

74HC299

8-bit universal shift register; 3-state

Rev. 5 — 17 January 2019

Product data sheet

1. General description

The 74HC299 is an 8-bit universal shift register with 3-state outputs. It contains eight edge-triggered D-type flip-flops and the interstage logic necessary to perform synchronous shift-right, shift-left, parallel load and hold operations. The type of operation is determined by the mode select inputs S0 and S1. Pins I/O0 to I/O7 are flip-flop 3-state buffer outputs which allow them to operate as data inputs in parallel load mode. The serial outputs Q0 and Q7 are used for expansion in serial shifting of longer words. A LOW signal on the asynchronous master reset input \overline{MR} overrides the Sn and clock CP inputs and resets the flip-flops. All other state changes are initiated by the rising edge of the clock pulse. Inputs can change when the clock is either state, provided that the recommended set-up and hold times are observed. A HIGH signal on the 3-state output enable inputs $\overline{OE}1$ or $\overline{OE}2$ disables the 3-state buffers and the I/O outputs assume a high-impedance OFF-state. In this condition, the shift, hold, load and reset operations can still occur. The 3-state buffers are also disabled by HIGH signals on both S0 and S1, when in preparation for a parallel load operation. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

2. Features and benefits

- CMOS input levels
- Multiplexed inputs/outputs provide improved bit density
- Four operating modes:
 - Shift left
 - Shift right
 - Hold (store)
 - Load data
- Operates with output enable or at high-impedance OFF-state
- 3-state outputs drive bus lines directly
- Cascadable for n-bit word lengths
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 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			Version
	Temperature range	Name	Description	
74HC299D	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74HC299DB	-40 °C to +125 °C	SSOP20	plastic shrink small outline package; 20 leads; body width 5.3 mm	SOT339-1

4. Functional diagram

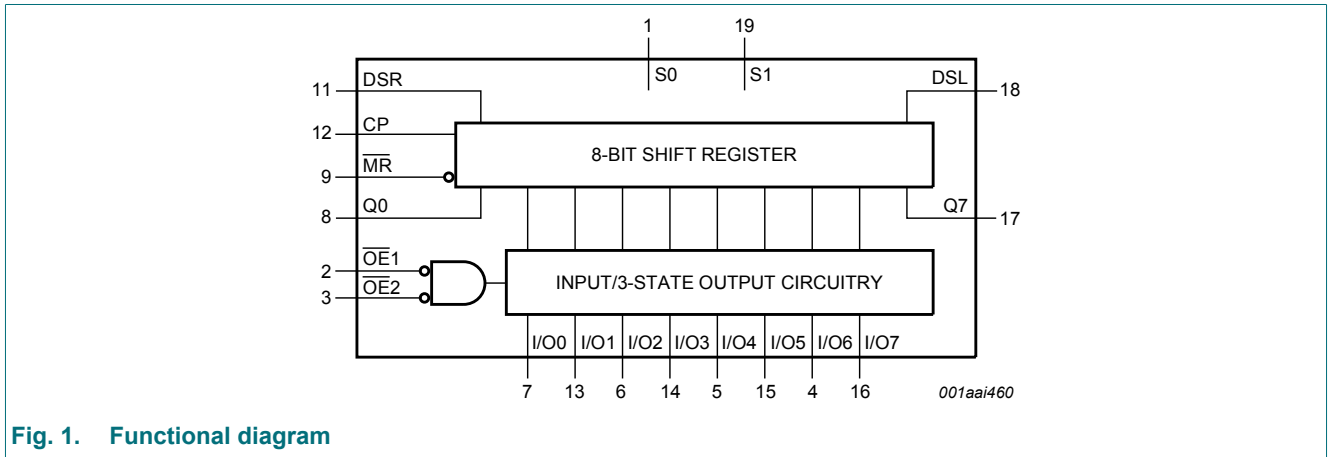


Fig. 1. Functional diagram

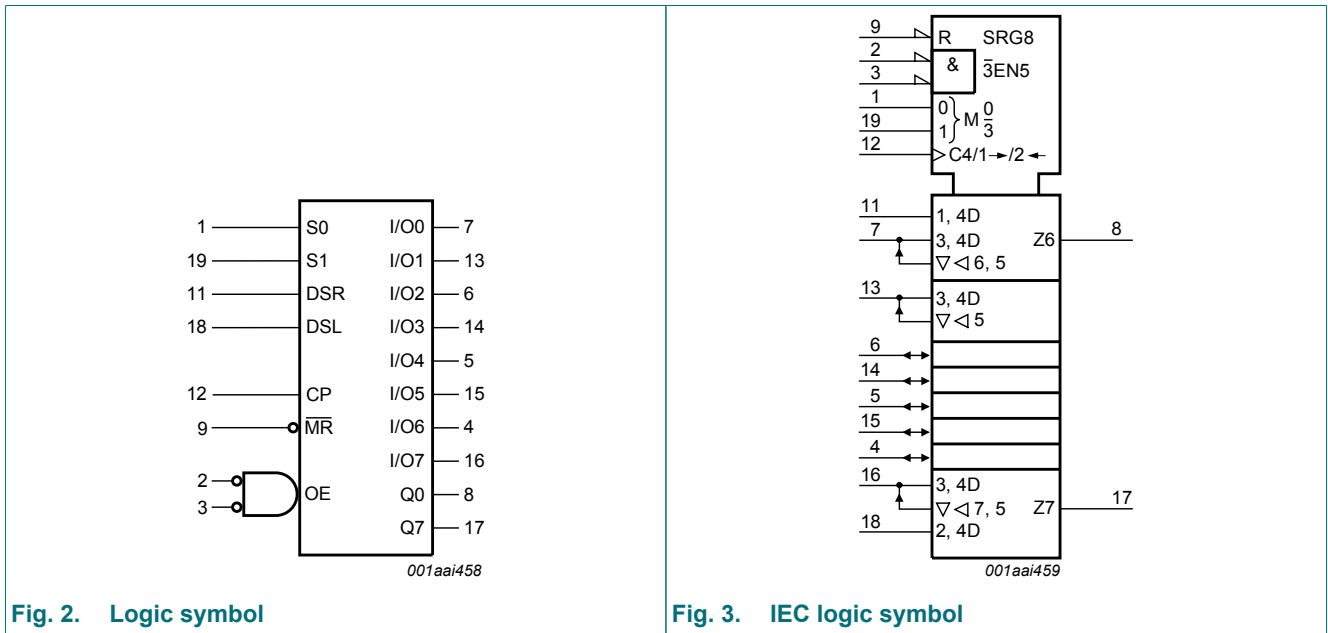


Fig. 2. Logic symbol

Fig. 3. IEC logic symbol

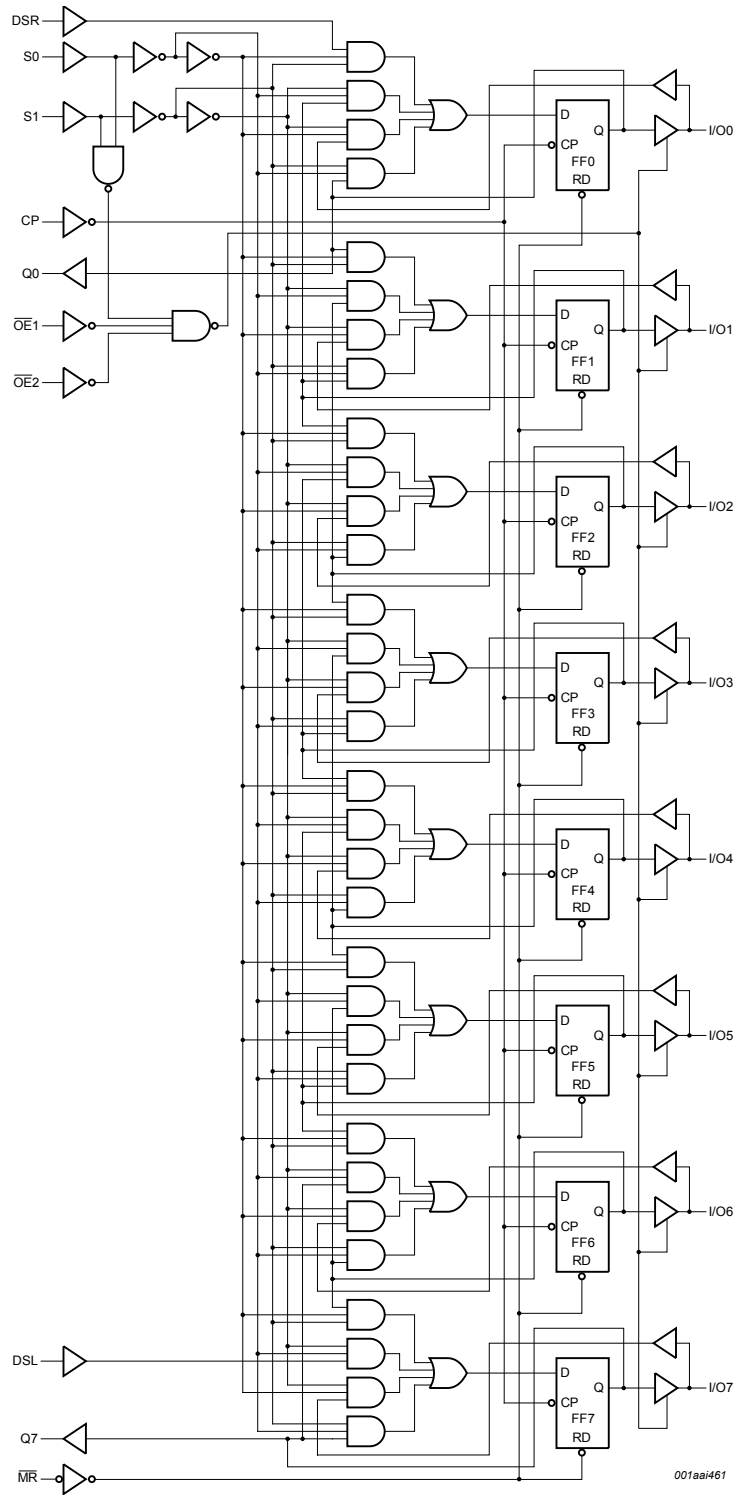


Fig. 4. Logic diagram

5. Pinning information

5.1. Pinning

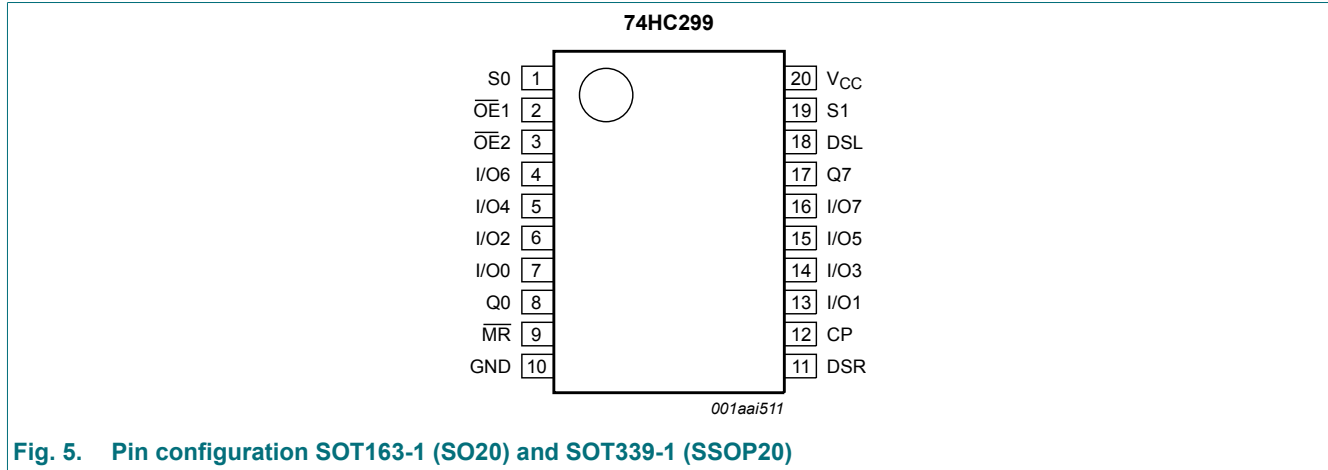


Fig. 5. Pin configuration SOT163-1 (SO20) and SOT339-1 (SSOP20)

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
S0, S1	1, 19	mode select input
$\overline{OE}1$, $\overline{OE}2$	2, 3	3-state output enable input (active LOW)
I/O0, I/O1, I/O2, I/O3, I/O4, I/O5, I/O6, I/O7	7, 13, 6, 14, 5, 15, 4, 16	parallel data input or 3-state parallel output (bus driver)
Q0, Q7	8, 17	serial output (standard output)
\overline{MR}	9	asynchronous master reset input (active LOW)
GND	10	ground (0 V)
DSR	11	serial data shift-right input
CP	12	clock input (LOW to HIGH, edge-triggered)
DSL	18	serial data shift-left input
V _{CC}	20	positive supply voltage

6. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; \uparrow = LOW to HIGH CP transition; X = don't care.

Input				Response
\overline{MR}	S1	S0	CP	
L	X	X	X	asynchronous reset; Q0 to Q7 = LOW
H	H	H	\uparrow	parallel load; I/On \rightarrow Qn
H	L	H	\uparrow	shift right; DSR \rightarrow Q0, Q0 \rightarrow Q1, etc.
H	H	L	\uparrow	shift left; DSL \rightarrow Q7, Q7 \rightarrow Q6, etc.
H	L	L	X	hold

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	V
I_{IK}	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$ [1]	-	± 20	mA
I_{OK}	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1]	-	± 20	mA
I_O	output current	$-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$			
		standard outputs	-	± 25	mA
		bus driver outputs	-	± 35	mA
I_{CC}	supply current	standard outputs	-	50	mA
		bus driver outputs	-	70	mA
I_{GND}	ground current	standard outputs	-50	-	mA
		bus driver outputs	-70	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$			
		SO20 package [2]	-	500	mW
		SSOP20 package [3]	-	500	mW

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

[2] P_{tot} derates linearly at 8 mW/K above 70 °C.

[3] P_{tot} derates linearly at 5.5 mW/K above 60 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		2.0	5.0	6.0	V
V_I	input voltage		0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.0\text{ V}$	-	-	625	ns/V
		$V_{CC} = 4.5\text{ V}$	-	1.67	139	ns/V
		$V_{CC} = 6.0\text{ V}$	-	-	83	ns/V

9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions; 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 _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
		V _{CC} = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V _{CC} = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
		V _{CC} = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		V _{CC} = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}								
		all outputs								
		I _O = -20 μA; V _{CC} = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I _O = -20 μA; V _{CC} = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I _O = -20 μA; V _{CC} = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		standard outputs								
		I _O = -4.0 mA; V _{CC} = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
		I _O = -5.2 mA; V _{CC} = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V
		bus driver outputs								
		I _O = -6.0 mA; V _{CC} = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
I _O = -7.8 mA; V _{CC} = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	V		
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}								
		all outputs								
		I _O = 20 μA; V _{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 20 μA; V _{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I _O = 20 μA; V _{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		standard outputs								
		I _O = 4.0 mA; V _{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I _O = 5.2 mA; V _{CC} = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
		bus driver outputs								
		I _O = 6.0 mA; V _{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
I _O = 7.8 mA; V _{CC} = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V		
I _I	input leakage current	V _I = V _{CC} or GND; V _{CC} = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I _{OZ}	OFF-state output current	V _I = V _{IH} or V _{IL} ; V _{CC} = 6.0 V; V _O = V _{CC} or GND	-	-	±0.5	-	±5.0	-	±10.0	μA
I _{CC}	supply current	V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	-	8.0	-	80	-	160	μA
C _I	input capacitance		-	3.5	-	-	-	-	-	pF
C _{I/O}	input/output capacitance		-	10	-	-	-	-	-	pF

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
C _{PD}	power dissipation capacitance	V _I = GND to V _{CC} [1]	-	120	-	-	-	-	-	pF

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

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

∑(C_L × V_{CC}² × f_o) = sum of outputs.

C_L = output load capacitance in pF;

V_{CC} = supply voltage in V.

10. Dynamic characteristics

Table 7. Dynamic characteristics

GND (ground = 0 V); for test circuit, see Fig. 10.

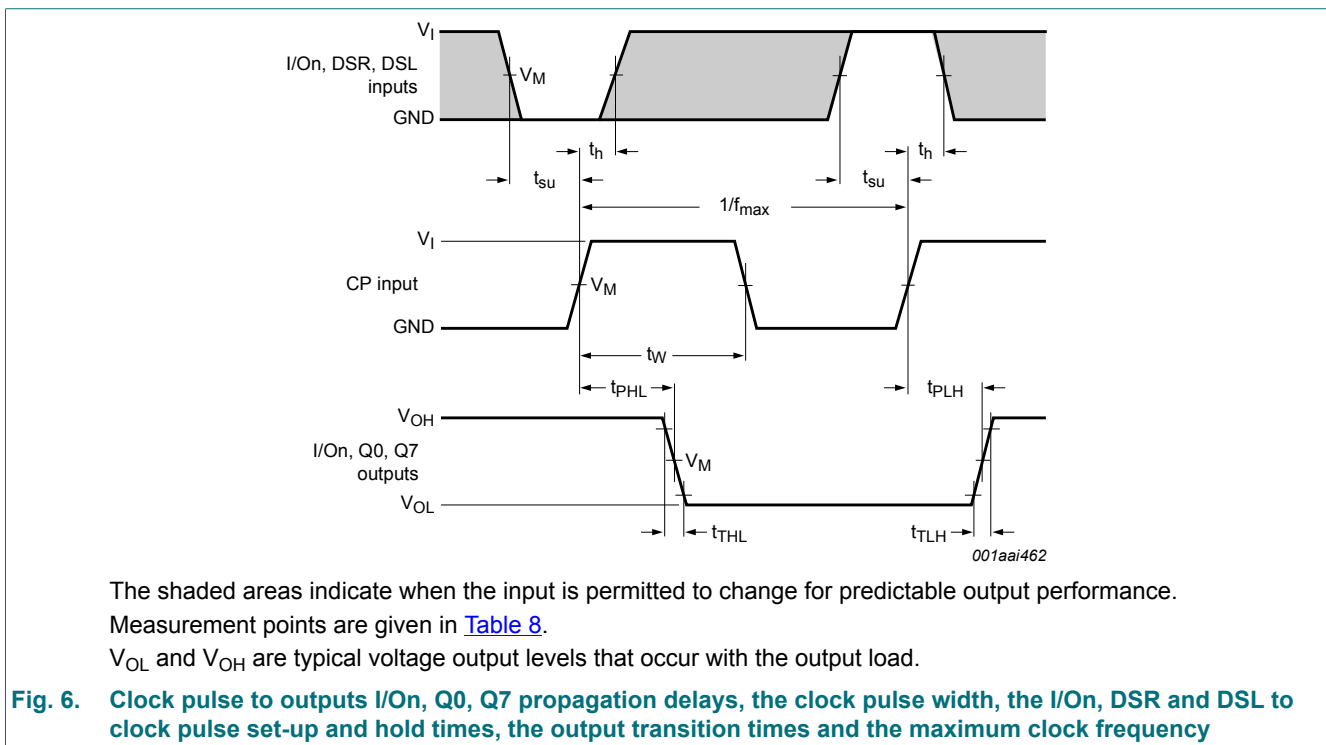
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t _{pd}	propagation delay	CP to Q0, Q7; see Fig. 6 [1]								
		V _{CC} = 2.0 V	-	66	200	-	250	-	300	ns
		V _{CC} = 4.5 V	-	24	40	-	50	-	60	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	20	-	-	-	-	-	ns
		V _{CC} = 6.0 V	-	19	34	-	43	-	51	ns
		CP to I/On; see Fig. 6								
		V _{CC} = 2.0 V	-	66	200	-	250	-	300	ns
		V _{CC} = 4.5 V	-	24	40	-	50	-	60	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	20	-	-	-	-	-	ns
		V _{CC} = 6.0 V	-	19	34	-	43	-	51	ns
		MR to Q0, Q7 or I/On; see Fig. 7 [2]								
		V _{CC} = 2.0 V	-	66	200	-	250	-	300	ns
		V _{CC} = 4.5 V	-	24	40	-	50	-	60	ns
		V _{CC} = 5.0 V; C _L = 15 pF	-	20	-	-	-	-	-	ns
V _{CC} = 6.0 V	-	19	34	-	43	-	51	ns		
t _t	transition time	bus driver (I/On); see Fig. 6 [3]								
		V _{CC} = 2.0 V	-	14	60	-	75	-	90	ns
		V _{CC} = 4.5 V	-	5	12	-	15	-	18	ns
		V _{CC} = 6.0 V	-	4	10	-	13	-	15	ns
		standard (Q0, Q7); see Fig. 6								
		V _{CC} = 2.0 V	-	19	75	-	95	-	110	ns
		V _{CC} = 4.5 V	-	7	15	-	19	-	22	ns
V _{CC} = 6.0 V	-	6	13	-	16	-	19	ns		

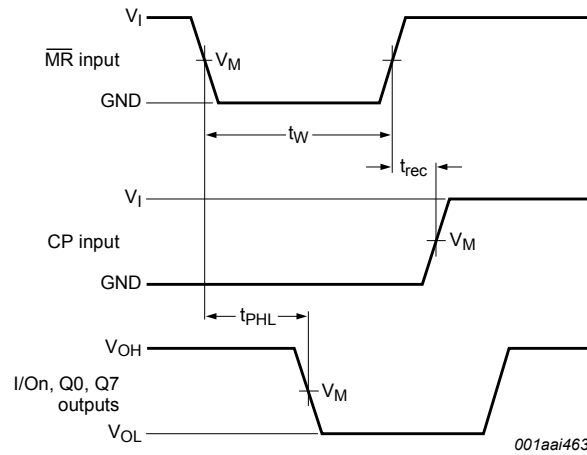
Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t _w	pulse width	CP HIGH or LOW; see Fig. 6								
		V _{CC} = 2.0 V	80	17	-	100	-	120	-	ns
		V _{CC} = 4.5 V	16	6	-	20	-	24	-	ns
		V _{CC} = 6.0 V	14	5	-	17	-	20	-	ns
		MR LOW; see Fig. 7								
		V _{CC} = 2.0 V	80	19	-	100	-	120	-	ns
		V _{CC} = 4.5 V	16	7	-	20	-	24	-	ns
V _{CC} = 6.0 V	14	6	-	17	-	20	-	ns		
t _{PZH}	OFF-state to HIGH propagation delay	OE _n to I/On; see Fig. 9 [4]								
		V _{CC} = 2.0 V	-	50	155	-	195	-	235	ns
		V _{CC} = 4.5 V	-	18	31	-	39	-	47	ns
		V _{CC} = 6.0 V	-	14	26	-	33	-	40	ns
t _{PZL}	OFF-state to LOW propagation delay	OE _n to I/On; see Fig. 9								
		V _{CC} = 2.0 V	-	41	130	-	165	-	195	ns
		V _{CC} = 4.5 V	-	15	26	-	33	-	39	ns
		V _{CC} = 6.0 V	-	12	22	-	28	-	33	ns
t _{PHZ}	HIGH to OFF-state propagation delay	OE _n to I/On; see Fig. 9 [5]								
		V _{CC} = 2.0 V	-	66	185	-	230	-	280	ns
		V _{CC} = 4.5 V	-	24	37	-	46	-	56	ns
		V _{CC} = 6.0 V	-	19	31	-	39	-	48	ns
t _{PLZ}	LOW to OFF-state propagation delay	OE _n to I/On; see Fig. 9								
		V _{CC} = 2.0 V	-	55	155	-	195	-	235	ns
		V _{CC} = 4.5 V	-	20	31	-	39	-	47	ns
		V _{CC} = 6.0 V	-	16	26	-	33	-	40	ns
t _{rec}	recovery time	MR to CP; see Fig. 7								
		V _{CC} = 2.0 V	5	-14	-	5	-	5	-	ns
		V _{CC} = 4.5 V	5	-5	-	5	-	5	-	ns
		V _{CC} = 6.0 V	5	-4	-	5	-	5	-	ns
t _{su}	set-up time	DSR, DSL to CP; see Fig. 6								
		V _{CC} = 2.0 V	100	33	-	125	-	150	-	ns
		V _{CC} = 4.5 V	20	12	-	25	-	30	-	ns
		V _{CC} = 6.0 V	17	10	-	21	-	26	-	ns
		S0, S1 to CP; see Fig. 8								
		V _{CC} = 2.0 V	100	33	-	125	-	150	-	ns
		V _{CC} = 4.5 V	20	12	-	25	-	30	-	ns
		V _{CC} = 6.0 V	17	10	-	21	-	26	-	ns
		I/On to CP; see Fig. 6								
		V _{CC} = 2.0 V	125	39	-	155	-	190	-	ns
		V _{CC} = 4.5 V	25	14	-	31	-	38	-	ns
		V _{CC} = 6.0 V	21	11	-	26	-	32	-	ns

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t_h	hold time	I/On, DSR, DSL to CP; see Fig. 6								
		$V_{CC} = 2.0\text{ V}$	0	-14	-	0	-	0	-	ns
		$V_{CC} = 4.5\text{ V}$	0	-5	-	0	-	0	-	ns
		$V_{CC} = 6.0\text{ V}$	0	-4	-	0	-	0	-	ns
		S0, S1 to CP; see Fig. 8								
		$V_{CC} = 2.0\text{ V}$	0	-28	-	0	-	0	-	ns
		$V_{CC} = 4.5\text{ V}$	0	-10	-	0	-	0	-	ns
$V_{CC} = 6.0\text{ V}$	0	-8	-	0	-	0	-	ns		
f_{max}	maximum frequency	CP input; see Fig. 6								
		$V_{CC} = 2.0\text{ V}$	5.0	15	-	4.0	-	3.4	-	MHz
		$V_{CC} = 4.5\text{ V}$	25	45	-	20	-	17	-	MHz
		$V_{CC} = 5.0\text{ V}; C_L = 15\text{ pF}$	-	50	-	-	-	-	-	MHz
		$V_{CC} = 6.0\text{ V}$	29	54	-	24	-	20	-	MHz

- [1] t_{pd} is the same as t_{PHL} and t_{PLH} .
- [2] t_{pd} is the same as t_{PHL} .
- [3] t_t is the same as t_{THL} and t_{TLH} .
- [4] t_{en} is the same as t_{PZH} and t_{PZL} .
- [5] t_{dis} is the same as t_{PHZ} and t_{PLZ} .

10.1. Waveforms and test circuit

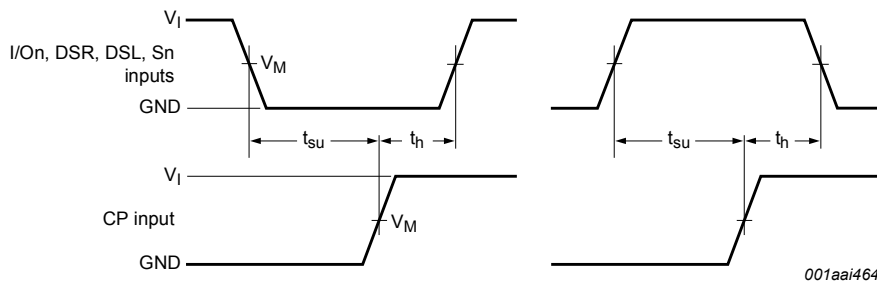




Measurement points are given in [Table 8](#).

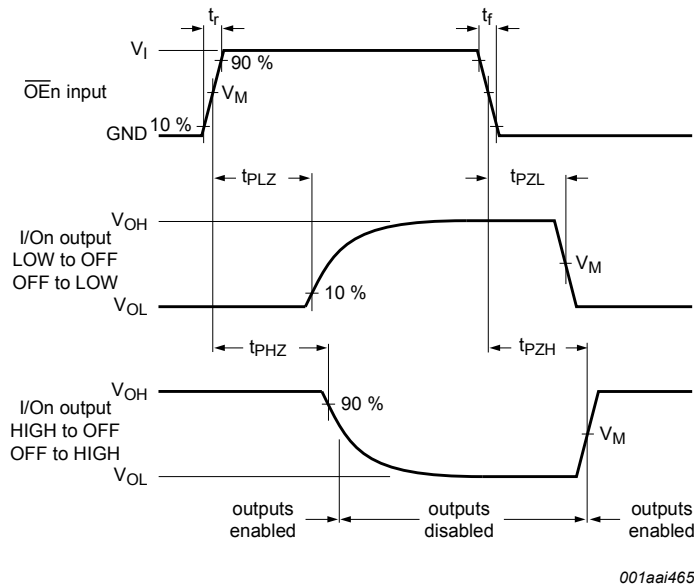
V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig. 7. The master reset pulse width (LOW), the master reset to outputs I/On, Q0, Q7 propagation delays and the master reset to clock pulse removal time



Measurement points are given in [Table 8](#).

Fig. 8. Set-up and hold times from the mode control inputs S0, S1 to the clock pulse



Measurement points are given in [Table 8](#).

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

Fig. 9. 3-state enable and disable times for \overline{OEn} inputs

Table 8. Measurement points

Input		Output
V_I	V_M	V_M
V_{CC}	$0.5V_{CC}$	$0.5V_{CC}$

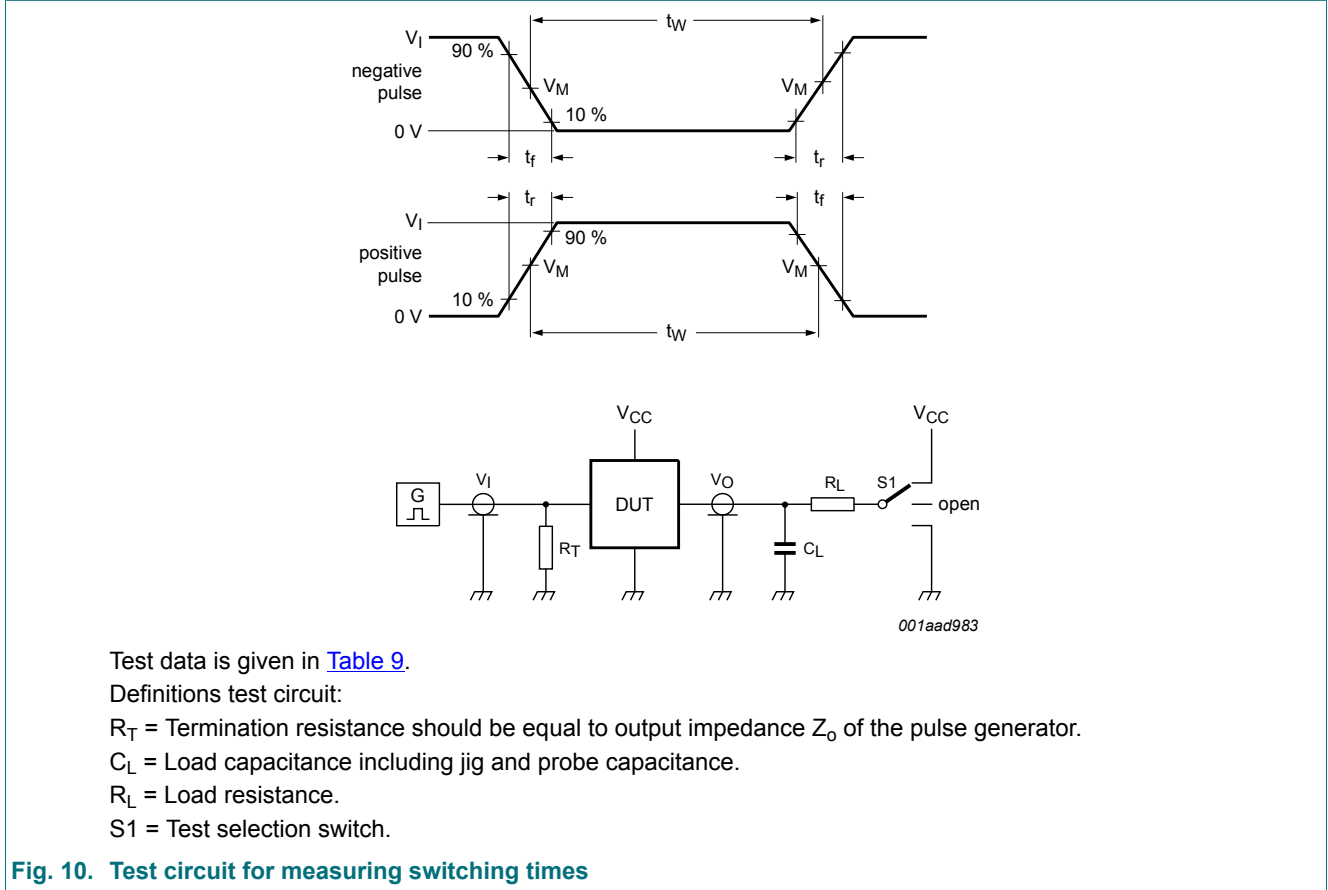


Fig. 10. Test circuit for measuring switching times

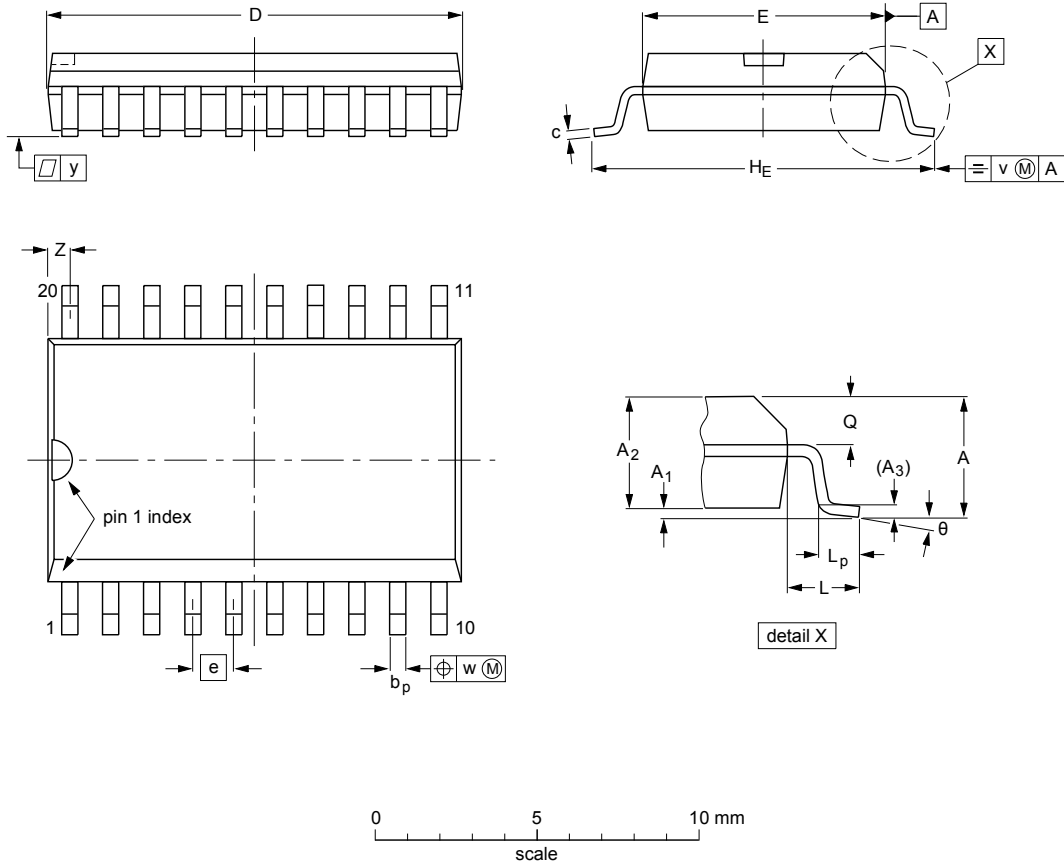
Table 9. Test data

Input		Load		S1 position
V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}
V_{CC}	6 ns	15 pF, 50 pF	1 kΩ	open

11. Package outline

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.1	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.05	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

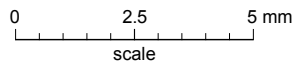
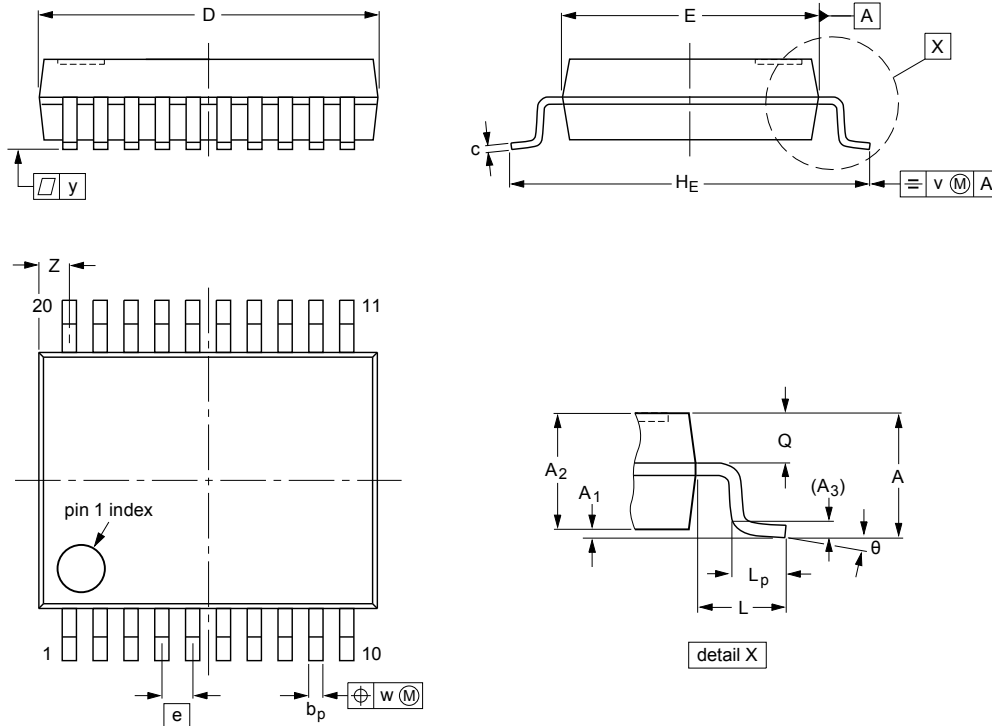
1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT163-1	075E04	MS-013				-99-12-27 03-02-19

Fig. 11. Package outline SOT163-1 (SO20)

SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm

SOT339-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	z ⁽¹⁾	θ
mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	7.4 7.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.9 0.5	8° 0°

Note

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT339-1		MO-150				99-12-27 03-02-19

Fig. 12. Package outline SOT339-1 (SSOP20)

12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC299 v.5	20190117	Product data sheet	-	74HC299 v.4
Modifications:	<ul style="list-style-type: none"> 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. Type number 74HC299PW (SOT360-1) removed. 			
74HC299 v.4	20160226	Product data sheet	-	74HC_HCT299 v.3
Modifications:	<ul style="list-style-type: none"> Type numbers 74HC299N and 74HCT299N (SOT146-1) removed. Type number 74HCT299D (SOT163-1) removed. Type number 74HCT299DB (SOT339-1) removed. Type number 74HCT299PW (SOT360-1) removed. 			
74HC_HCT299 v.3	20080728	Product data sheet	-	74HC_HCT299_CNV_2
Modifications:	<ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate. Section 3: Ordering information added Section 12: Package outline drawings added Section 9 "Static characteristics": Family data added Section 11 "Waveforms": Test circuit added 			
74HC_HCT299_CNV v.2	19970828	Product specification	-	-

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>.

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 — Nexperia products are 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.

Non-automotive qualified products — Unless this data sheet expressly states that this specific Nexperia product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Nexperia accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Nexperia's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond Nexperia's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Nexperia for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Nexperia's standard warranty and Nexperia's product specifications.

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

1. General description	1
2. Features and benefits	1
3. Ordering information	1
4. Functional diagram	2
5. Pinning information	4
5.1. Pinning.....	4
5.2. Pin description.....	4
6. Functional description	4
7. Limiting values	5
8. Recommended operating conditions	5
9. Static characteristics	6
10. Dynamic characteristics	7
10.1. Waveforms and test circuit.....	9
11. Package outline	12
12. Abbreviations	14
13. Revision history	14
14. Legal information	15

© Nexperia B.V. 2019. All rights reserved

For more information, please visit: <http://www.nexperia.com>
For sales office addresses, please send an email to: salesaddresses@nexperia.com
Date of release: 17 January 2019
