI}$	$0.5V_{CCO}$	V_{OL} + 0.1 V	V_{OH} − 0.1 V
1.5 V ± 0.1 V	$0.5V_{CCI}$	$0.5V_{CCO}$	V_{OL} + 0.1 V	V_{OH} − 0.1 V
1.8 V ± 0.15 V	$0.5V_{CCI}$	$0.5V_{CCO}$	V_{OL} + 0.15 V	V_{OH} − 0.15 V
2.5 V ± 0.2 V	$0.5V_{CCI}$	$0.5V_{CCO}$	V_{OL} + 0.15 V	V_{OH} − 0.15 V
3.3 V ± 0.3 V	$0.5V_{CCI}$	$0.5V_{CCO}$	V_{OL} + 0.3 V	V_{OH} − 0.3 V
5.0 V ± 0.5 V	$0.5V_{CCI}$	$0.5V_{CCO}$	V_{OL} + 0.3 V	V_{OH} − 0.3 V

[1] V_{CCI} is the supply voltage associated with the input and V_{CCO} is the supply voltage associated with the output.



Test data is given in Table 15.

All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz; Z_O = 50 Ω; dV/dt ≥ 1.0 V/ns.

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

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

Fig 7. Test circuit for measuring switching times

Table 15. Test data

Supply voltage		Input		Load		V_{EXT}		
$V_{CC(A)}$	$V_{CC(B)}$	V_I[1]	$\Delta t/\Delta V$	C_L	R_L[2]	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}[3]
1.2 V to 3.6 V	1.65 V to 5.5 V	V_{CCI}	≤ 1.0 ns/V	15 pF	50 kΩ, 1 MΩ	open	open	$2V_{CCO}$

[1] V_{CCI} is the supply voltage associated with the input.

[2] For measuring data rate, pulse width, propagation delay and output rise and fall measurements, R_L = 1 MΩ; for measuring enable and disable times, R_L = 50 kΩ.

[3] V_{CCO} is the supply voltage associated with the output.

12. Application information

12.1 Applications

Voltage level-translation applications. The NTB0101 can be used to interface between devices or systems operating at different supply voltages. See Figure 8 for a typical operating circuit using the NTB0101.

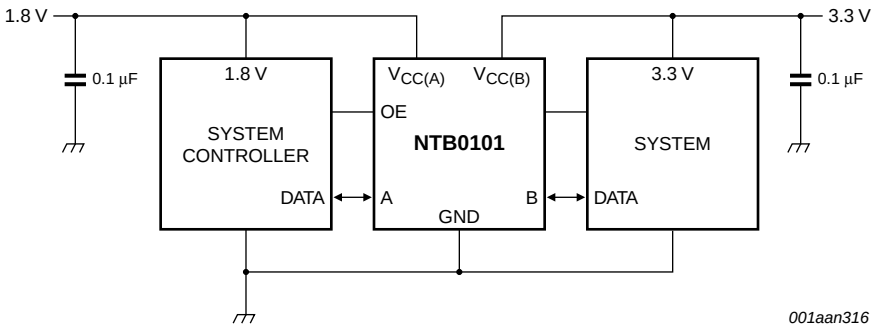


Fig 8. Typical operating circuit

12.2 Architecture

The architecture of the NTB0101 is shown in Figure 9. The device does not require an extra input signal to control the direction of data flow from A to B or from B to A. In a static state, the output drivers of the NTB0101 can maintain a defined output level, but the output architecture is designed to be weak, so that they can be overdriven by an external driver when data on the bus starts flowing in the opposite direction. The output of one-shot circuits detect rising or falling edges on the A or B ports. During a rising edge, the one-shot circuits turn on the PMOS transistors (T1, T3) for a short duration, accelerating the LOW-to-HIGH transition. Similarly, during a falling edge, the one-shot circuits turn on the NMOS transistors (T2, T4) for a short duration, accelerating the HIGH-to-LOW transition. During output transitions the typical output impedance is 70 Ω at V_{CCO} = 1.2 V to 1.8 V, 50 Ω at V_{CCO} = 1.8 V to 3.3 V and 40 Ω at V_{CCO} = 3.3 V to 5.0 V.

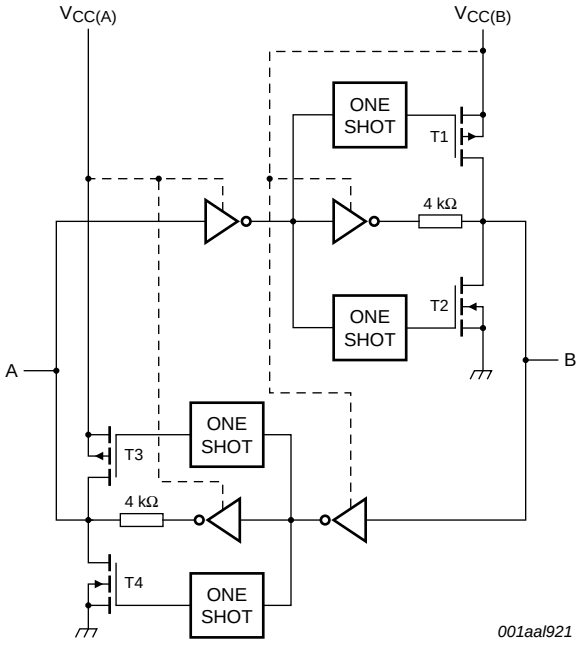
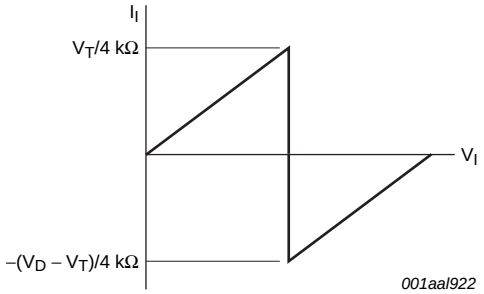


Fig 9. Architecture of NTB0101 I/O cell

12.3 Input driver requirements

For correct operation, the device driving the data I/Os of the NTB0101 must have a minimum drive capability of ±2 mA See Figure 10 for a plot of typical input current versus input voltage.



V_T: input threshold voltage of the NTB0101 (typically V_{CCI} / 2).

V_D: supply voltage of the external driver.

Fig 10. Typical input current versus input voltage graph

12.4 Power-up

During operation $V_{CC(A)}$ must never be higher than $V_{CC(B)}$, however during power-up $V_{CC(A)} \geq V_{CC(B)}$ does not damage the device, so either power supply can be ramped up first. There is no special power-up sequencing required. The NTB0101 includes circuitry that disables all output ports when either $V_{CC(A)}$ or $V_{CC(B)}$ is switched off.

12.5 Enable and disable

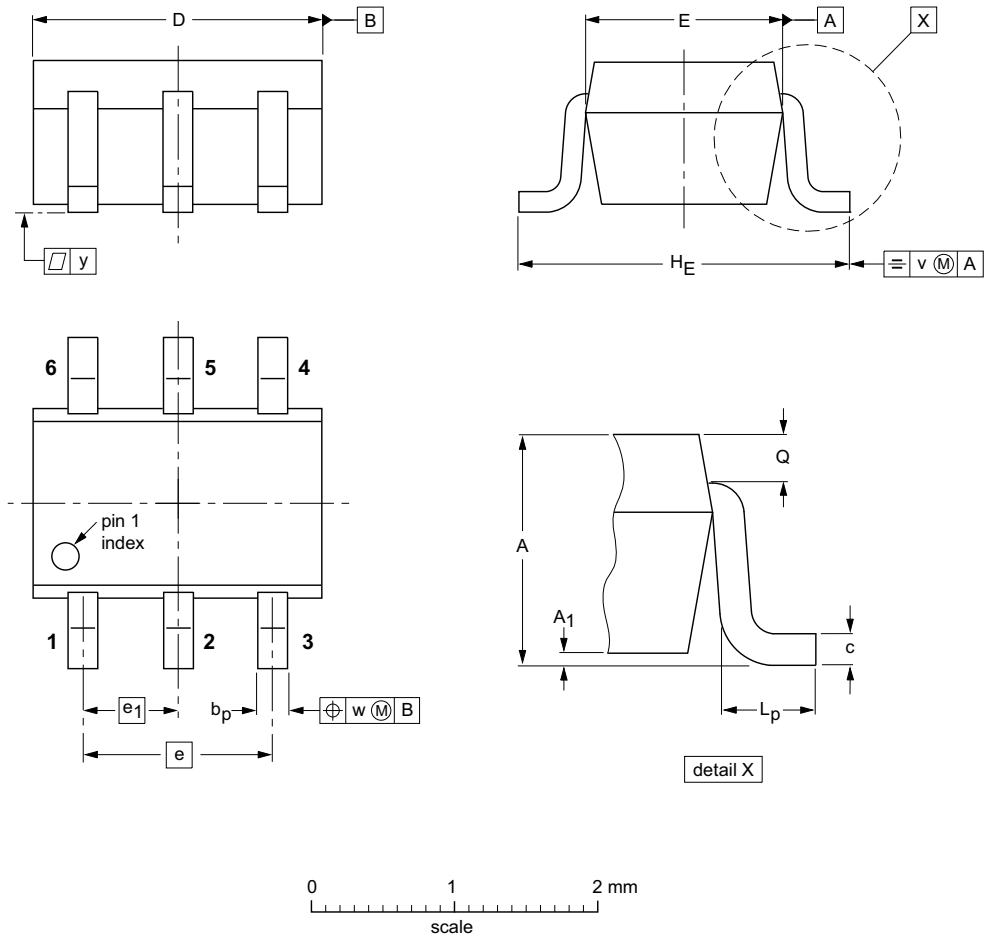
An output enable input (OE) is used to disable the device. Setting OE = LOW causes all I/Os to assume the high-impedance OFF-state. The disable time (t_{dis} with no external load) indicates the delay between when OE goes LOW and when outputs actually become disabled. The enable time (t_{en}) indicates the amount of time the user must allow for one one-shot circuitry to become operational after OE is taken HIGH. To ensure the high-impedance OFF-state during power-up or power-down, pin OE should be tied to GND through a pull-down resistor, the minimum value of the resistor is determined by the current-sourcing capability of the driver.

12.6 Pull-up or pull-down resistors on I/O lines

As mentioned previously the NTB0101 is designed with low static drive strength to drive capacitive loads of up to 70 pF. To avoid output contention issues, any pull-up or pull-down resistors used must be above 50 kΩ. For this reason the NTB0101 is not recommended for use in open drain driver applications such as 1-Wire or I^2C-bus. For these applications, the NTS0101 level translator is recommended.

13. Package outline

Plastic surface-mounted package; 6 leads **SOT363**



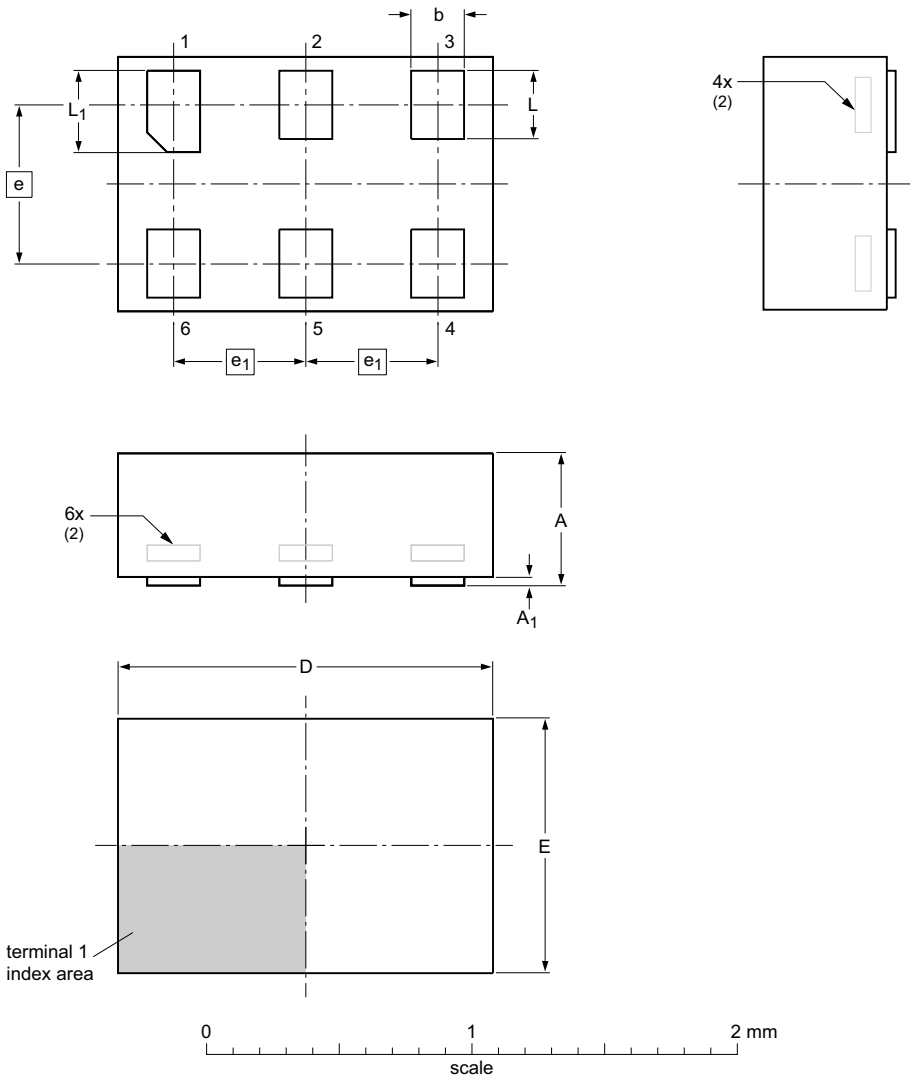
DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT363			SC-88			~~04-11-08~~ 06-03-16

Fig 11. Package outline SOT363 (SC-88)

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1.45 x 0.5 mm SOT886



Dimensions (mm are the original dimensions)

Unit		A(1)	A_1	b	D	E	e	e_1	L	L_1
	max	0.5	0.04	0.25	1.50	1.05			0.35	0.40
mm	nom			0.20	1.45	1.00	0.6	0.5	0.30	0.35
	min			0.17	1.40	0.95			0.27	0.32

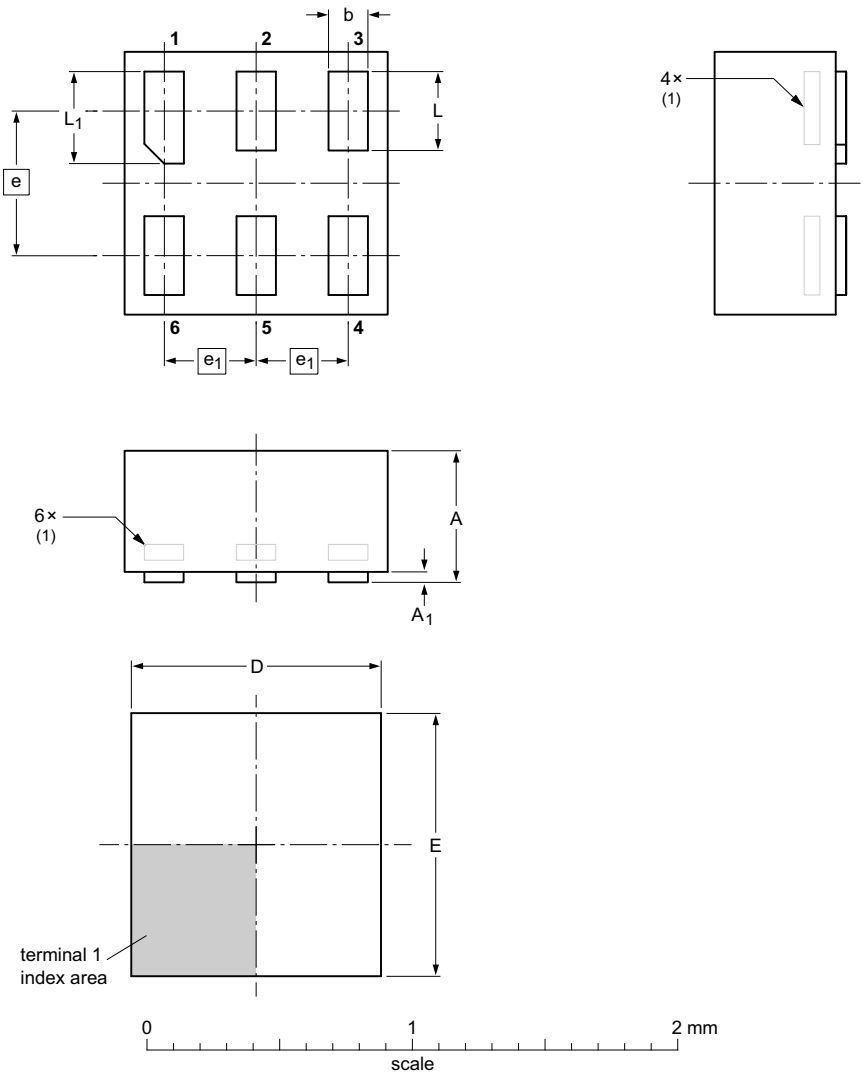
Notes
1. Including plating thickness.
2. Can be visible in some manufacturing processes.

sot886_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT886		MO-252				~~04-07-22~~ 12-01-05

Fig 12. Package outline SOT886 (XSON6)

XSON6: plastic extremely thin small outline package; no leads; 6 terminals; body 1 x 1 x 0.5 mm **SOT891**



DIMENSIONS (mm are the original dimensions)

UNIT	A max	A_1 max	b	D	E	e	e_1	L	L_1
mm	0.5	0.04	0.20 0.12	1.05 0.95	1.05 0.95	0.55	0.35	0.35 0.27	0.40 0.32

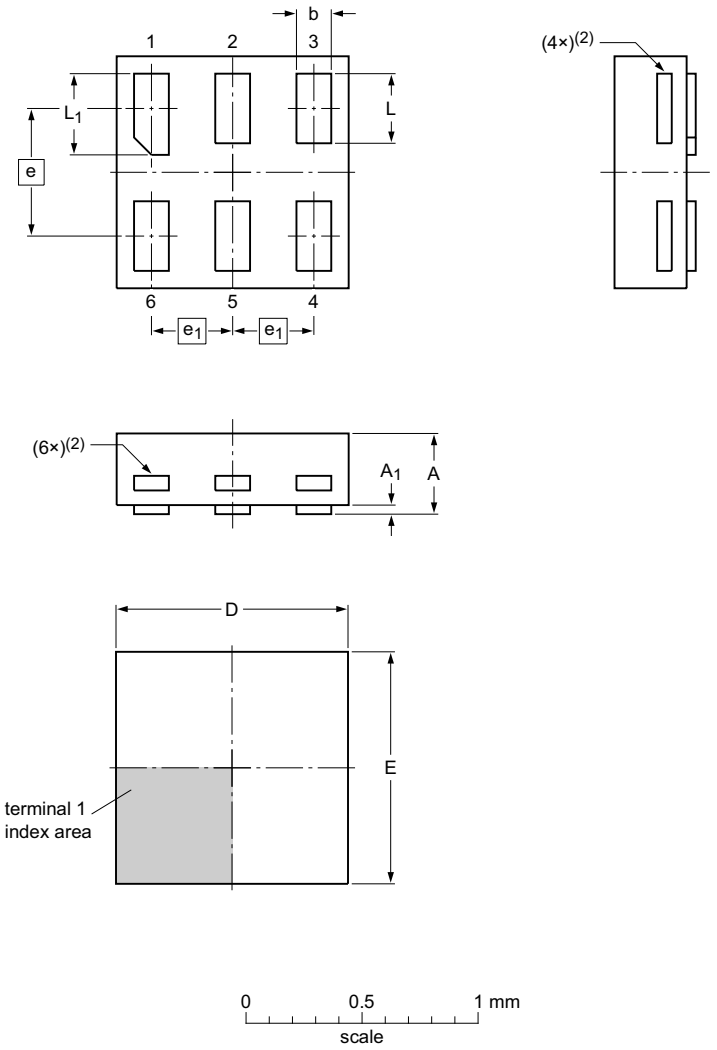
Note

1. Can be visible in some manufacturing processes.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT891						~~05-04-06~~ 07-05-15

Fig 13. Package outline SOT891 (XSON6)

XSON6: extremely thin small outline package; no leads;
6 terminals; body 1.0 x 1.0 x 0.35 mm **SOT1202**



Dimensions

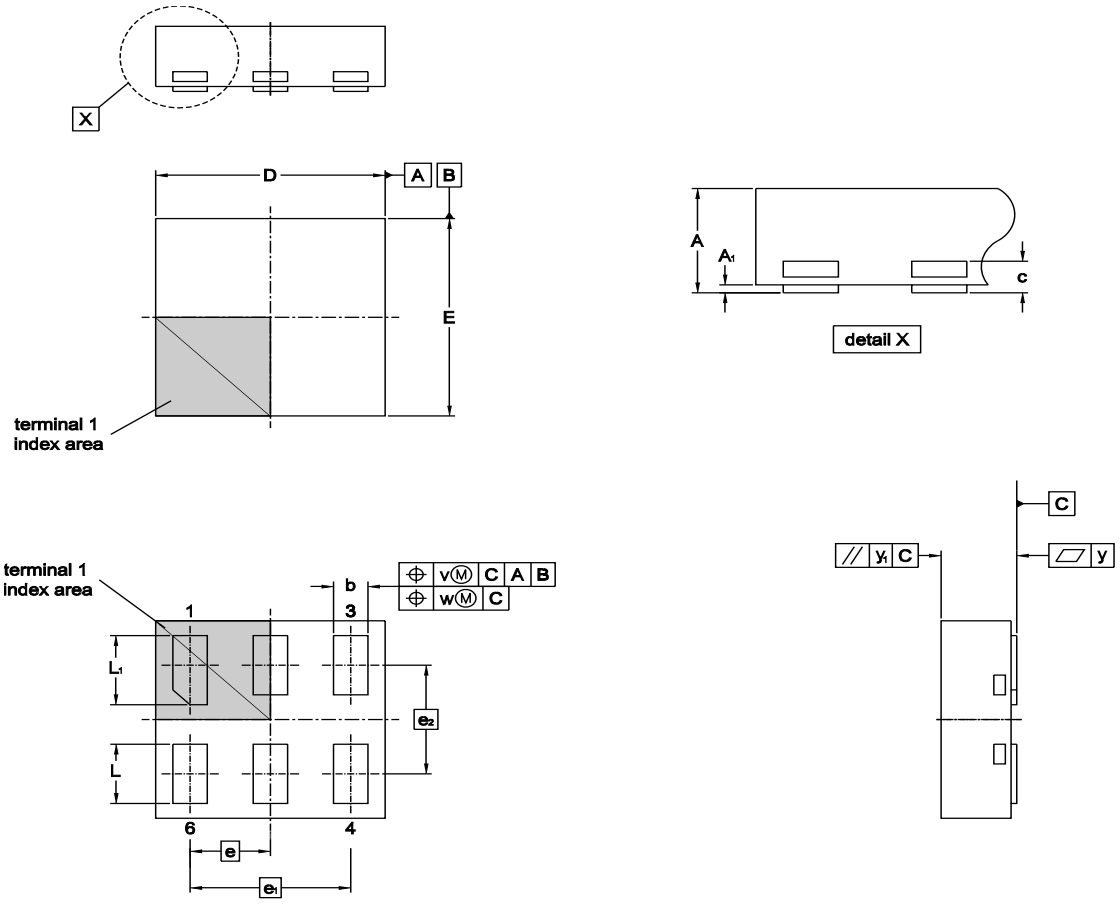
	Unit	A(1)	A_1	b	D	E	e	e_1	L	L_1
	max	0.35	0.04	0.20	1.05	1.05			0.35	0.40
mm	nom			0.15	1.00	1.00	0.55	0.35	0.30	0.35
	min			0.12	0.95	0.95			0.27	0.32

Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

sot1202_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1202						~~10-04-02~~ 10-04-06

Fig 14. Package outline SOT1202 (XSON6)



Dimensions (mm are the original dimensions)

UNIT		A	A_1	b	c	D[1]	E[1]	e	e_1	e_2	L	L_1	v	w	y	y_1
	MAX	0.33	0.05	0.20		1.05	1.05				0.35	0.40				
mm	NOM	0.32	0.02	0.15	0.10	1.00	1.00	0.35	0.70	0.55	0.30	0.35	0.1	0.05	0.05	0.1
	MIN	0.30	0.00	0.10		0.95	0.95				0.25	0.30				

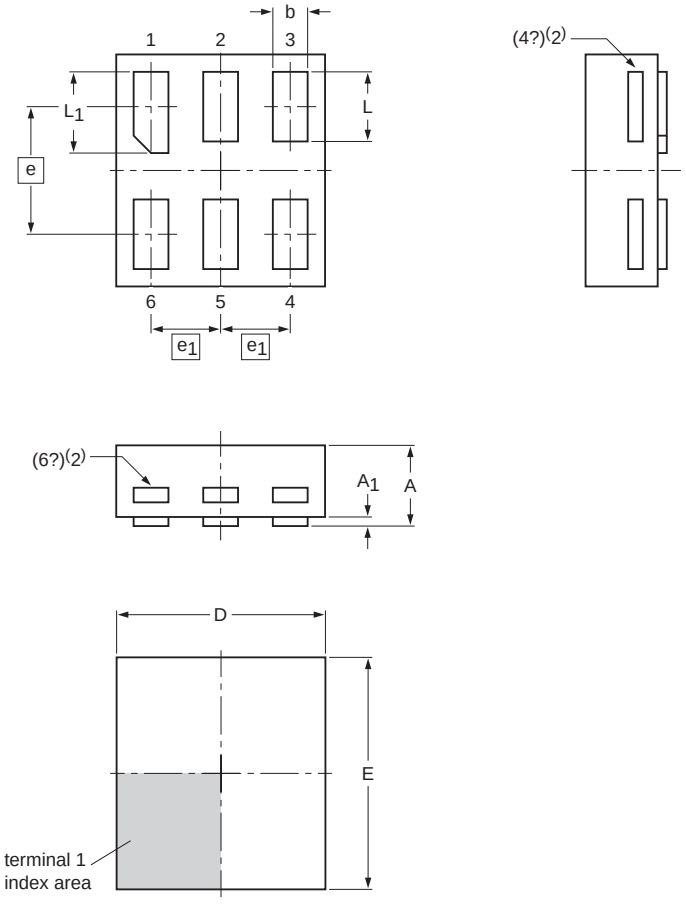
Notes
1. Plastic or metal protrusions of 0.075 maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT1202-2	----------	-----	----------			08-MAR-2018

Fig 15. Package outline SOT1202-2 (X2SON6)

XSON6: extremely thin small outline package; no leads;
6 terminals; body 0.9 x 1.0 x 0.35 mm

SOT1115



Dimensions

Unit		A(1)	A_1	b	D	E	e	e_1	L	L_1
	max	0.35	0.04	0.20	0.95	1.05			0.35	0.40
mm	nom			0.15	0.90	1.00	0.55	0.3	0.30	0.35
	min			0.12	0.85	0.95			0.27	0.32

Note
1. Including plating thickness.
2. Visible depending upon used manufacturing technology.

sot1115_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1115						~~10-04-02~~ 10-04-07

Fig 16. Package outline SOT1115 (XSON6)

14. Abbreviations

Table 16. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
NMOS	N-type Metal Oxide Semiconductor
PMOS	P-type Metal Oxide Semiconductor
PRR	Pulse Repetition Rate

15. Revision history

Table 17. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NTB0101 v.7	20180409	Product data sheet		NTB0101 v.6
Modifications:	• Corrected Figure 15 “Package outline SOT1202-2 (X2SON6)” • Table 2 “Ordering options” – Updated orderable part number, packing method and minimum order quantity for NTB0101GS1			
NTB0101 v.6	20180301	Product data sheet		NTB0101 v.5
Modifications:	• Added NTB0101GN and NTB0101GS1 • Section 3 “Ordering information” – Updated table notes for Table 1 “Device information” – Added Section 3.1 “Ordering options”			
NTB0101 v.5	20160224	Product data sheet		NTB0101 v.4
Modifications:	• Deleted NTB0101GV			
NTB0101 v.4	20120806	Product data sheet	-	NTB0101 v.3
Modifications:	• Package outline drawing of SOT886 (Figure 12) modified.			
NTB0101 v.3	20111110	Product data sheet	-	NTB0101 v.2
Modifications:	• Legal pages updated.			
NTB0101 v.2	20110505	Product data sheet	-	NTB0101 v.1
NTB0101 v.1	20101230	Product data sheet	-	-

16. Legal information

16.1 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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18. Contents

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