

74AHCV541A

Octal buffer/line driver; 3-state

Rev. 7 — 25 September 2023

Product data sheet

1. General description

The 74AHCV541A is an 8-bit buffer/line driver with 3-state outputs and Schmitt trigger inputs. The device features two output enables ($\overline{OE}1$ and $\overline{OE}2$). A HIGH on $\overline{OE}n$ causes the associated outputs to assume a high-impedance OFF-state.

Inputs are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

The data (A_n) and control ($\overline{OE}n$) inputs include Schmitt trigger inputs, capable of transforming slowly changing input signals into sharply defined, jitter-free output signals.

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

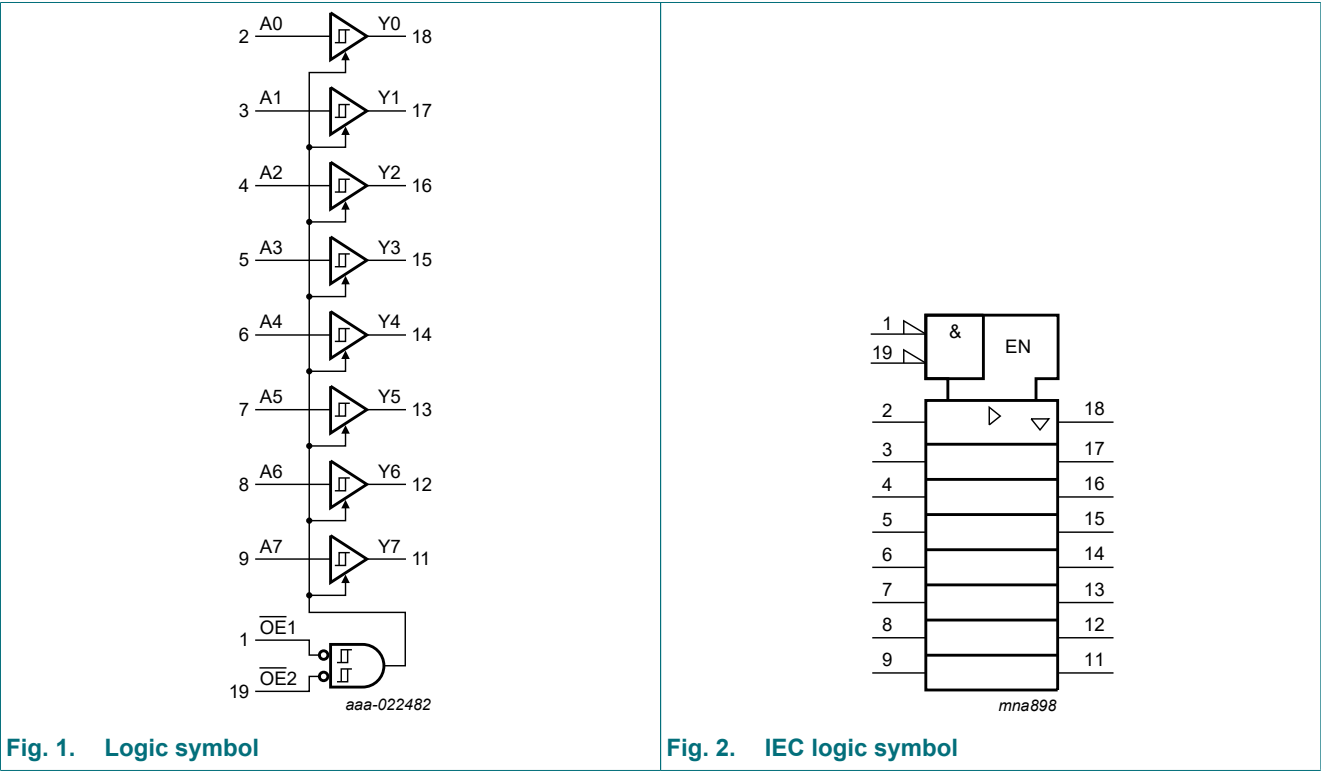
- Wide supply voltage range from 1.8 V to 5.5 V
- Typical t_{pd} of 3.0 ns at 5 V
- Typical $V_{OL(p)} < 0.8$ V at $V_{CC} = 3.3$ V, $T_{amb} = 25$ °C
- Typical $V_{OH(v)} > 2.3$ V at $V_{CC} = 3.3$ V, $T_{amb} = 25$ °C
- Supports mixed-mode voltage operation on all ports
- I_{OFF} circuitry provides partial Power-down mode operation
- Latch-up performance exceeds 250 mA per JESD 78 Class II
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 3000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 2000 V
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

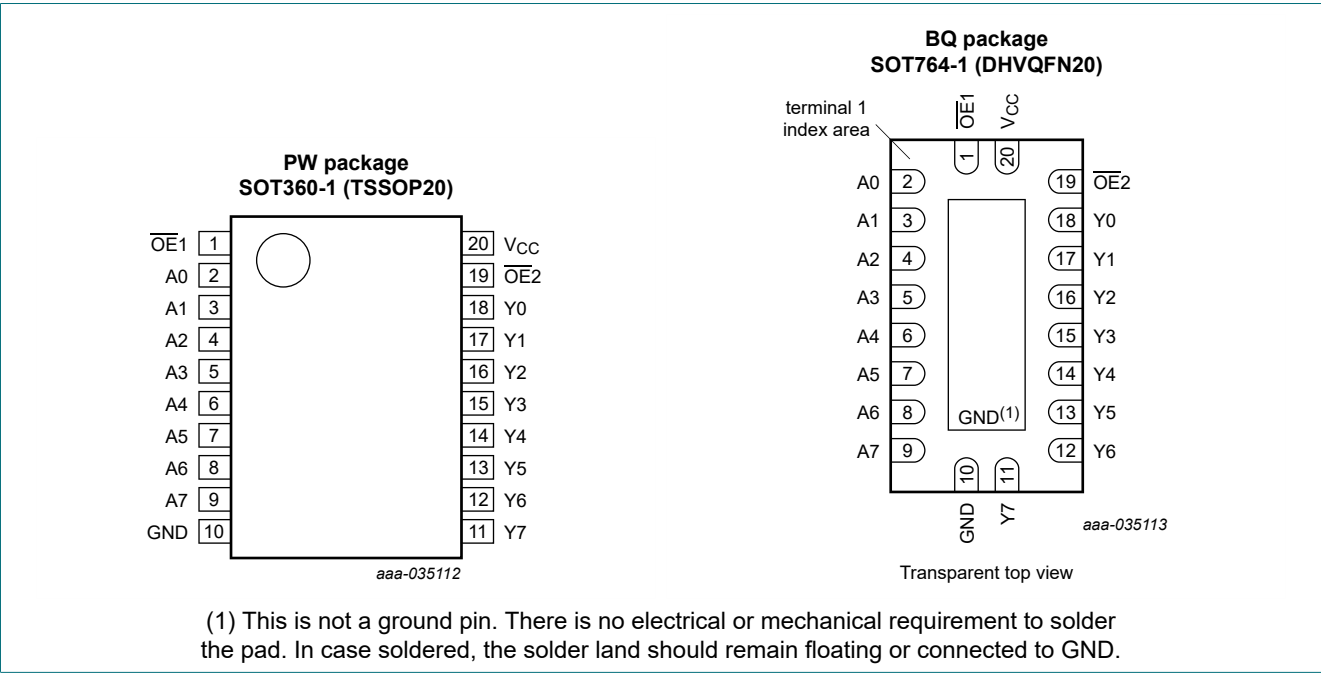
Type number	Package			
	Temperature range	Name	Description	Version
74AHCV541APW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74AHCV541ABQ	-40 °C to +125 °C	DHVQFN20	plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 × 4.5 × 0.85 mm	SOT764-1

4. Functional diagram



5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
OE1, OE2	1, 19	output enable input (active LOW)
A0, A1, A2, A3, A4, A5, A6, A7	2, 3, 4, 5, 6, 7, 8, 9	data input
GND	10	ground (0 V)
Y0, Y1, Y2, Y3, Y4, Y5, Y6, Y7	18, 17, 16, 15, 14, 13, 12, 11	data output
V _{CC}	20	supply voltage

6. Functional description

Table 3. Functional table

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

Control		Input	Output
OE1	OE2	A _n	Y _n
L	L	L	L
L	L	H	H
X	H	X	Z
H	X	X	Z

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		-0.5	+7.0	V
V _I	input voltage	[1]	-0.5	+7.0	V
V _O	output voltage	active mode [2][3]	-0.5	V _{CC} + 0.5	V
		power-down or 3-state mode [2]	-0.5	+7.0	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 _{CC}	-	±50	mA
I _{CC}	supply current		-	100	mA
I _{GND}	ground current		-100	-	mA
T _{stg}	storage temperature		-65	+150	°C
P _{tot}	total power dissipation	T _{amb} = -40 °C to +125 °C [4]	-	500	mW

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

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

[3] This value is limited to 7.0 V maximum.

[4] For SOT360-1 (TSSOP20) package: P_{tot} derates linearly with 10.0 mW/K above 100 °C.

For SOT764-1 (DHVQFN20) package: P_{tot} derates linearly with 12.9 mW/K above 111 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		1.8	5.5	V
V_I	input voltage		0	5.5	V
V_O	output voltage	active mode	0	V_{CC}	V
		power-down or 3-state mode	0	5.5	V
T_{amb}	ambient temperature		-40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	-	50	ms/V
		$V_{CC} = 3.0 \text{ V to } 3.6 \text{ V}$	-	20	ms/V
		$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	-	1	ms/V

9. Static characteristics

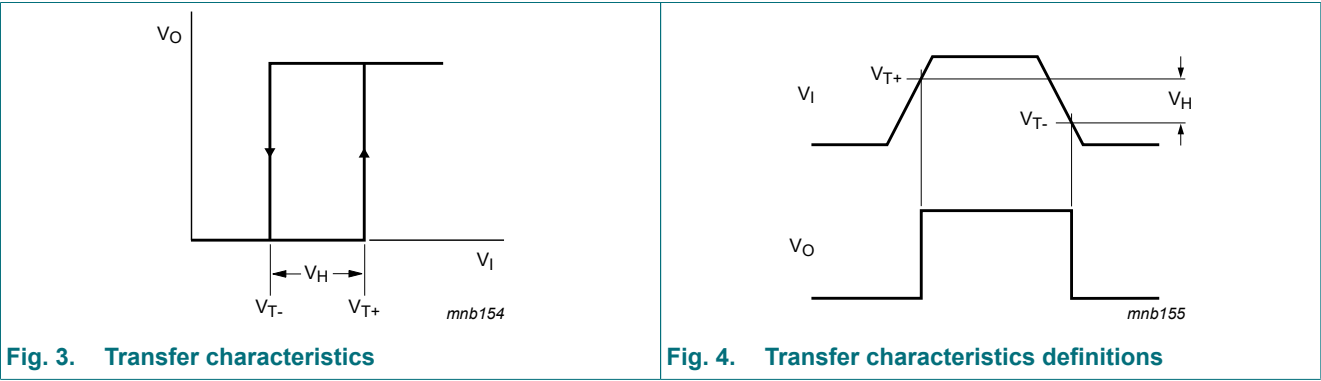
Table 6. Static characteristics

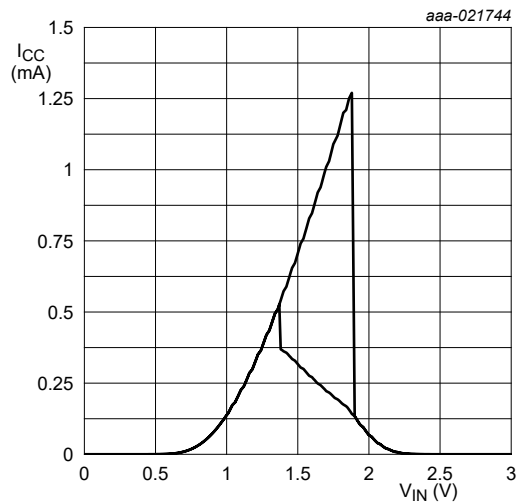
Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V_{T+}	positive-going threshold voltage	$V_{CC} = 1.8 \text{ V}$	-	-	1.65	-	1.65	-	1.65	V
		$V_{CC} = 2.3 \text{ V}$	-	-	1.85	-	1.85	-	1.85	V
		$V_{CC} = 3.0 \text{ V}$	-	-	2.2	-	2.2	-	2.2	V
		$V_{CC} = 4.5 \text{ V}$	-	-	3.15	-	3.15	-	3.15	V
		$V_{CC} = 5.5 \text{ V}$	-	-	3.85	-	3.85	-	3.85	V
V_{T-}	negative-going threshold voltage	$V_{CC} = 1.8 \text{ V}$	0.15	-	-	0.15	-	0.15	-	V
		$V_{CC} = 2.3 \text{ V}$	0.45	-	-	0.45	-	0.45	-	V
		$V_{CC} = 3.0 \text{ V}$	0.9	-	-	0.9	-	0.9	-	V
		$V_{CC} = 4.5 \text{ V}$	1.35	-	-	1.35	-	1.35	-	V
		$V_{CC} = 5.5 \text{ V}$	1.65	-	-	1.65	-	1.65	-	V
V_H	hysteresis voltage	$V_{CC} = 1.8 \text{ V}$	0.15	-	1.05	0.15	1.05	0.15	1.05	V
		$V_{CC} = 2.3 \text{ V}$	0.2	-	1.1	0.2	1.1	0.2	1.1	V
		$V_{CC} = 3.0 \text{ V}$	0.3	-	1.2	0.3	1.2	0.3	1.2	V
		$V_{CC} = 4.5 \text{ V}$	0.4	-	1.4	0.4	1.4	0.4	1.4	V
		$V_{CC} = 5.5 \text{ V}$	0.5	-	1.6	0.5	1.6	0.5	1.6	V
V_{OH}	HIGH-level output voltage	$V_I = V_{T+} \text{ or } V_{T-}$								V
		$I_O = -50 \mu\text{A}; V_{CC} = 1.8 \text{ V}$	1.7	1.8	-	1.7	-	1.7	-	V
		$I_O = -50 \mu\text{A}; V_{CC} = 3.0 \text{ V}$	2.9	3.0	-	2.9	-	2.9	-	V
		$I_O = -50 \mu\text{A}; V_{CC} = 4.5 \text{ V}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_O = -8 \text{ mA}; V_{CC} = 3.0 \text{ V}$	2.58	-	-	2.48	-	2.48	-	V
		$I_O = -16 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.94	-	-	3.80	-	3.80	-	V

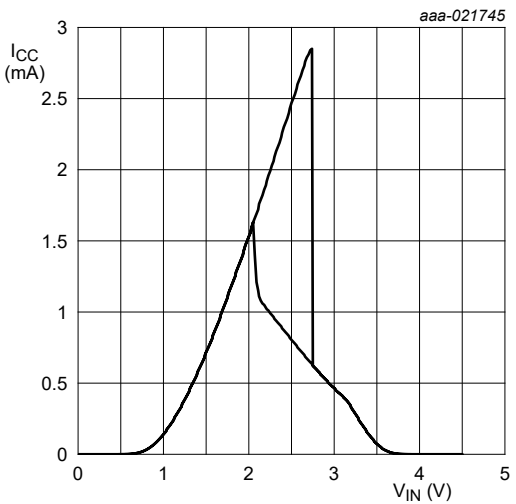
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
V _{OL}	LOW-level output voltage	V _I = V _{T+} or V _{T-}								
		I _O = 50 µA; V _{CC} = 1.8 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 µA; V _{CC} = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 50 µA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 8 mA; V _{CC} = 3.0 V	-	-	0.36	-	0.44	-	0.44	V
		I _O = 16 mA; V _{CC} = 4.5 V	-	-	0.44	-	0.55	-	0.55	V
I _{OZ}	OFF-state output current	V _{CC} = 1.8 V to 5.5 V; V _I = V _{IH} or V _{IL} ; V _O = GND to 5.5 V	-	-	±0.25	-	±2.5	-	±2.5	µA
I _{OFF}	power-off leakage current	V _I or V _O = GND to 5.5 V; V _{CC} = 0 V	-	-	0.5	-	5	-	5	µA
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 0 V to 5.5 V	-	-	±0.1	-	±1	-	±1	µA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V	-	-	2	-	20	-	20	µA

9.1. Transfer characteristics waveforms

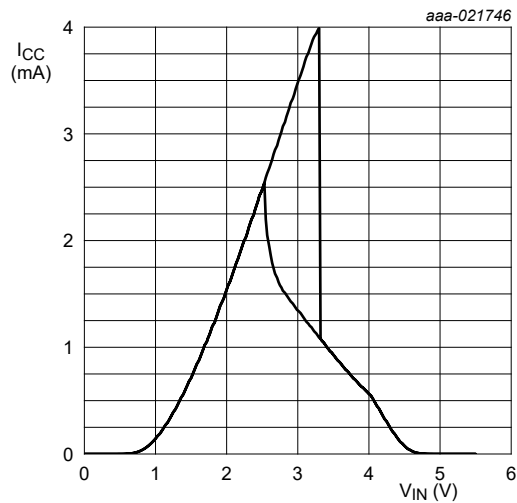




a. $V_{CC} = 3.0$ V



b. $V_{CC} = 4.5$ V



c. $V_{CC} = 5.5$ V

Fig. 5. Typical transfer characteristics

10. Dynamic characteristics

Table 7. Dynamic characteristics

$GND = 0\text{ V}$. For test circuit see Fig. 8.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
t_{pd}	propagation delay	An to Yn; see Fig. 6 [2]								
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$								
		$C_L = 15\text{ pF}$	-	5.1	11.3	1	13.5	1	13.5	ns
		$C_L = 50\text{ pF}$	-	7.0	15.9	1	18.5	1	18.5	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$								
		$C_L = 15\text{ pF}$	-	3.9	7	1	8.5	1	8.5	ns
		$C_L = 50\text{ pF}$	-	5.4	10.5	1	12	1	12	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$								
		$C_L = 15\text{ pF}$	-	3.0	5	1	6	1	6	ns
		$C_L = 50\text{ pF}$	-	4.2	7	1	8	1	8	ns
t_{en}	enable time	OEn to Yn; see Fig. 7 [2]								
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$								
		$C_L = 15\text{ pF}$	-	5.9	17.4	1	21	1	21	ns
		$C_L = 50\text{ pF}$	-	7.9	22.2	1	25.5	1	25.5	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$								
		$C_L = 15\text{ pF}$	-	4.4	10.5	1	12.5	1	12.5	ns
		$C_L = 50\text{ pF}$	-	6.0	14	1	16	1	16	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$								
		$C_L = 15\text{ pF}$	-	3.2	7.2	1	8.5	1	8.5	ns
		$C_L = 50\text{ pF}$	-	4.5	9.2	1	10.5	1	10.5	ns
t_{dis}	disable time	OEn to Yn; see Fig. 7 [2]								
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$								
		$C_L = 15\text{ pF}$	-	6.7	17.8	1	21	1	21	ns
		$C_L = 50\text{ pF}$	-	11.2	22.3	1	25.5	1	25.5	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$								
		$C_L = 15\text{ pF}$	-	5.4	11.9	1	14	1	14	ns
		$C_L = 50\text{ pF}$	-	8.8	15.4	1	17.5	1	17.5	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$								
		$C_L = 15\text{ pF}$	-	4.3	8.5	1	9.5	1	9.5	ns
		$C_L = 50\text{ pF}$	-	6.5	10.5	1	11.5	1	11.5	ns
$t_{sk(o)}$	skew	$C_L = 50\text{ pF}$								
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	-	2	-	2	-	2	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	-	1.5	-	1.5	-	1.5	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	1	-	1	-	1	ns

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
C _I	input capacitance	V _I = V _{CC} or GND; V _{CC} = 3.3 V	-	2	6	-	6	-	6	pF
C _O	output capacitance	V _O = V _{CC} or GND; V _{CC} = 3.3 V	-	5	-	-	-	-	-	pF
C _{PD}	power dissipation capacitance	per buffer; C _L = 0 pF; f = 10 MHz; V _{CC} = 5 V; V _I = GND to V _{CC}	-	15	-	-	-	-	-	pF

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 2.5 V, 3.3 V, and 5 V respectively, unless otherwise specified.

[2] 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}.

[3] C_{PD} is used to determine the dynamic power dissipation P_D (μW).

$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$ where:

f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in V.

Table 8. Noise characteristics

GND = 0 V. For test circuit see Fig. 8.

Symbol	Parameter	Conditions	T _{amb} = 25 °C			Unit
			Min	Typ	Max	
V _{CC} = 3.3 V; C _L = 50 pF						
V _{OL(p)}	LOW-level output voltage (peak)		-	0.3	0.8	V
V _{OL(v)}	LOW-level output voltage (valley)		-0.8	-0.2	-	V
V _{OH(v)}	HIGH-level output voltage (valley)		-	2.9	-	V
V _{IH(AC)}	AC HIGH-level input voltage		2.31	-	-	V
V _{IL(AC)}	AC LOW-level input voltage		-	-	0.99	V
V _{CC} = 5.0 V; C _L = 50 pF						
V _{OL(p)}	LOW-level output voltage (peak)		-	0.6	1.5	V
V _{OL(v)}	LOW-level output voltage (valley)		-1.5	-0.6	-	V
V _{OH(v)}	HIGH-level output voltage (valley)		-	4.0	-	V
V _{IH(AC)}	AC HIGH-level input voltage		3.5	-	-	V
V _{IL(AC)}	AC LOW-level input voltage		-	-	1.5	V

10.1. Waveforms and test circuit

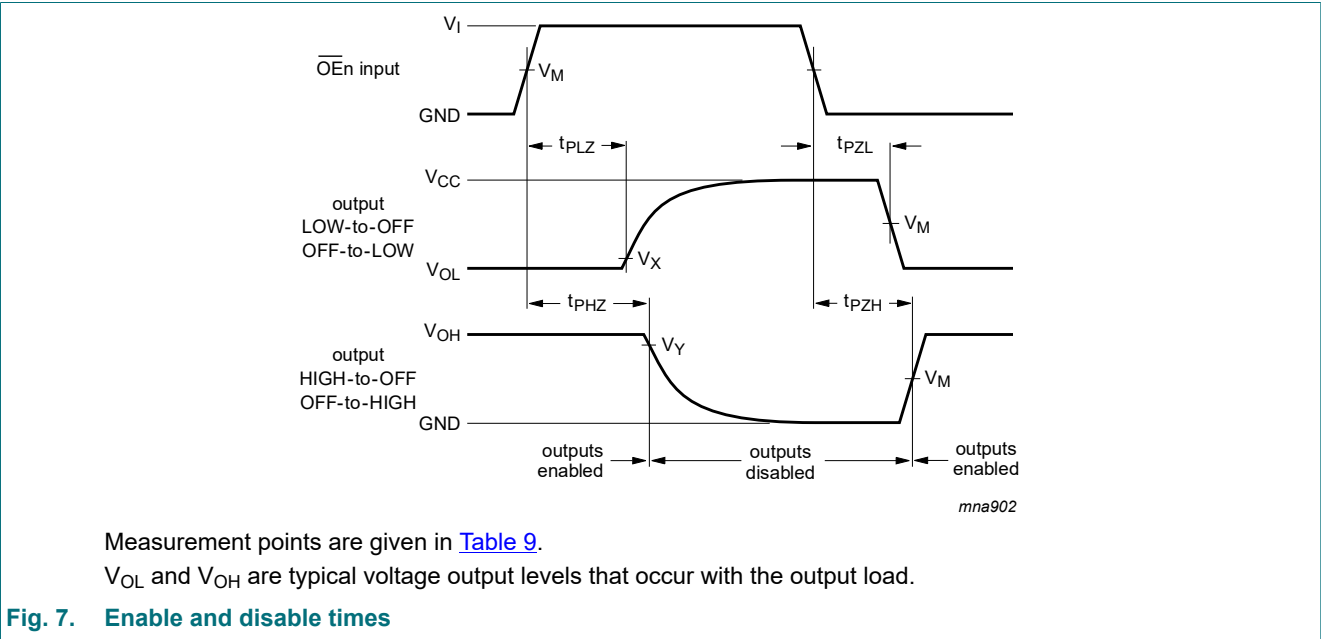
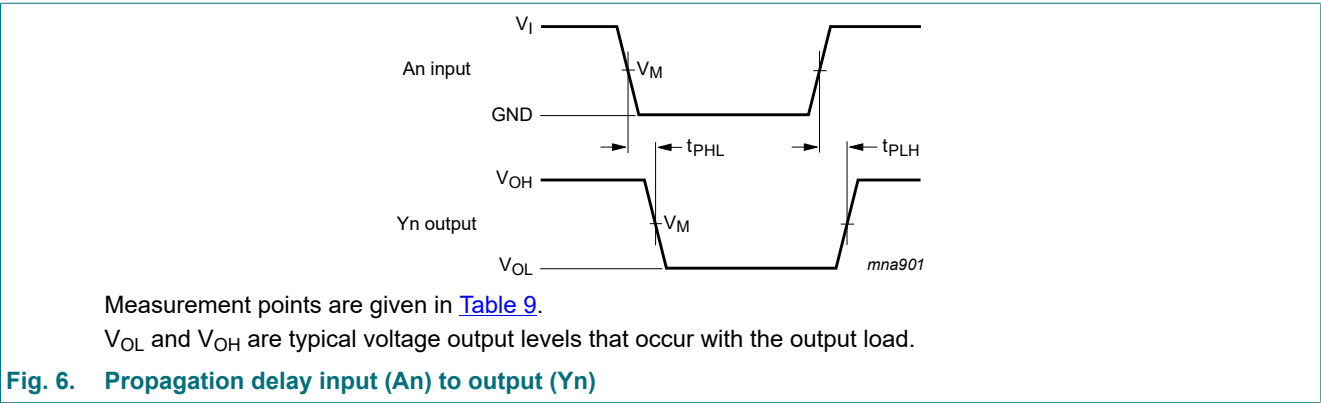


Table 9. Measurement points

Input	Output		
V_M	V_M	V_X	V_Y
$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$

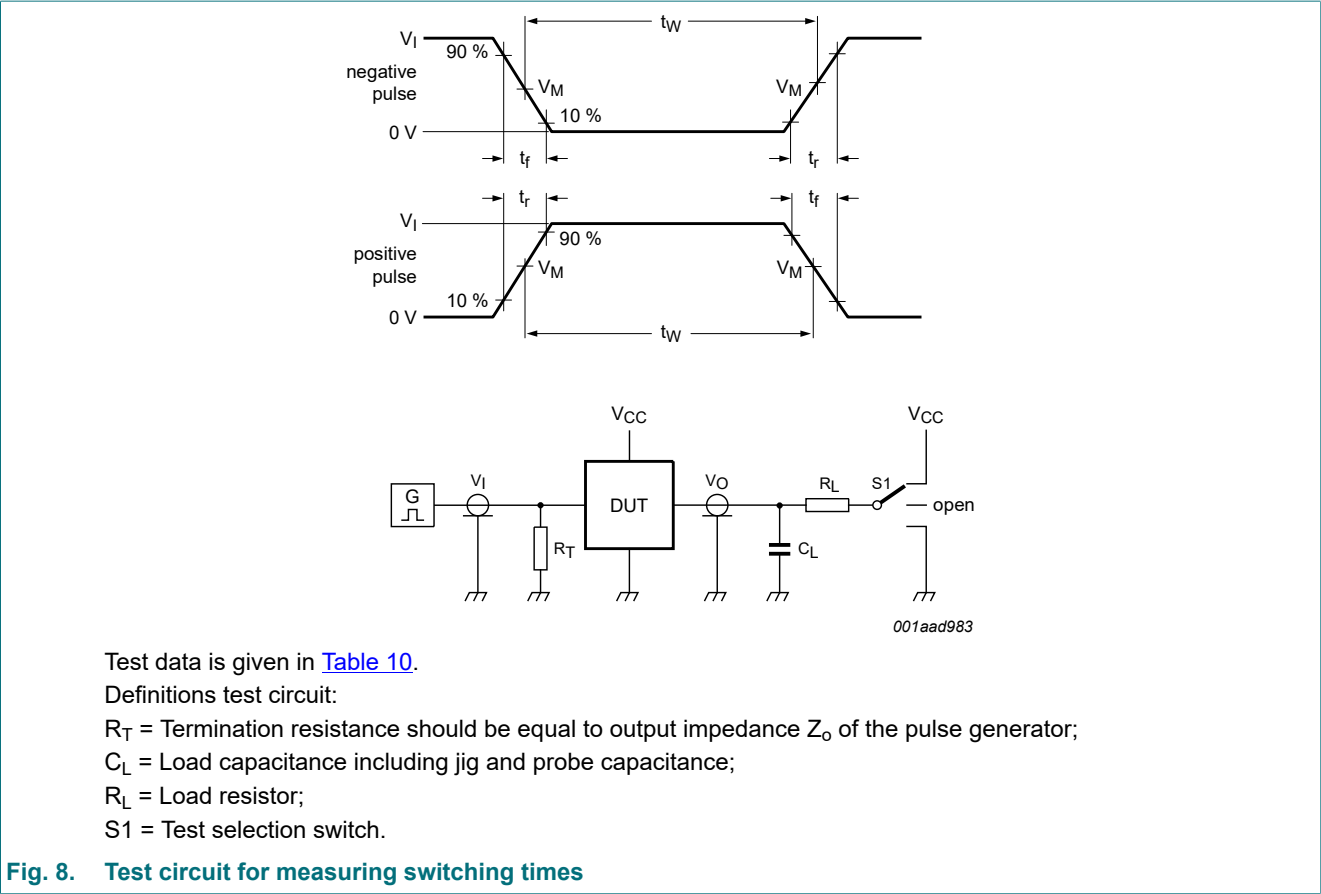


Table 10. Test data

Input		Load		S1 position		
V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
GND to V_{CC}	3.0 ns	15 pF, 50 pF	1 k Ω	open	GND	V_{CC}

11. Package outline

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1

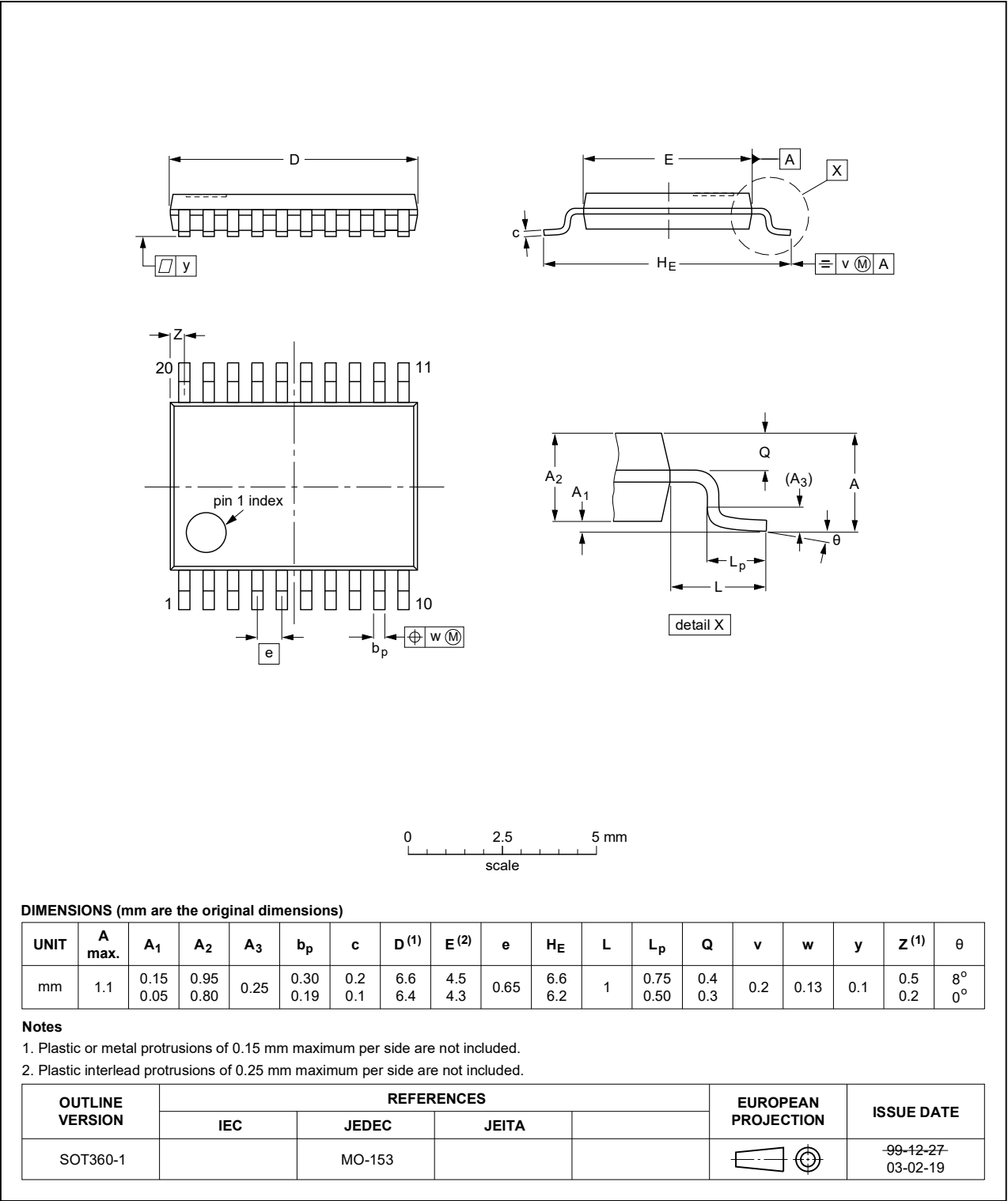


Fig. 9. Package outline SOT360-1 (TSSOP20)

DHVQFN20: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads;
20 terminals; body 2.5 x 4.5 x 0.85 mm

SOT764-1

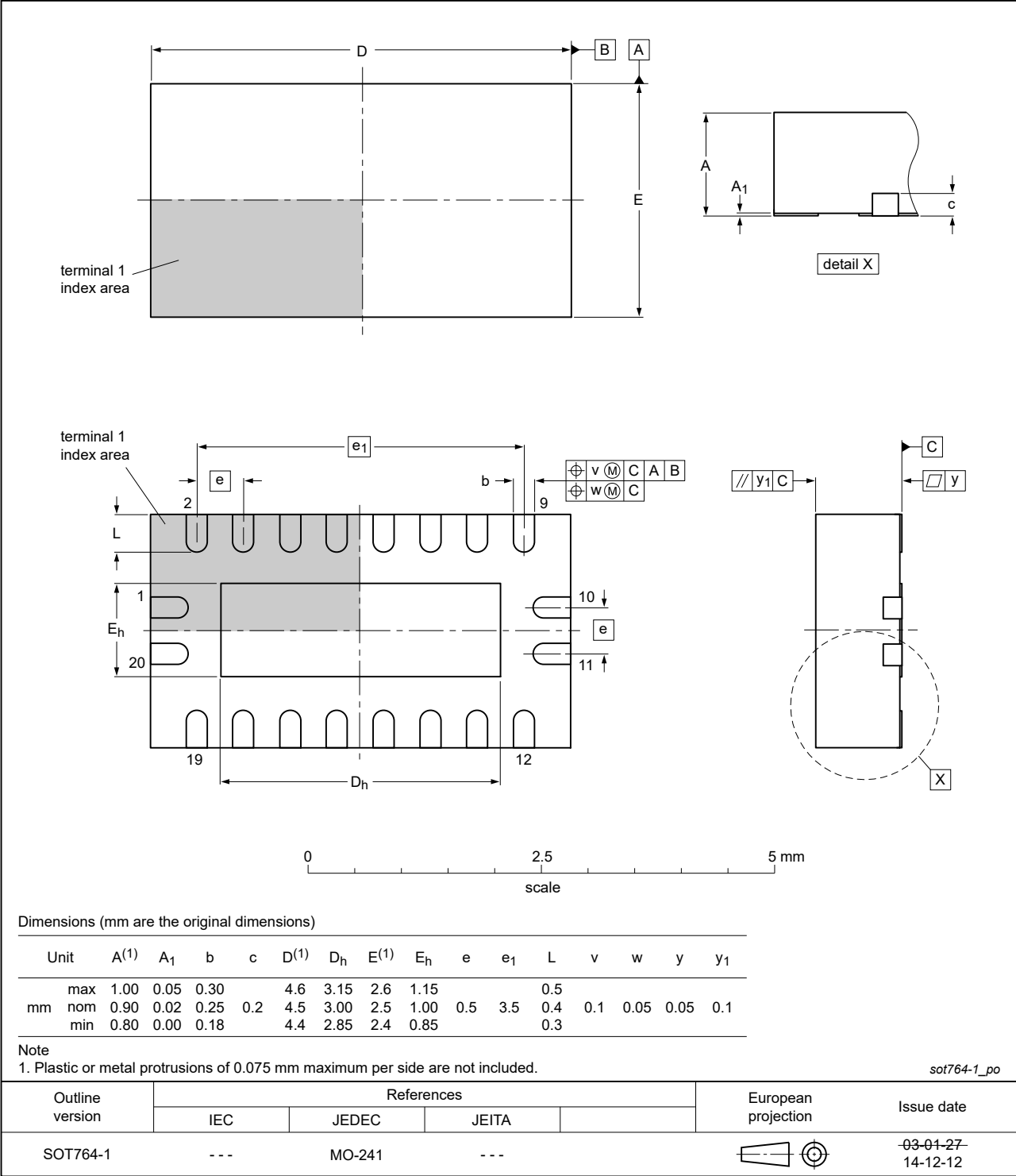


Fig. 10. Package outline SOT764-1 (DHVQFN20)

12. Abbreviations

Table 11. Abbreviations

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

13. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHCV541A v.7	20230925	Product data sheet	-	74AHCV541A v.6
Modifications:	- The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. - Legal texts have been adapted to the new company name where appropriate. Section 2: ESD specification updated according to the latest JEDEC standard. Table 4: Derating values for P_{tot} total power dissipation updated.			
74AHCV541A v.6	20161215	Product data sheet	-	74AHCV541A v.5
Modifications:	Added type number 74AHCV541ABQ (SOT764-1)			
74AHCV541A v.5	20161107	Product data sheet	-	74AHCV541A v.4
Modifications:	Type number 74AHCV541AD removed.			
74AHCV541A v.4	20160420	Product data sheet	-	74AHCV541A v.3
Modifications:	Fig. 1 updated.			
74AHCV541A v.3	20160224	Product data sheet	-	74AHCV541A v.2
Modifications:	Table 7: C_{PD} value corrected (errata).			
74AHCV541A v.2	20160126	Product data sheet	-	74AHCV541A v.1
Modifications:	Table 7: conditions C_{PD} corrected (errata). Fig. 5 updated.			
74AHCV541A v.1	20151223	Product data sheet	-	-

14. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at <https://www.nexperia.com>.

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Contents

1. General description	1
2. Features and benefits	1
3. Ordering information	1
4. Functional diagram	2
5. Pinning information	2
5.1. Pinning	2
5.2. Pin description	3
6. Functional description	3
7. Limiting values	3
8. Recommended operating conditions	4
9. Static characteristics	4
9.1. Transfer characteristics waveforms	5
10. Dynamic characteristics	7
10.1. Waveforms and test circuit	9
11. Package outline	11
12. Abbreviations	13
13. Revision history	13
14. Legal information	14

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