74AVCH2T45-Q100

Dual-bit, dual-supply voltage level translator/transceiver; 3-state

Rev. 1 — 7 December 2022 Product data sheet

1. General description

The 74AVCH2T45-Q100 is a dual bit, dual supply transceiver that enables bidirectional level translation. It features two data input-output ports (nA and nB), 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 nA and DIR are referenced to $V_{CC(A)}$ and pins nB are referenced to $V_{CC(B)}$. A HIGH on DIR allows transmission from nA to nB and a LOW on DIR allows transmission from nB to nA.

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 74AVCH2T45-Q100 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.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from -40 °C to +85 °C and from -40 °C to +125 °C
- Wide supply voltage range: 0.8 V to 3.6 V for $V_{CC(A)}$ and $V_{CC(B)}$
- High noise immunity
- Suspend mode
- Bus hold on data inputs
- 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
- Maximum data rates:
  - 500 Mbps (1.8 V to 3.3 V translation)
  - 320 Mbps (< 1.8 V to 3.3 V translation)
  - 320 Mbps (translate to 2.5 V or 1.8 V)
  - 280 Mbps (translate to 1.5 V)
  - 240 Mbps (translate to 1.2 V)
- Latch-up performance exceeds 100 mA per JESD 78 Class II
- 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: ANSI/ESDA/Jedec JS-001 Class 3B exceeds 8000 V
  - CDM: ANSI/ESDA/Jedec JS-002 Class C3 exceeds 1000 V

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AVCH2T45DC-Q100	-40 °C to +125 °C	VSSOP8	plastic very thin shrink small outline package; 8 leads; body width 2.3 mm	SOT765-1

4. Marking

Table 2. Marking

Type number	Marking code [1]
74AVCH2T45DC-Q100	K45

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

5. Functional diagram

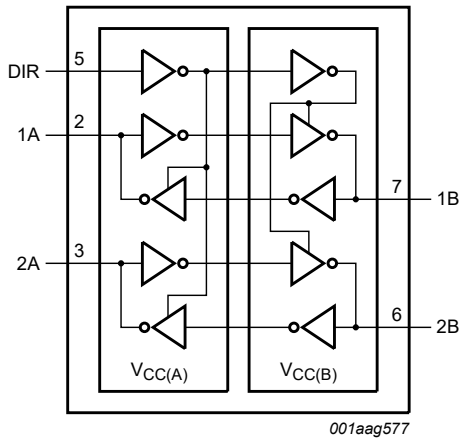


Fig. 1. Logic symbol

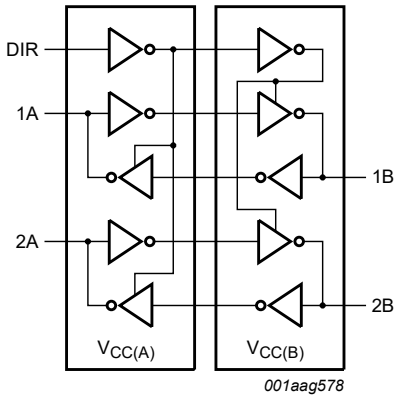
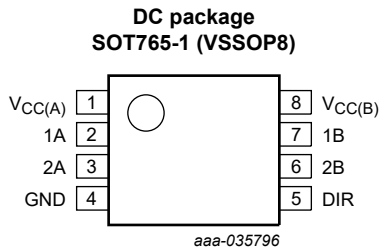


Fig. 2. Logic diagram

6. Pinning information

6.1. Pinning



6.2. Pin description

Table 3. Pin description

Symbol	Pin	Description
$V_{CC(A)}$	1	supply voltage port A and DIR
1A	2	data input or output
2A	3	data input or output
GND	4	ground (0 V)
DIR	5	direction control
2B	6	data input or output
1B	7	data input or output
$V_{CC(B)}$	8	supply voltage port B

7. Functional description

Table 4. Function table

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

Supply voltage	Input	Input/output[1]	
$V_{CC(A)}$, $V_{CC(B)}$	DIR[2]	nA	nB
0.8 V to 3.6 V	L	nA = nB	input
0.8 V to 3.6 V	H	input	nB = nA
GND[3]	X	Z	Z

[1] The input circuit of the data I/O is always active.
[2] The DIR input circuit is referenced to $V_{CC(A)}$.
[3] 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 A			-0.5	+4.6	V
$V_{CC(B)}$	supply voltage 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_{CCO}		-	±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 rating 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 SOT765-1 (VSSOP8) package: P_{tot} derates linearly with 4.9 mW/K above 99 °C.

9. Recommended operating conditions

Table 6. Recommended operating conditions

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{CC(A)}$	supply voltage A			0.8	3.6	V
$V_{CC(B)}$	supply voltage 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
Δt/ΔV	input transition rise and fall rate	V_{CCI} = 0.8 V to 3.6 V		-	5	ns/V

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

10. Static characteristics

Table 7. Typical static characteristics at T_{amb} = 25 °C

At recommended operating conditions; voltages are referenced to GND (ground = 0 V). [1][2]

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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 or 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	V_I = 0.42 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.2 V [3]	-	26	-	µA
I_{BHH}	bus hold HIGH current	V_I = 0.78 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.2 V [4]	-	-24	-	µA
I_{BHLO}	bus hold LOW overdrive current	V_I = GND to V_{CCI}; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.2 V [5]	-	28	-	µA
I_{BHHO}	bus hold HIGH overdrive current	V_I = GND to V_{CCI}; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.2 V [6]	-	-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 [7]	-	±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	-	1.0	-	pF
$C_{I/O}$	input/output capacitance	A and B port; Suspend mode; V_O = V_{CCO} or GND; $V_{CC(A)}$ = $V_{CC(B)}$ = 3.3 V	-	4.0	-	pF

[1] V_{CCO} is the supply voltage associated with the output port.
[2] V_{CCI} is the supply voltage associated with the data input port.
[3] The bus hold circuit can sink at least the minimum low sustaining current at V_{IL} max. I_{BHL} should be measured after lowering V_I to GND and then raising it to V_{IL} max.
[4] The bus hold circuit can source at least the minimum high sustaining current at V_{IH} min. I_{BHH} should be measured after raising V_I to V_{CC} and then lowering it to V_{IH} min.
[5] An external driver must source at least I_{BHLO} to switch this node from LOW to HIGH.
[6] An external driver must sink at least I_{BHHO} to switch this node from HIGH to LOW.
[7] For I/O ports, the parameter I_{OZ} includes the input leakage current.

Table 8. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).[1][2]

Symbol	Parameter	Conditions	-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Max	Min	Max	
V_{IH}	HIGH-level input voltage	data input					
		V_{CCI} = 0.8 V	$0.70V_{CCI}$	-	$0.70V_{CCI}$	-	V
		V_{CCI} = 1.1 V to 1.95 V	$0.65V_{CCI}$	-	$0.65V_{CCI}$	-	V
		V_{CCI} = 2.3 V to 2.7 V	1.6	-	1.6	-	V
		V_{CCI} = 3.0 V to 3.6 V	2	-	2	-	V
		DIR input					
		$V_{CC(A)}$ = 0.8 V	$0.70V_{CC(A)}$	-	$0.70V_{CC(A)}$	-	V
		$V_{CC(A)}$ = 1.1 V to 1.95 V	$0.65V_{CC(A)}$	-	$0.65V_{CC(A)}$	-	V
		$V_{CC(A)}$ = 2.3 V to 2.7 V	1.6	-	1.6	-	V
		$V_{CC(A)}$ = 3.0 V to 3.6 V	2	-	2	-	V
V_{IL}	LOW-level input voltage	data input					
		V_{CCI} = 0.8 V	-	$0.30V_{CCI}$	-	$0.30V_{CCI}$	V
		V_{CCI} = 1.1 V to 1.95 V	-	$0.35V_{CCI}$	-	$0.35V_{CCI}$	V
		V_{CCI} = 2.3 V to 2.7 V	-	0.7	-	0.7	V
		V_{CCI} = 3.0 V to 3.6 V	-	0.9	-	0.9	V
		DIR input					
		$V_{CC(A)}$ = 0.8 V	-	$0.30V_{CC(A)}$	-	$0.30V_{CC(A)}$	V
		$V_{CC(A)}$ = 1.1 V to 1.95 V	-	$0.35V_{CC(A)}$	-	$0.35V_{CC(A)}$	V
		$V_{CC(A)}$ = 2.3 V to 2.7 V	-	0.7	-	0.7	V
		$V_{CC(A)}$ = 3.0 V to 3.6 V	-	0.9	-	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	V_{CCO} - 0.1	-	V_{CCO} - 0.1	-	V
		I_O = -3 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.1 V	0.85	-	0.85	-	V
		I_O = -6 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.4 V	1.05	-	1.05	-	V
		I_O = -8 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.65 V	1.2	-	1.2	-	V
		I_O = -9 mA; $V_{CC(A)} = V_{CC(B)}$ = 2.3 V	1.75	-	1.75	-	V
		I_O = -12 mA; $V_{CC(A)} = V_{CC(B)}$ = 3.0 V	2.3	-	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	-	0.1	V
		I_O = 3 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.1 V	-	0.25	-	0.25	V
		I_O = 6 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.4 V	-	0.35	-	0.35	V
		I_O = 8 mA; $V_{CC(A)} = V_{CC(B)}$ = 1.65 V	-	0.45	-	0.45	V
		I_O = 9 mA; $V_{CC(A)} = V_{CC(B)}$ = 2.3 V	-	0.55	-	0.55	V
		I_O = 12 mA; $V_{CC(A)} = V_{CC(B)}$ = 3.0 V	-	0.7	-	0.7	V
I_I	input leakage current	DIR input; V_I = 0 V or 3.6 V; $V_{CC(A)} = V_{CC(B)}$ = 0.8 V to 3.6 V	-	±1	-	±1.5	µA

Symbol	Parameter	Conditions	-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Max	Min	Max	
I_{BHL}	bus hold LOW current	A or B port [3]					
		V_I = 0.49 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.4 V	15	-	15	-	µA
		V_I = 0.58 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.65 V	25	-	25	-	µA
		V_I = 0.70 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 2.3 V	45	-	45	-	µA
		V_I = 0.80 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 3.0 V	100	-	90	-	µA
I_{BHH}	bus hold HIGH current	A or B port [4]					
		V_I = 0.91 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.4 V	-15	-	-15	-	µA
		V_I = 1.07 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 1.65 V	-25	-	-25	-	µA
		V_I = 1.60 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 2.3 V	-45	-	-45	-	µA
		V_I = 2.00 V; $V_{CC(A)}$ = $V_{CC(B)}$ = 3.0 V	-100	-	-100	-	µA
I_{BHLO}	bus hold LOW overdrive current	A or B port [5]					
		$V_{CC(A)}$ = $V_{CC(B)}$ = 1.6 V	125	-	125	-	µA
		$V_{CC(A)}$ = $V_{CC(B)}$ = 1.95 V	200	-	200	-	µA
		$V_{CC(A)}$ = $V_{CC(B)}$ = 2.7 V	300	-	300	-	µA
		$V_{CC(A)}$ = $V_{CC(B)}$ = 3.6 V	500	-	500	-	µA
I_{BHHO}	bus hold HIGH overdrive current	A or B port [6]					
		$V_{CC(A)}$ = $V_{CC(B)}$ = 1.6 V	-125	-	-125	-	µA
		$V_{CC(A)}$ = $V_{CC(B)}$ = 1.95 V	-200	-	-200	-	µA
		$V_{CC(A)}$ = $V_{CC(B)}$ = 2.7 V	-300	-	-300	-	µA
		$V_{CC(A)}$ = $V_{CC(B)}$ = 3.6 V	-500	-	-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 to 3.6 V [7]	-	±5	-	±7.5	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	-	±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	-	±5	-	±35	µA
I_{CC}	supply current	A port; V_I = 0 V or V_{CCI}; I_O = 0 A					
		$V_{CC(A)}$ = 0.8 V to 3.6 V; $V_{CC(B)}$ = 0.8 V to 3.6 V	-	8	-	11.5	µA
		$V_{CC(A)}$ = 3.6 V; $V_{CC(B)}$ = 0 V	-	8	-	11.5	µA
		$V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 3.6 V	-2	-	-8	-	µA
		B port; V_I = 0 V or V_{CCI}; I_O = 0 A					
		$V_{CC(A)}$ = 0.8 V to 3.6 V; $V_{CC(B)}$ = 0.8 V to 3.6 V	-	8	-	11.5	µA
		$V_{CC(A)}$ = 3.6 V; $V_{CC(B)}$ = 0 V	-2	-	-8	-	µA
		$V_{CC(A)}$ = 0 V; $V_{CC(B)}$ = 3.6 V	-	8	-	11.5	µA
		A plus B port ($I_{CC(A)}$ + $I_{CC(B)}$); I_O = 0 A; V_I = 0 V or V_{CCI}; $V_{CC(A)}$ = 0.8 V to 3.6 V; $V_{CC(B)}$ = 0.8 V to 3.6 V	-	16	-	23	µA

[1] V_{CCO} is the supply voltage associated with the output port.
[2] V_{CCI} is the supply voltage associated with the data input port.
[3] The bus hold circuit can sink at least the minimum low sustaining current at V_{IL} max. I_{BHL} should be measured after lowering V_I to GND and then raising it to V_{IL} max.
[4] The bus hold circuit can source at least the minimum high sustaining current at V_{IH} min.

I_{BHH} should be measured after raising V_I to V_{CC} and then lowering it to V_{IH} min.
[5] An external driver must source at least I_{BHLO} to switch this node from LOW to HIGH.
[6] An external driver must sink at least I_{BHHO} to switch this node from HIGH to LOW.
[7] For I/O ports, the parameter I_{OZ} includes the input leakage current.

11. Dynamic characteristics

Table 9. Typical dynamic characteristics at $V_{CC(A)}$ = 0.8 V and T_{amb} = 25 °C

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 5; for waveforms see Fig. 3 and Fig. 4. [1] [2]

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}.
[2] t_{en} is a calculated value using the formula shown in Section 12.4

Table 10. Typical dynamic characteristics at $V_{CC(B)}$ = 0.8 V and T_{amb} = 25 °C

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 5; for waveforms see Fig. 3 and Fig. 4. [1] [2]

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}.
[2] t_{en} is a calculated value using the formula shown in Section 12.4

Table 11. Typical power dissipation capacitance at $V_{CC(A)} = V_{CC(B)}$ and T_{amb} = 25 °C

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

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 = ∞ Ω.

Table 12. Dynamic characteristics for temperature range -40 °C to +85 °C

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 5; for waveforms see Fig. 3 and Fig. 4. [1][2]

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}.
[2] t_{en} is a calculated value using the formula shown in Section 12.4

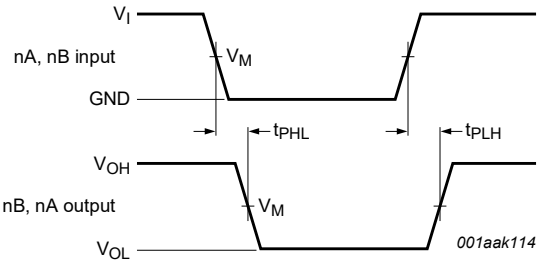
Table 13. Dynamic characteristics for temperature range -40 °C to +125 °C

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 5; for waveforms see Fig. 3 and Fig. 4. [1] [2]

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	6.1	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}.
[2] t_{en} is a calculated value using the formula shown in Section 12.4

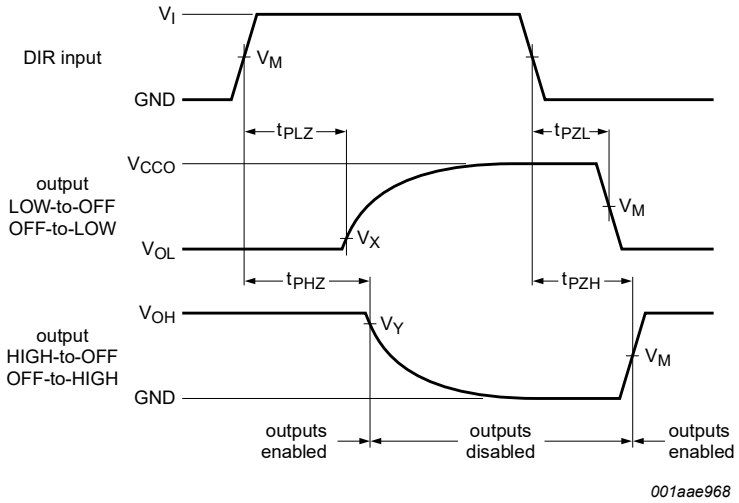
11.1. Waveforms and test circuit



Measurement points are given in Table 14.

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

Fig. 3. The data input (nA, nB) to output (nB, nA) propagation delay times



Measurement points are given in Table 14.

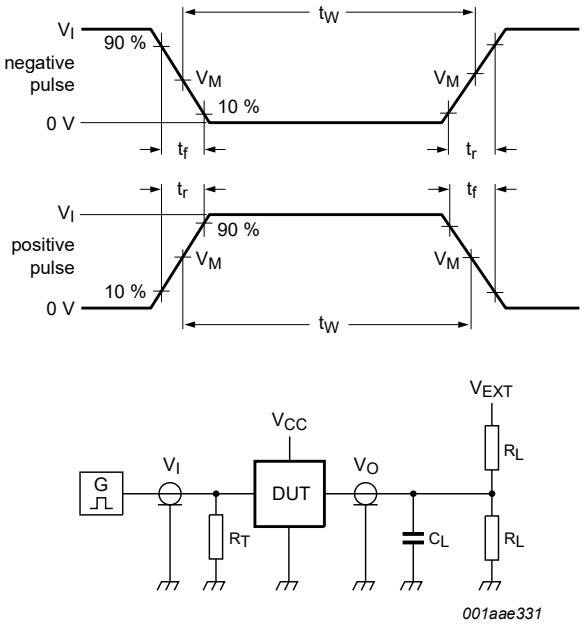
V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig. 4. 3-state enable and disable times

Table 14. 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	$0.5V_{CCI}$	$0.5V_{CCO}$	V_{OL} + 0.1 V	V_{OH} - 0.1 V
1.65 V to 2.7 V	$0.5V_{CCI}$	$0.5V_{CCO}$	V_{OL} + 0.15 V	V_{OH} - 0.15 V
3.0 V to 3.6 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 data input port.
[2] V_{CCO} is the supply voltage associated with the output port.



Test data is given in Table 15.

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. 5. 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]	$\Delta t/\Delta V$ [2]	C_L	R_L	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ} [3]
1.1 V to 1.6 V	V_{CCI}	≤ 1.0 ns/V	15 pF	2 kΩ	open	GND	$2V_{CCO}$
1.65 V to 2.7 V	V_{CCI}	≤ 1.0 ns/V	15 pF	2 kΩ	open	GND	$2V_{CCO}$
3.0 V to 3.6 V	V_{CCI}	≤ 1.0 ns/V	15 pF	2 kΩ	open	GND	$2V_{CCO}$

[1] V_{CCI} is the supply voltage associated with the data input port.
[2] dV/dt ≥ 1.0 V/ns
[3] V_{CCO} is the supply voltage associated with the output port.

12. Application information

12.1. Unidirectional logic level-shifting application

The circuit given in Fig. 6 is an example of the 74AVCH2T45-Q100 being used in an unidirectional logic level-shifting application.

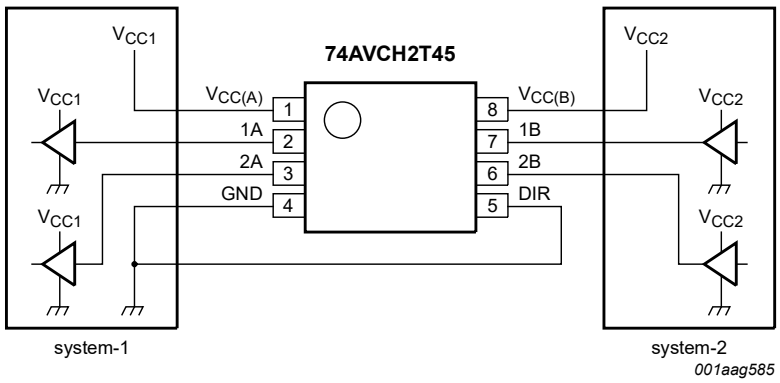


Fig. 6. Unidirectional logic level-shifting application

Table 16. 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	1A	OUT1	output level depends on V_{CC1} voltage
3	2A	OUT2	output level depends on V_{CC1} voltage
4	GND	GND	device GND
5	DIR	DIR	the GND (LOW level) determines B port to A port direction
6	2B	IN2	input threshold value depends on V_{CC2} voltage
7	1B	IN1	input threshold value depends on V_{CC2} voltage
8	$V_{CC(B)}$	V_{CC2}	supply voltage of system-2 (0.8 V to 3.6 V)

12.2. Bidirectional logic level-shifting application

Fig. 7 shows the 74AVCH2T45-Q100 being used in a bidirectional logic level-shifting application. Since the device does not have an output enable (OE) pin, the system designer should take precautions to avoid bus contention between system-1 and system-2 when changing directions.

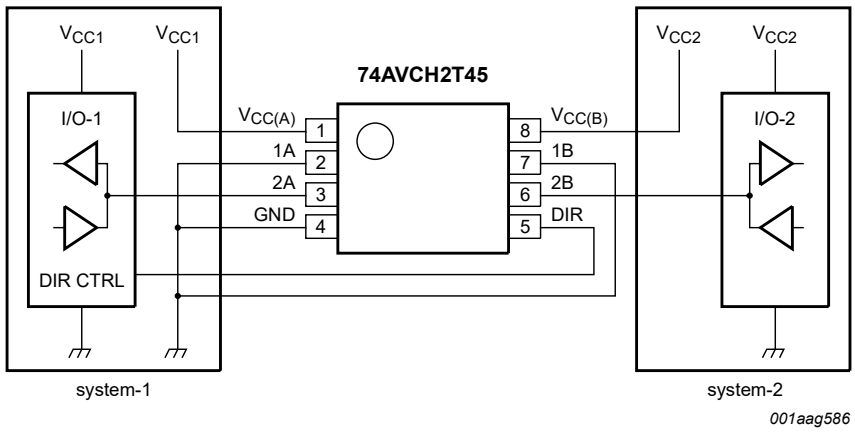


Fig. 7. Bidirectional logic level-shifting application

Table 17 gives a sequence that will illustrate data transmission from system-1 to system-2 and then from system-2 to system-1.

Table 17. 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.

12.3. Power-up considerations

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

Table 18. 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

12.4. Enable times

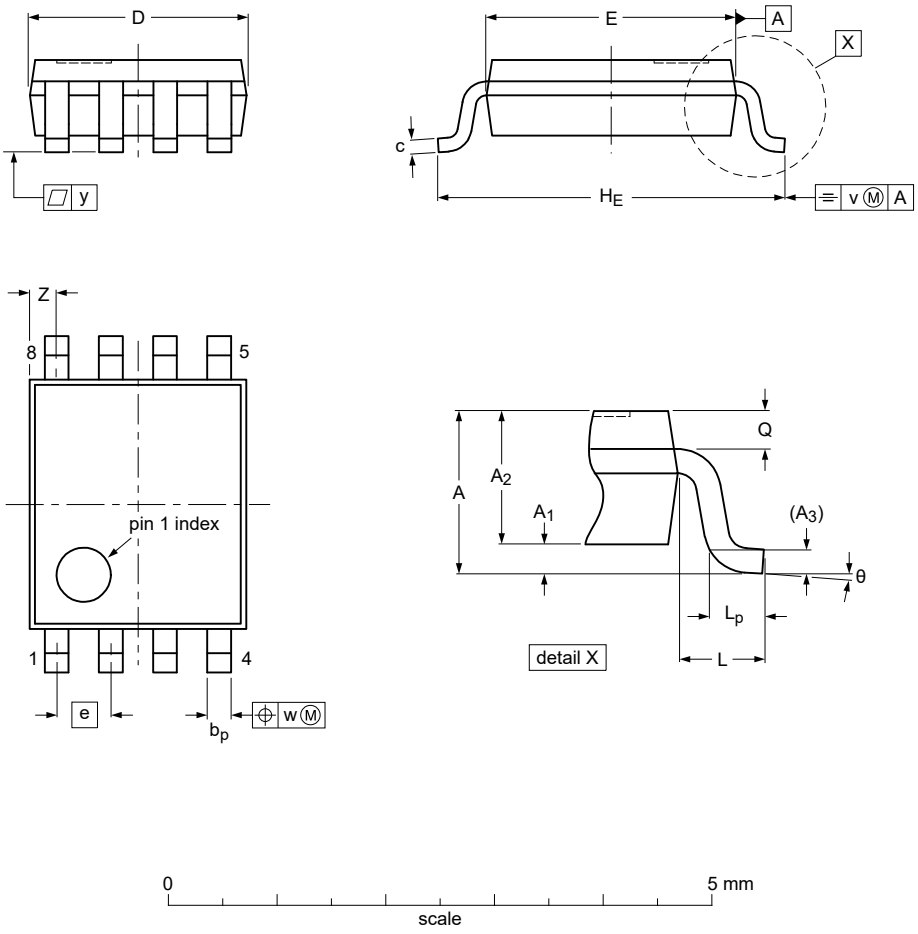
The enable times for the 74AVCH2T45-Q100 are calculated from the following formulas:

- t_{en} (DIR to nA) = t_{dis} (DIR to nB) + t_{pd} (nB to nA)
- t_{en} (DIR to nB) = t_{dis} (DIR to nA) + t_{pd} (nA to nB)

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 74AVCH2T45-Q100 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.

13. Package outline

VSSOP8: plastic very thin shrink small outline package; 8 leads; body width 2.3 mm **SOT765-1**



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
max		0.15	0.85		0.27	0.23	2.1	2.4		3.2		0.40	0.21				0.4	8°
mm nom	1			0.12					0.5		0.4			0.2	0.08	0.1		
min		0.00	0.60		0.17	0.08	1.9	2.2		3.0		0.15	0.19				0.1	0°

Note
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.

sot765-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT765-1		MO-187				~~07-06-02~~ 16-05-31

Fig. 8. Package outline SOT765-1 (VSSOP8)

14. Abbreviations

Table 19. Abbreviations

Acronym	Description
CDM	Charged Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model

15. Revision history

Table 20. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AVCH2T45_Q100 v.1	20221207	Product data sheet	-	-

16. 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.

Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Nexperia does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Nexperia sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Nexperia and its customer, unless Nexperia and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the Nexperia product is deemed to offer functions and qualities beyond those described in the Product data sheet.

Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, Nexperia does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Nexperia takes no responsibility for the content in this document if provided by an information source outside of Nexperia.

In no event shall Nexperia be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

Notwithstanding any damages that customer might incur for any reason whatsoever, Nexperia's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of Nexperia.

Right to make changes — Nexperia reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use in automotive applications — This Nexperia product has been qualified for use in automotive applications. Unless otherwise agreed in writing, the product is not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an Nexperia product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Nexperia and its suppliers accept no liability for inclusion and/or use of Nexperia products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Nexperia makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Nexperia products, and Nexperia accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the Nexperia product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Nexperia does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using Nexperia products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). Nexperia does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — Nexperia products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nexperia.com/profile/terms, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Nexperia hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Nexperia products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

Contents

For more information, please visit: http://www.nexperia.com
For sales office addresses, please send an email to: salesaddresses@nexperia.com
Date of release: 7 December 2022