74AVCH1T45

Dual supply translating transceiver; 3-state

Rev. 01 — 25 October 2007 Product data sheet

1. General description

The 74AVCH1T45 is a single bit, dual supply transceiver that enables bidirectional level translation. It features two data input-output ports (A and B), a direction control input (DIR) and dual supply pins ($V_{CC(A)}$ and $V_{CC(B)}$). Both $V_{CC(A)}$ and $V_{CC(B)}$ can be supplied at any voltage between 0.8 V and 3.6 V making the device suitable for translating between any of the low voltage nodes (0.8 V, 1.2 V, 1.5 V, 1.8 V, 2.5 V and 3.3 V). Pins A and DIR are referenced to $V_{CC(A)}$ and pin B is referenced to $V_{CC(B)}$. A HIGH on DIR allows transmission from A to B and a LOW on DIR allows transmission from B to A.

The device is fully specified for partial power-down applications using I_{OFF}. The I_{OFF} circuitry disables the output, preventing any damaging backflow current through the device when it is powered down. In suspend mode when either $V_{CC(A)}$ or $V_{CC(B)}$ are at GND level, both A and B are in the high-impedance OFF-state.

The 74AVCH1T45 has active bus hold circuitry which is provided to hold unused or floating data inputs at a valid logic level. This feature eliminates the need for external pull-up or pull-down resistors.

2. Features

- Wide supply voltage range:
  - $V_{CC(A)}$: 0.8 V to 3.6 V
  - $V_{CC(B)}$: 0.8 V to 3.6 V
- High noise immunity
- Complies with JEDEC standards:
  - JESD8-12 (0.8 V to 1.3 V)
  - JESD8-11 (0.9 V to 1.65 V)
  - JESD8-7 (1.2 V to 1.95 V)
  - JESD8-5 (1.8 V to 2.7 V)
  - JESD8-B (2.7 V to 3.6 V)
- ESD protection:
  - HBM JESD22-A114E Class 3B exceeds 8000 V
  - MM JESD22-A115-A exceeds 200 V
  - CDM JESD22-C101C exceeds 1000 V
- Maximum data rates:
  - 500 Mbit/s (1.8 V to 3.3 V translation)
  - 320 Mbit/s (< 1.8 V to 3.3 V translation)
  - 320 Mbit/s (translate to 2.5 V or 1.8 V)
  - 280 Mbit/s (translate to 1.5 V)

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    - 240 Mbit/s (translate to 1.2 V)
- Suspend mode
- Bus hold on data inputs
- Latch-up performance exceeds 100 mA per JESD 78 Class II
- Inputs accept voltages up to 3.6 V
- Low noise overshoot and undershoot < 10 % of V_{CC}
- I_{OFF} circuitry provides partial Power-down mode operation
- Multiple package options
- 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
74AVCH1T45GW	–40 °C to +125 °C	SC-88	plastic surface-mounted package; 6 leads	SOT363
74AVCH1T45GM	–40 °C to +125 °C	XSON6	plastic extremely thin small outline package; no leads; 6 terminals; body 1 × 1.45 × 0.5 mm	SOT886

4. Marking

Table 2. Marking

Type number	Marking code
74AVCH1T45GW	K5
74AVCH1T45GM	K5

5. Functional diagram

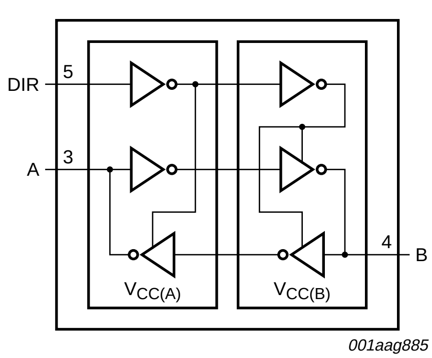


Fig 1. Logic symbol

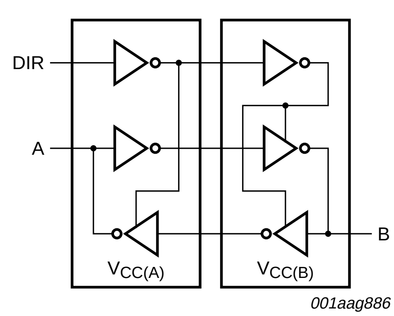


Fig 2. Logic diagram

6. Pinning information

6.1 Pinning

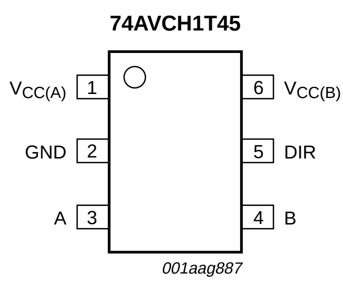


Fig 3. Pin configuration SOT363

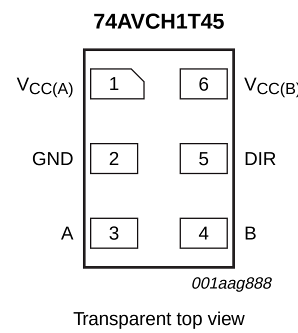


Fig 4. Pin configuration SOT886

6.2 Pin description

Table 3. Pin description

Symbol	Pin	Description
$V_{CC(A)}$	1	supply voltage port A and DIR
GND	2	ground (0 V)
A	3	data input or output
B	4	data input or output
DIR	5	direction control
$V_{CC(B)}$	6	supply voltage port B

7. Functional description

Table 4. Function table[1]

Supply voltage	Input	Input/output[3]	
$V_{CC(A)}$, $V_{CC(B)}$	DIR[2]	A	B
0.8 V to 3.6 V	L	A = B	input
0.8 V to 3.6 V	H	input	B = A
GND[4]	X	Z	Z

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

[2] The DIR input circuit is referenced to $V_{CC(A)}$.

[3] The input circuit of the data I/O is always active.

[4] If at least one of $V_{CC(A)}$ or $V_{CC(B)}$ is at GND level, the device goes into suspend mode.

8. 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 port A			–0.5	+4.6	V
$V_{CC(B)}$	supply voltage port B			–0.5	+4.6	V
I_{IK}	input clamping current	$V_I < 0$ V		–50	-	mA
V_I	input voltage		[1]	–0.5	+4.6	V
I_{OK}	output clamping current	$V_O < 0$ V		–50	-	mA
V_O	output voltage	Active mode	[1][2][3]	–0.5	V_{CCO} + 0.5	V
		Suspend or 3-state mode	[1]	–0.5	+4.6	V
I_O	output current	V_O = 0 V to V_{CC}		-	±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 voltage ratings and 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 port.

[3] V_{CCO} + 0.5 V should not exceed 4.6 V.

[4] For SC-88 packages: above 87.5 °C the value of P_{tot} derates linearly with 4.0 mW/K.
For XSON6 packages: above 45 °C the value of P_{tot} derates linearly with 2.4 mW/K.

9. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{CC(A)}$	supply voltage port A			0.8	3.6	V
$V_{CC(B)}$	supply voltage port B			0.8	3.6	V
V_I	input voltage			0	3.6	V
V_O	output voltage	Active mode	[1]	0	V_{CCO}	V
		Suspend or 3-state mode		0	3.6	V
T_{amb}	ambient temperature			–40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CCI} = 0.8 V to 3.6 V	[2]	-	5	ns/V

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

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

10. Static characteristics

Table 7. Static characteristics

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

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
T_{amb} = 25 °C							
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		$I_O = -1.5$ mA; $V_{CC(A)} = V_{CC(B)} = 0.8$ V		-	0.69	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		$I_O = 1.5$ mA; $V_{CC(A)} = V_{CC(B)} = 0.8$ V		-	0.07	-	V
I_I	input leakage current	DIR input; $V_I = 0$ V to 3.6 V; $V_{CC(A)} = V_{CC(B)} = 0.8$ V to 3.6 V		-	±0.025	±0.25	μA
I_{BHL}	bus hold LOW current	A or B port; $V_I = 0.42$ V; $V_{CC(A)} = V_{CC(B)} = 1.2$ V		-	26	-	μA
I_{BHH}	bus hold HIGH current	A or B port; $V_I = 0.78$ V; $V_{CC(A)} = V_{CC(B)} = 1.2$ V		-	−24	-	μA
I_{BHLO}	bus hold LOW overdrive current	A or B port; $V_{CC(A)} = V_{CC(B)} = 1.2$ V	[1]	-	28	-	μA
I_{BHHO}	bus hold HIGH overdrive current	A or B port; $V_{CC(A)} = V_{CC(B)} = 1.2$ V	[1]	-	−26	-	μA
I_{OZ}	OFF-state output current	A or B port; $V_O = 0$ V or V_{CCO}; $V_{CC(A)} = V_{CC(B)} = 0.8$ V to 3.6 V	[2]	-	±0.5	±2.5	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; $V_{CC(B)} = 0.8$ V to 3.6 V		-	±0.1	±1	μA
		B port; V_I or $V_O = 0$ V to 3.6 V; $V_{CC(B)} = 0$ V; $V_{CC(A)} = 0.8$ V to 3.6 V		-	±0.1	±1	μA
C_I	input capacitance	DIR input; $V_I = 0$ V or 3.3 V; $V_{CC(A)} = V_{CC(B)} = 3.3$ V		-	1	-	pF
$C_{I/O}$	input/output capacitance	A and B port; suspend mode; $V_O = 3.3$ V or 0 V; $V_{CC(A)} = V_{CC(B)} = 3.3$ V		-	4	-	pF
T_{amb} = −40 °C to +85 °C							
V_{IH}	HIGH-level input voltage	data input	[3]				
		$V_{CCI} = 0.8$ V		$0.70 \times V_{CCI}$	-	-	V
		$V_{CCI} = 1.1$ V to 1.95 V		$0.65 \times V_{CCI}$	-	-	V
		$V_{CCI} = 2.3$ V to 2.7 V		1.6	-	-	V
		$V_{CCI} = 3.0$ V to 3.6 V		2	-	-	V
		DIR input					
		$V_{CCI} = 0.8$ V		$0.70 \times V_{CC(A)}$	-	-	V
		$V_{CCI} = 1.1$ V to 1.95 V		$0.65 \times V_{CC(A)}$	-	-	V
		$V_{CCI} = 2.3$ V to 2.7 V		1.6	-	-	V
		$V_{CCI} = 3.0$ V to 3.6 V		2	-	-	V

Table 7. Static characteristics *...continued*
At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{IL}	LOW-level input voltage	data input	[3]				
		V_{CCI} = 0.8 V		-	-	0.30 × V_{CCI}	V
		V_{CCI} = 1.1 V to 1.95 V		-	-	0.35 × V_{CCI}	V
		V_{CCI} = 2.3 V to 2.7 V		-	-	0.7	V
		V_{CCI} = 3.0 V to 3.6 V		-	-	0.9	V
		DIR input					
		V_{CCI} = 0.8 V		-	-	0.30 × $V_{CC(A)}$	V
		V_{CCI} = 1.1 V to 1.95 V		-	-	0.35 × $V_{CC(A)}$	V
		V_{CCI} = 2.3 V to 2.7 V		-	-	0.7	V
		V_{CCI} = 3.0 V to 3.6 V		-	-	0.9	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		I_O = –100 μA; $V_{CC(A)} = V_{CC(B)}$ = 0.8 V to 3.6 V	[2]	V_{CCO} – 0.1	-	-	V
		I_O = –3 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.1 V		0.85	-	-	V
		I_O = –6 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.4 V		1.05	-	-	V
		I_O = –8 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.65 V		1.2	-	-	V
		I_O = –9 mA; $V_{CC(A)} = V_{CC(B)}$ = 2.3 V		1.75	-	-	V
		I_O = –12 mA; $V_{CC(A)} = V_{CC(B)}$ = 3.0 V		2.3	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}					
		I_O = 100 μA; $V_{CC(A)} = V_{CC(B)}$ = 0.8 V to 3.6 V		-	-	0.1	V
		I_O = 3 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.1 V		-	-	0.25	V
		I_O = 6 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.4 V		-	-	0.35	V
		I_O = 8 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.65 V		-	-	0.45	V
		I_O = 9 mA; $V_{CC(A)} = V_{CC(B)}$ = 2.3 V		-	-	0.55	V
		I_O = 12 mA; $V_{CC(A)} = V_{CC(B)}$ = 3.0 V		-	-	0.7	V
I_I	input leakage current	DIR input; V_I = 0 V to 3.6 V; $V_{CC(A)} = V_{CC(B)}$ = 0.8 V to 3.6 V		-	-	±1	μA
I_{BHL}	bus hold LOW current	A or B port					
		V_I = 0.49 V; $V_{CC(A)} = V_{CC(B)}$ = 1.4 V		15	-	-	μA
		V_I = 0.58 V; $V_{CC(A)} = V_{CC(B)}$ = 1.65 V		25	-	-	μA
		V_I = 0.70 V; $V_{CC(A)} = V_{CC(B)}$ = 2.3 V		45	-	-	μA
		V_I = 0.80 V; $V_{CC(A)} = V_{CC(B)}$ = 3.0 V		100	-	-	μA
I_{BHH}	bus hold HIGH current	A or B port					
		V_I = 0.91 V; $V_{CC(A)} = V_{CC(B)}$ = 1.4 V		–15	-	-	μA
		V_I = 1.07 V; $V_{CC(A)} = V_{CC(B)}$ = 1.65 V		–25	-	-	μA
		V_I = 1.60 V; $V_{CC(A)} = V_{CC(B)}$ = 2.3 V		–45	-	-	μA
		V_I = 2.00 V; $V_{CC(A)} = V_{CC(B)}$ = 3.0 V		–100	-	-	μA

Table 7. Static characteristics *…continued*
At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{BHLO}	bus hold LOW overdrive current	A or B port	[1]				
		$V_{CC(A)} = V_{CC(B)} = 1.6$ V		125	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 1.95$ V		200	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 2.7$ V		300	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 3.6$ V		500	-	-	μA
I_{BHHO}	bus hold HIGH overdrive current	A or B port	[1]				
		$V_{CC(A)} = V_{CC(B)} = 1.6$ V		−125	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 1.95$ V		−200	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 2.7$ V		−300	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 3.6$ V		−500	-	-	μA
I_{OZ}	OFF-state output current	A or B port; $V_O = 0$ V or V_{CCO}; $V_{CC(A)} = V_{CC(B)} = 0.8$ V to 3.6 V	[2]	-	-	±5	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; $V_{CC(B)} = 0.8$ V to 3.6 V		-	-	±5	μA
		B port; V_I or $V_O = 0$ V to 3.6 V; $V_{CC(B)} = 0$ V; $V_{CC(A)} = 0.8$ V to 3.6 V		-	-	±5	μA
I_{CC}	supply current	A port; $V_I = 0$ V or V_{CCI}; $I_O = 0$ A	[3]				
		$V_{CC(A)} = V_{CC(B)} = 0.8$ V to 3.6 V		-	-	8	μA
		$V_{CC(A)} = 3.6$ V; $V_{CC(B)} = 0$ V		-	-	8	μA
		$V_{CC(A)} = 0$ V; $V_{CC(B)} = 3.6$ V		−2	0	-	μA
		B port; $V_I = 0$ V or V_{CCI}; $I_O = 0$ A					
		$V_{CC(A)} = V_{CC(B)} = 0.8$ V to 3.6 V		-	-	8	μA
		$V_{CC(A)} = 3.6$ V; $V_{CC(B)} = 0$ V		−2	0	-	μA
		$V_{CC(A)} = 0$ V; $V_{CC(B)} = 3.6$ V		-	-	8	μA
		A plus B port ($I_{CC(A)} + I_{CC(B)}$); $I_O = 0$ A; $V_I = 0$ V or V_{CCI}; $V_{CC(A)} = V_{CC(B)} = 0.8$ V to 3.6 V		-	-	16	μA
T_{amb} = −40 °C to +125 °C							
V_{IH}	HIGH-level input voltage	data input	[3]				
		$V_{CCI} = 0.8$ V		$0.70 \times V_{CCI}$	-	-	V
		$V_{CCI} = 1.1$ V to 1.95 V		$0.65 \times V_{CCI}$	-	-	V
		$V_{CCI} = 2.3$ V to 2.7 V		1.6	-	-	V
		$V_{CCI} = 3.0$ V to 3.6 V		2	-	-	V
		DIR input					
		$V_{CCI} = 0.8$ V		$0.70 \times V_{CC(A)}$	-	-	V
		$V_{CCI} = 1.1$ V to 1.95 V		$0.65 \times V_{CC(A)}$	-	-	V
		$V_{CCI} = 2.3$ V to 2.7 V		1.6	-	-	V
		$V_{CCI} = 3.0$ V to 3.6 V		2	-	-	V

Table 7. Static characteristics *...continued*

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

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{IL}	LOW-level input voltage	data input	[3]				
		V_{CCI} = 0.8 V		-	-	0.30 × V_{CCI}	V
		V_{CCI} = 1.1 V to 1.95 V		-	-	0.35 × V_{CCI}	V
		V_{CCI} = 2.3 V to 2.7 V		-	-	0.7	V
		V_{CCI} = 3.0 V to 3.6 V		-	-	0.9	V
		DIR input					
		V_{CCI} = 0.8 V		-	-	0.30 × $V_{CC(A)}$	V
		V_{CCI} = 1.1 V to 1.95 V		-	-	0.35 × $V_{CC(A)}$	V
		V_{CCI} = 2.3 V to 2.7 V		-	-	0.7	V
		V_{CCI} = 3.0 V to 3.6 V		-	-	0.9	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = −100 μA; $V_{CC(A)}$ = $V_{CC(B)}$ = 0.8 V to 3.6 V	[2]	V_{CCO} − 0.1	-	-	V
		I_O = −3 mA; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.1 V		0.85	-	-	V
		I_O = −6 mA; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.4 V		1.05	-	-	V
		I_O = −8 mA; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.65 V		1.2	-	-	V
		I_O = −9 mA; $V_{CC(A)}$ = $V_{CC(B)}$ = 2.3 V		1.75	-	-	V
		I_O = −12 mA; $V_{CC(A)}$ = $V_{CC(B)}$ = 3.0 V		2.3	-	-	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}					
		I_O = 100 μA; $V_{CC(A)}$ = $V_{CC(B)}$ = 0.8 V to 3.6 V		-	-	0.1	V
		I_O = 3 mA; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.1 V		-	-	0.25	V
		I_O = 6 mA; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.4 V		-	-	0.35	V
		I_O = 8 mA; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.65 V		-	-	0.45	V
		I_O = 9 mA; $V_{CC(A)}$ = $V_{CC(B)}$ = 2.3 V		-	-	0.55	V
		I_O = 12 mA; $V_{CC(A)}$ = $V_{CC(B)}$ = 3.0 V		-	-	0.7	V
I_I	input leakage current	DIR input; V_I = 0 V to 3.6 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 0.8 V to 3.6 V		-	-	±1.5	μA
I_{BHL}	bus hold LOW current	A or B port					
		V_I = 0.49 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.4 V		15	-	-	μA
		V_I = 0.58 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.65 V		25	-	-	μA
		V_I = 0.70 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 2.3 V		45	-	-	μA
		V_I = 0.80 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 3.0 V		90	-	-	μA
I_{BHH}	bus hold HIGH current	A or B port					
		V_I = 0.91 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.4 V		−15	-	-	μA
		V_I = 1.07 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.65 V		−25	-	-	μA
		V_I = 1.60 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 2.3 V		−45	-	-	μA
		V_I = 2.00 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 3.0 V		−100	-	-	μA

Table 7. Static characteristics *…continued*

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

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{BHLO}	bus hold LOW overdrive current	A or B port	[1]				
		$V_{CC(A)} = V_{CC(B)} = 1.6$ V		125	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 1.95$ V		200	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 2.7$ V		300	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 3.6$ V		500	-	-	μA
I_{BHHO}	bus hold HIGH overdrive current	A or B port	[1]				
		$V_{CC(A)} = V_{CC(B)} = 1.6$ V		–125	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 1.95$ V		–200	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 2.7$ V		–300	-	-	μA
		$V_{CC(A)} = V_{CC(B)} = 3.6$ V		–500	-	-	μA
I_{OZ}	OFF-state output current	A or B port; $V_O = 0$ V or V_{CCO}; $V_{CC(A)} = V_{CC(B)} = 0.8$ V to 3.6 V	[2]	-	-	±7.5	μA
I_{OFF}	power-off leakage current	A port; V_I or $V_O = 0$ V to 3.6 V; $V_{CC(B)} = 0$ V; $V_{CC(A)} = 0.8$ V to 3.6 V		-	-	±35	μA
		B port; V_I or $V_O = 0$ V to 3.6 V; $V_{CC(B)} = 0$ V; $V_{CC(A)} = 0.8$ V to 3.6 V		-	-	±35	μA
I_{CC}	supply current	A port; $V_I = 0$ V or V_{CCI}; $I_O = 0$ A	[3]				
		$V_{CC(A)} = V_{CC(B)} = 0.8$ V to 3.6 V		-	-	12	μA
		$V_{CC(A)} = 3.6$ V; $V_{CC(B)} = 0$ V		-	-	12	μA
		$V_{CC(A)} = 0$ V; $V_{CC(B)} = 3.6$ V		–8	0	-	μA
		B port; $V_I = 0$ V or V_{CCI}; $I_O = 0$ A					
		$V_{CC(A)} = V_{CC(B)} = 0.8$ V to 3.6 V		-	-	12	μA
		$V_{CC(A)} = 3.6$ V; $V_{CC(B)} = 0$ V		–8	0	-	μA
		$V_{CC(A)} = 0$ V; $V_{CC(B)} = 3.6$ V		-	-	12	μA
		A plus B port ($I_{CC(A)} + I_{CC(B)}$); $I_O = 0$ A; $V_I = 0$ V or V_{CCI}; $V_{CC(A)} = V_{CC(B)} = 0.8$ V to 3.6 V		-	-	24	μA

[1] In order to guarantee the node switches, an external driver must source/sink at least I_{BHLO} / I_{BHHO} when the input is in the range V_{IL} to V_{IH}.

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

[3] V_{CCI} is the supply voltage associated with the data input port.

11. Dynamic characteristics

Table 8. Typical dynamic characteristics at $V_{CC(A)}$ = 0.8 V and T_{amb} = 25 °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
			0.8 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	
t_{pd}	propagation delay	A to B	15.8	8.4	8.0	8.0	8.7	9.5	ns
		B to A	15.8	12.7	12.4	12.2	12.0	11.8	ns
t_{dis}	disable time	DIR to A	12.2	12.2	12.2	12.2	12.2	12.2	ns
		DIR to B	11.7	7.9	7.6	8.2	8.7	10.2	ns
t_{en}	enable time	DIR to A	27.5	20.6	20.0	20.4	20.7	22.0	ns
		DIR to B	28.0	20.6	20.2	20.2	20.9	21.7	ns

[1] t_{pd} is the same as t_{PLH} and t_{PHL}; t_{dis} is the same as t_{PLZ} and t_{PHZ}; t_{en} is the same as t_{PZL} and t_{PZH}.
t_{en} is a calculated value using the formula shown in Section 13.4 "Enable times"

Table 9. Typical dynamic characteristics at $V_{CC(B)}$ = 0.8 V and T_{amb} = 25 °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	$V_{CC(A)}$						Unit
			0.8 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	
t_{pd}	propagation delay	A to B	15.8	12.7	12.4	12.2	12.0	11.8	ns
		B to A	15.8	8.4	8.0	8.0	8.7	9.5	ns
t_{dis}	disable time	DIR to A	12.2	4.9	3.8	3.7	2.8	3.4	ns
		DIR to B	11.7	9.2	9.0	8.8	8.7	8.6	ns
t_{en}	enable time	DIR to A	27.5	17.6	17.0	16.8	17.4	18.1	ns
		DIR to B	28.0	17.6	16.2	15.9	14.8	15.2	ns

[1] t_{pd} is the same as t_{PLH} and t_{PHL}; t_{dis} is the same as t_{PLZ} and t_{PHZ}; t_{en} is the same as t_{PZL} and t_{PZH}.
t_{en} is a calculated value using the formula shown in Section 13.4 "Enable times"

Table 10. Typical power dissipation capacitance at $V_{CC(A)}$ = $V_{CC(B)}$ and T_{amb} = 25 °C [1][2]

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

Symbol	Parameter	Conditions	$V_{CC(A)}$ and $V_{CC(B)}$						Unit
			0.8 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	
C_{PD}	power dissipation capacitance	A port: (direction A to B); B port: (direction B to A)	1	2	2	2	2	2	pF
		A port: (direction B to A); B port: (direction A to B)	9	11	11	12	14	17	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; $R_L = \infty\ \Omega$.

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
			1.2 V ± 0.1 V		1.5 V ± 0.1 V		1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$V_{CC(A)}$ = 1.1 V to 1.3 V													
t_{pd}	propagation delay	A to B	1.0	9.0	0.7	6.8	0.6	6.1	0.5	5.7	0.5	6.1	ns
		B to A	1.0	9.0	0.8	8.0	0.7	7.7	0.6	7.2	0.5	7.1	ns
t_{dis}	disable time	DIR to A	2.2	8.8	2.2	8.8	2.2	8.8	2.2	8.8	2.2	8.8	ns
		DIR to B	2.2	8.4	1.8	6.7	2.0	6.9	1.7	6.2	2.4	7.2	ns
t_{en}	enable time	DIR to A	-	17.4	-	14.7	-	14.6	-	13.4	-	14.3	ns
		DIR to B	-	17.8	-	15.6	-	14.9	-	14.5	-	14.9	ns
$V_{CC(A)}$ = 1.4 V to 1.6 V													
t_{pd}	propagation delay	A to B	1.0	8.0	0.7	5.4	0.6	4.6	0.5	3.7	0.5	3.5	ns
		B to A	1.0	6.8	0.8	5.4	0.7	5.1	0.6	4.7	0.5	4.5	ns
t_{dis}	disable time	DIR to A	1.6	6.3	1.6	6.3	1.6	6.3	1.6	6.3	1.6	6.3	ns
		DIR to B	2.0	7.6	1.8	5.9	1.6	6.0	1.2	4.8	1.7	5.5	ns
t_{en}	enable time	DIR to A	-	14.4	-	11.3	-	11.1	-	9.5	-	10.0	ns
		DIR to B	-	14.3	-	11.7	-	10.9	-	10.0	-	9.8	ns
$V_{CC(A)}$ = 1.65 V to 1.95 V													
t_{pd}	propagation delay	A to B	1.0	7.7	0.6	5.1	0.5	4.3	0.5	3.4	0.5	3.1	ns
		B to A	1.0	6.1	0.7	4.6	0.5	4.4	0.5	3.9	0.5	3.7	ns
t_{dis}	disable time	DIR to A	1.6	5.5	1.6	5.5	1.6	5.5	1.6	5.5	1.6	5.5	ns
		DIR to B	1.8	7.8	1.8	5.7	1.4	5.8	1.0	4.5	1.5	5.2	ns
t_{en}	enable time	DIR to A	-	13.9	-	10.3	-	10.2	-	8.4	-	8.9	ns
		DIR to B	-	13.2	-	10.6	-	9.8	-	8.9	-	8.6	ns
$V_{CC(A)}$ = 2.3 V to 2.7 V													
t_{pd}	propagation delay	A to B	1.0	7.2	0.5	4.7	0.5	3.9	0.5	3.0	0.5	2.6	ns
		B to A	1.0	5.7	0.6	3.8	0.5	3.4	0.5	3.0	0.5	2.8	ns
t_{dis}	disable time	DIR to A	1.5	4.2	1.5	4.2	1.5	4.2	1.5	4.2	1.5	4.2	ns
		DIR to B	1.7	7.3	2.0	5.2	1.5	5.1	0.6	4.2	1.1	4.8	ns
t_{en}	enable time	DIR to A	-	13.0	-	9.0	-	8.5	-	7.2	-	7.6	ns
		DIR to B	-	11.4	-	8.9	-	8.1	-	7.2	-	6.8	ns
$V_{CC(A)}$ = 3.0 V to 3.6 V													
t_{pd}	propagation delay	A to B	1.0	7.1	0.5	4.5	0.5	3.7	0.5	2.8	0.5	2.4	ns
		B to A	1.0	6.1	0.6	3.6	0.5	3.1	0.5	2.6	0.5	2.4	ns
t_{dis}	disable time	DIR to A	1.5	4.7	1.5	4.7	1.5	4.7	1.5	4.7	1.5	4.7	ns
		DIR to B	1.7	7.2	0.7	5.5	0.6	5.5	0.7	4.1	1.7	4.7	ns
t_{en}	enable time	DIR to A	-	13.3	-	9.1	-	8.6	-	6.7	-	7.1	ns
		DIR to B	-	11.8	-	9.2	-	8.4	-	7.5	-	7.1	ns

[1] t_{pd} is the same as t_{PLH} and t_{PHL}; t_{dis} is the same as t_{PLZ} and t_{PHZ}; t_{en} is the same as t_{PZL} and t_{PZH}.
t_{en} is a calculated value using the formula shown in Section 13.4 "Enable times"

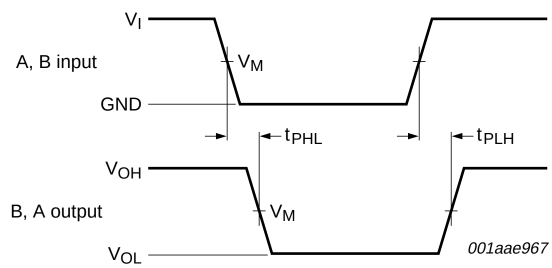
Table 12. Dynamic characteristics for temperature range –40 °C to +125 °C [1]

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
			1.2 V ± 0.1 V		1.5 V ± 0.1 V		1.8 V ± 0.15 V		2.5 V ± 0.2 V		3.3 V ± 0.3 V		
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$V_{CC(A)}$ = 1.1 V to 1.3 V													
t_{pd}	propagation delay	A to B	1.0	9.9	0.7	7.5	0.6	6.8	0.5	6.3	0.5	6.8	ns
		B to A	1.0	9.9	0.8	8.8	0.7	8.5	0.6	8.0	0.5	7.9	ns
t_{dis}	disable time	DIR to A	2.2	9.7	2.2	9.7	2.2	9.7	2.2	9.7	2.2	9.7	ns
		DIR to B	2.2	9.2	1.8	7.4	2.0	7.6	1.7	6.9	2.4	8.0	ns
t_{en}	enable time	DIR to A	-	19.1	-	16.2	-	16.1	-	14.9	-	15.9	ns
		DIR to B	-	19.6	-	17.2	-	16.5	-	16.0	-	16.5	ns
$V_{CC(A)}$ = 1.4 V to 1.6 V													
t_{pd}	propagation delay	A to B	1.0	8.8	0.7	6.0	0.6	5.1	0.5	4.1	0.5	3.9	ns
		B to A	1.0	7.5	0.8	6.0	0.7	5.7	0.6	5.2	0.5	5.0	ns
t_{dis}	disable time	DIR to A	1.6	7.0	1.6	7.0	1.6	7.0	1.6	7.0	1.6	7.0	ns
		DIR to B	2.0	8.3	1.8	6.5	1.6	6.6	1.2	5.3	1.7	6.1	ns
t_{en}	enable time	DIR to A	-	15.8	-	12.5	-	12.3	-	10.5	-	11.1	ns
		DIR to B	-	15.8	-	13.0	-	12.7	-	11.1	-	10.9	ns
$V_{CC(A)}$ = 1.65 V to 1.95 V													
t_{pd}	propagation delay	A to B	1.0	8.5	0.6	5.7	0.5	4.8	0.5	3.8	0.5	3.5	ns
		B to A	1.0	6.8	0.7	5.1	0.5	4.9	0.5	4.3	0.5	4.1	ns
t_{dis}	disable time	DIR to A	1.6	6.1	1.6	6.1	1.6	6.1	1.6	6.1	1.6	6.1	ns
		DIR to B	1.8	8.6	1.8	6.3	1.4	6.4	1.0	5.0	1.5	5.8	ns
t_{en}	enable time	DIR to A	-	15.4	-	11.4	-	11.3	-	9.3	-	9.9	ns
		DIR to B	-	14.6	-	11.8	-	10.9	-	9.9	-	9.6	ns
$V_{CC(A)}$ = 2.3 V to 2.7 V													
t_{pd}	propagation delay	A to B	1.0	8.0	0.5	5.2	0.5	4.3	0.5	3.3	0.5	2.9	ns
		B to A	1.0	6.3	0.6	4.2	0.5	3.8	0.5	3.3	0.5	3.1	ns
t_{dis}	disable time	DIR to A	1.5	4.7	1.5	4.7	1.5	4.7	1.5	4.7	1.5	4.7	ns
		DIR to B	1.7	8.0	2.0	5.8	1.5	5.7	0.6	4.7	1.1	5.3	ns
t_{en}	enable time	DIR to A	-	14.3	-	10.0	-	9.5	-	8.0	-	8.4	ns
		DIR to B	-	12.7	-	9.9	-	9.0	-	8.0	-	7.6	ns
$V_{CC(A)}$ = 3.0 V to 3.6 V													
t_{pd}	propagation delay	A to B	1.0	7.9	0.5	5.0	0.5	4.1	0.5	3.1	0.5	2.7	ns
		B to A	1.0	6.8	0.6	4.0	0.5	3.5	0.5	2.9	0.5	2.7	ns
t_{dis}	disable time	DIR to A	1.5	5.2	1.5	5.2	1.5	5.2	1.5	5.2	1.5	5.2	ns
		DIR to B	1.7	7.9	0.7	6.0	0.6	6.1	0.7	4.6	1.7	5.2	ns
t_{en}	enable time	DIR to A	-	14.7	-	10.1	-	9.6	-	7.5	-	7.9	ns
		DIR to B	-	13.1	-	10.2	-	9.3	-	8.3	-	7.9	ns

[1] t_{pd} is the same as t_{PLH} and t_{PHL}; t_{dis} is the same as t_{PLZ} and t_{PHZ}; t_{en} is the same as t_{PZL} and t_{PZH}.
t_{en} is a calculated value using the formula shown in Section 13.4 "Enable times"

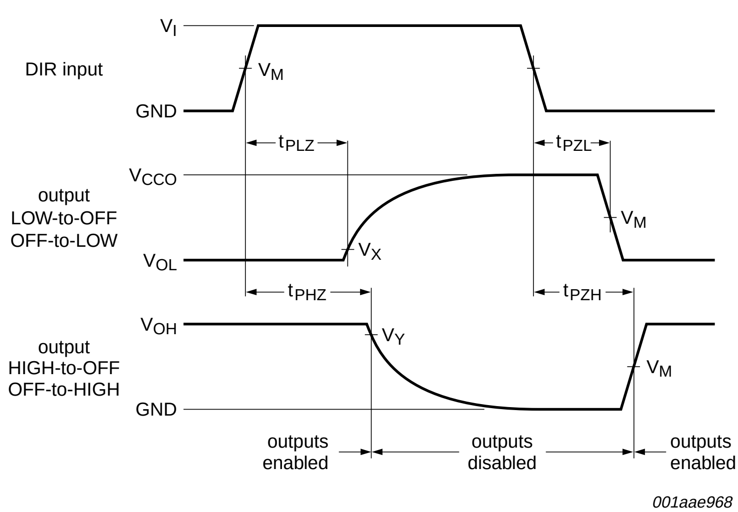
12. Waveforms



Measurement points are given in Table 13.

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

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



Measurement points are given in Table 13.

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

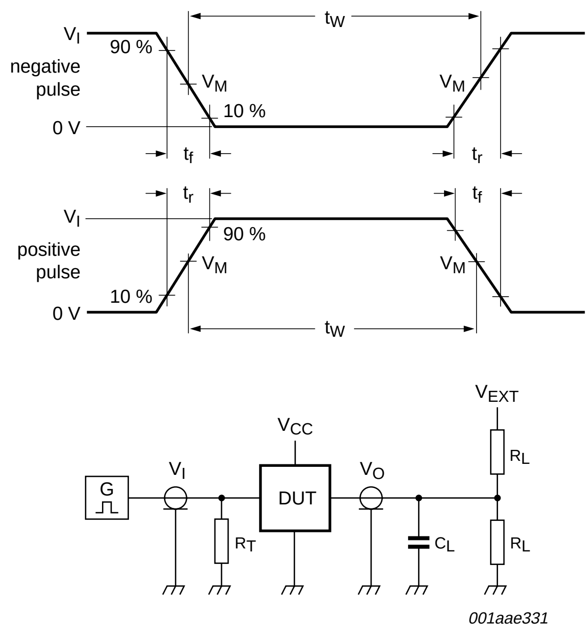
Fig 6. Enable and disable times

Table 13. Measurement points

Supply voltage	Input[1]	Output[2]		
$V_{CC(A)}$, $V_{CC(B)}$	V_M	V_M	V_X	V_Y
1.1 V to 1.6 V	$0.5 \times V_{CCI}$	$0.5 \times V_{CCO}$	V_{OL} + 0.1 V	V_{OH} − 0.1 V
1.65 V to 2.7 V	$0.5 \times V_{CCI}$	$0.5 \times V_{CCO}$	V_{OL} + 0.15 V	V_{OH} − 0.15 V
3.0 V to 3.6 V	$0.5 \times V_{CCI}$	$0.5 \times V_{CCO}$	V_{OL} + 0.3 V	V_{OH} − 0.3 V

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

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



Test data is given in Table 14.

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance.

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

Fig 7. Load circuitry for switching times

Table 14. 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	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}[2]
1.1 V to 1.6 V	V_{CCI}	≤ 1.0 ns/V	15 pF	2 kΩ	open	GND	2 × V_{CCO}
1.65 V to 2.7 V	V_{CCI}	≤ 1.0 ns/V	15 pF	2 kΩ	open	GND	2 × V_{CCO}
3.0 V to 3.6 V	V_{CCI}	≤ 1.0 ns/V	15 pF	2 kΩ	open	GND	2 × V_{CCO}

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

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

13. Application information

13.1 Unidirectional logic level-shifting application

The circuit given in Figure 8 is an example of the 74AVCH1T45 being used in an unidirectional logic level-shifting application.

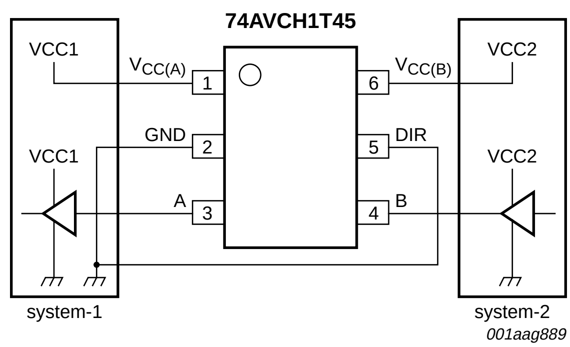


Fig 8. Unidirectional logic level-shifting application

Table 15. Description unidirectional logic level-shifting application

Pin	Name	Function	Description
1	$V_{CC(A)}$	V_{CC1}	supply voltage of system-1 (0.8 V to 3.6 V)
2	GND	GND	device GND
3	A	OUT	output level depends on V_{CC1} voltage
4	DIR	DIR	the GND (LOW level) determines B port to A port direction
5	B	IN	input threshold value depends on V_{CC2} voltage
6	$V_{CC(B)}$	V_{CC2}	supply voltage of system-2 (0.8 V to 3.6 V)

13.2 Bidirectional logic level-shifting application

Figure 9 shows the 74AVCH1T45 being used in a bidirectional logic level-shifting application. Since the device does not have an output enable pin, the system designer should take precautions to avoid bus contention between system-1 and system-2 when changing directions.

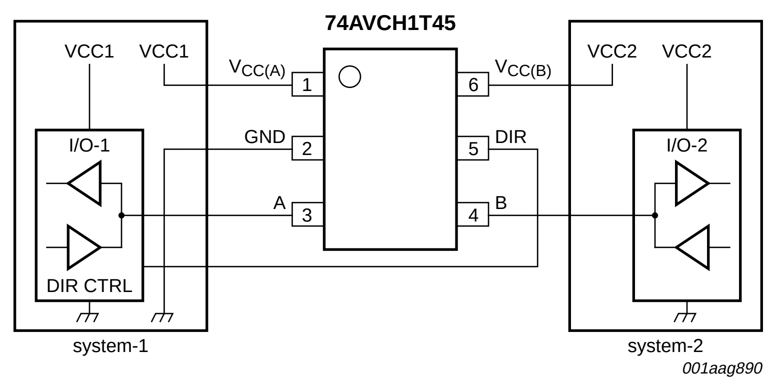


Fig 9. Bidirectional logic level-shifting application

Table 16 gives a sequence that will illustrate data transmission from system-1 to system-2 and then from system-2 to system-1.

Table 16. Description bidirectional logic level-shifting application[1]

State	DIR CTRL	I/O-1	I/O-2	Description
1	H	output	input	system-1 data to system-2
2	H	Z	Z	system-2 is getting ready to send data to system-1. I/O-1 and I/O-2 are disabled. The bus-line state depends on bus hold.
3	L	Z	Z	DIR bit is set LOW. I/O-1 and I/O-2 still are disabled. The bus-line state depends on bus hold.
4	L	input	output	system-2 data to system-1

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

13.3 Power-up considerations

The device is designed such that no special power-up sequence is required other than GND being applied first.

Table 17. Typical total supply current ($I_{CC(A)} + I_{CC(B)}$)

$V_{CC(A)}$	$V_{CC(B)}$							Unit
	0 V	0.8 V	1.2 V	1.5 V	1.8 V	2.5 V	3.3 V	
0 V	0	0.1	0.1	0.1	0.1	0.1	0.1	µA
0.8 V	0.1	0.1	0.1	0.1	0.1	0.7	2.3	µA
1.2 V	0.1	0.1	0.1	0.1	0.1	0.3	1.4	µA
1.5 V	0.1	0.1	0.1	0.1	0.1	0.1	0.9	µA
1.8 V	0.1	0.1	0.1	0.1	0.1	0.1	0.5	µA
2.5 V	0.1	0.7	0.3	0.1	0.1	0.1	0.1	µA
3.3 V	0.1	2.3	1.4	0.9	0.5	0.1	0.1	µA

13.4 Enable times

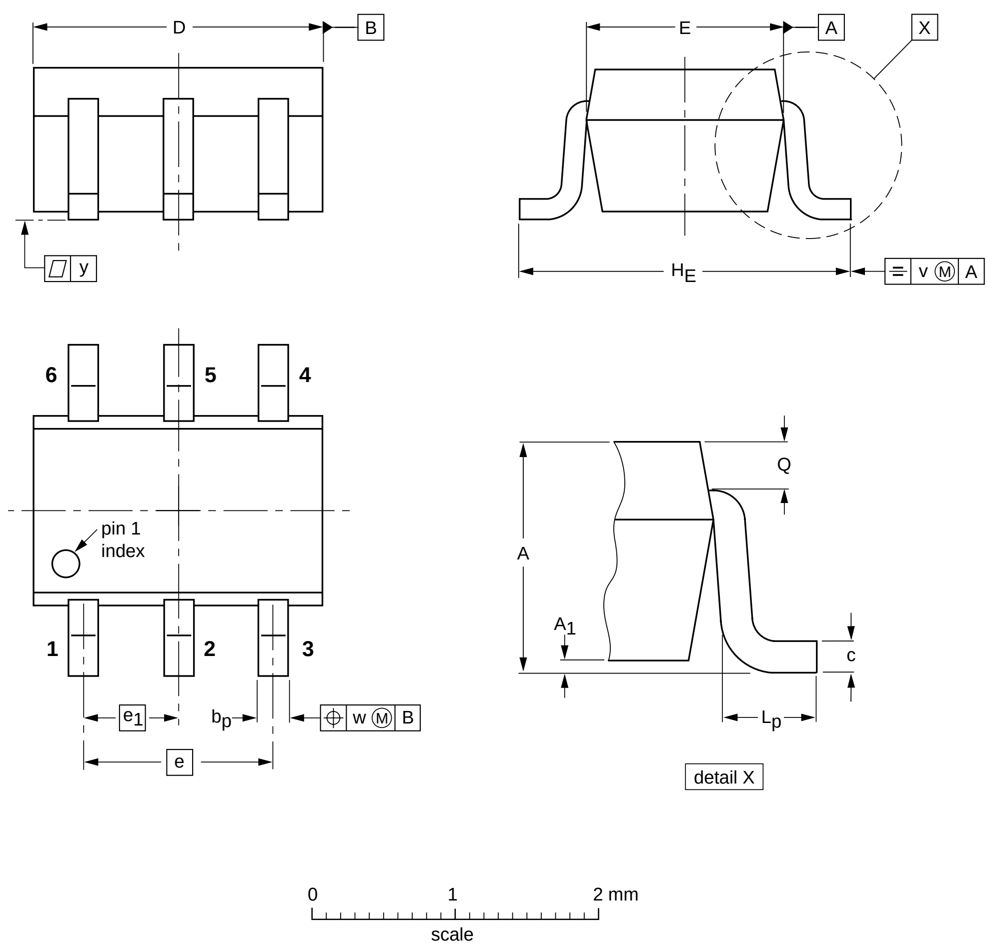
Calculate the enable times for the 74AVCH1T45 using the following formulas:

- t_{en} (DIR to A) = t_{dis} (DIR to B) + t_{pd} (B to A)
- t_{en} (DIR to B) = t_{dis} (DIR to A) + t_{pd} (A to B)

In a bidirectional application, these enable times provide the maximum delay from the time the DIR bit is switched until an output is expected. For example, if the 74AVCH1T45 initially is transmitting from A to B, then the DIR bit is switched, the B port of the device must be disabled before presenting it with an input. After the B port has been disabled, an input signal applied to it appears on the corresponding A port after the specified propagation delay.

14. Package outline

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



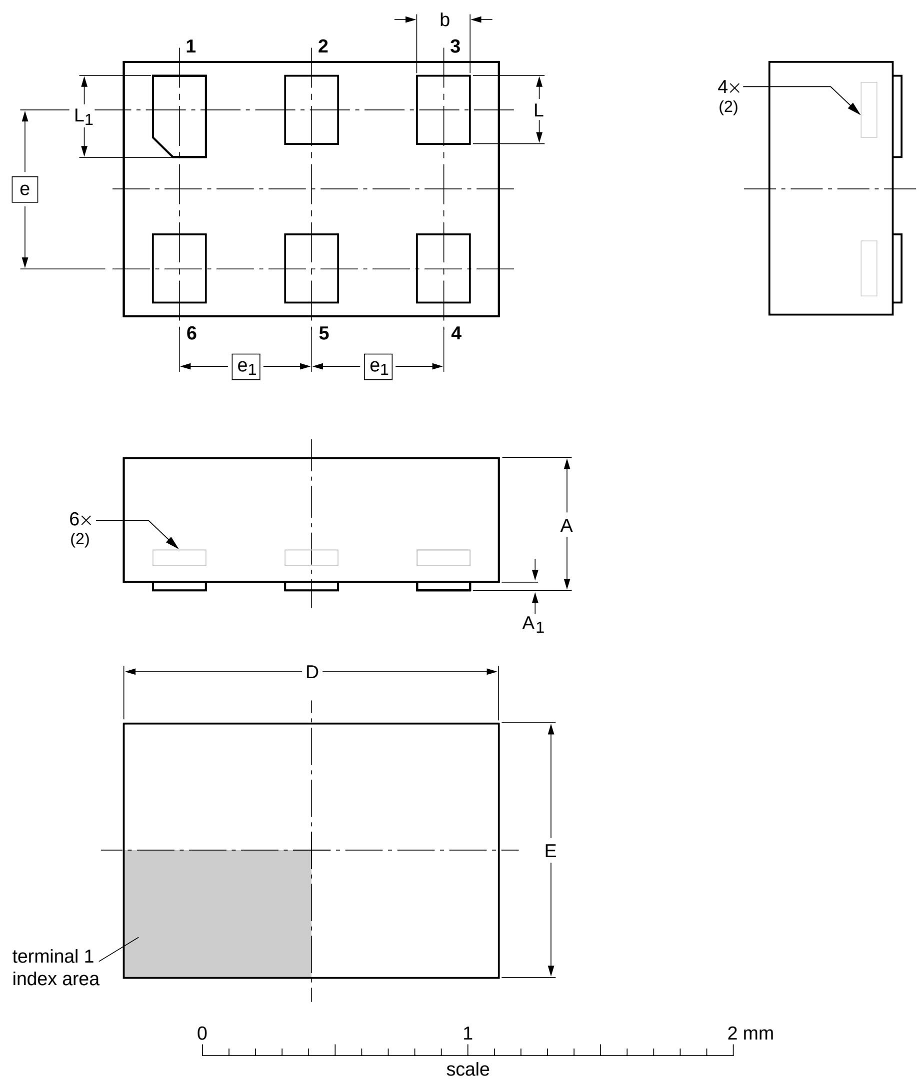
DIMENSIONS (mm are the original dimensions)

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 10. 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) max	A_1 max	b	D	E	e	e_1	L	L_1
mm	0.5	0.04	0.25 0.17	1.5 1.4	1.05 0.95	0.6	0.5	0.35 0.27	0.40 0.32

Notes

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT886		MO-252				~~04-07-15~~ 04-07-22

Fig 11. Package outline SOT886 (XSON6)

15. Abbreviations

Table 18. 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

16. Revision history

Table 19. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AVCH1T45_1	20071025	Product data sheet	-	-

17. Legal information

17.1 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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