74AHC9541A

Octal buffer/line driver; 3-state Rev. 1 — 28 June 2017

Product data sheet

General description

The 74AHC9541A is an 8-bit buffer/line driver with 3-state outputs and Schmitt trigger inputs. The device features an output enable input (OE) and select input (S). A HIGH on OE causes the associated outputs to assume a high-impedance OFF-state. A LOW on the select input S causes the buffer/line driver to act as an inverter.

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

The data (An), select (S) and output enable (OE) 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.

Features and benefits 2

- Wide supply voltage range from 1.8 V to 5.5 V
- Typical t_{pd} of 5.1 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 3 kV
 - MM JESD22-A115-A exceeds 150 V
 - CDM JESD22-C101E exceeds 2 kV
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

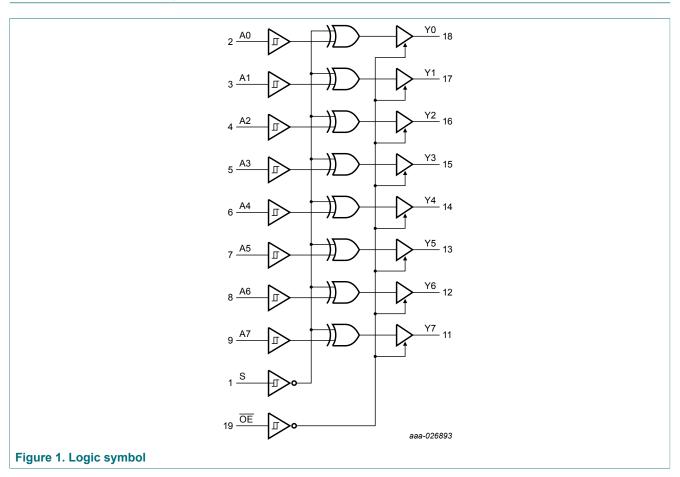
Ordering information 3

Table 1. Ordering information

Type number	Package							
	Temperature range	Name	Description	Version				
74AHC9541APW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1				

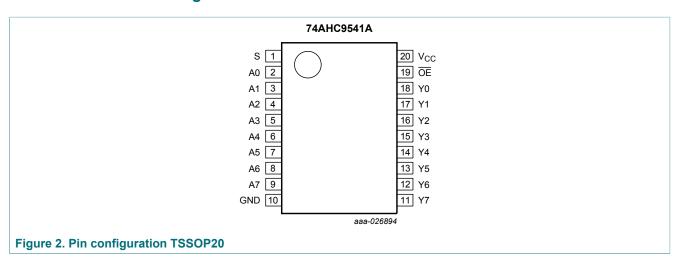


4 Functional diagram



5 Pinning information

5.1 Pinning



74AHC9541A

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5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
S	1	select input (active LOW)
A0 to A7	2, 3, 4, 5, 6, 7, 8, 9	data input
GND	10	ground (0 V)
Y0 to Y7	18, 17, 16, 15, 14, 13, 12, 11	data output
ŌE	19	output enable input (active LOW)
V _{CC}	20	supply voltage

6 Functional description

Table 3. Functional table

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

		Input	Output
OE	S	An	Yn
Н	X	X	Z
L	L	L	Н
L	L	Н	L
L	Н	L	L
L	Н	Н	Н

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
VI	input voltage		[1]	-0.5	+7.0	V
Vo	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	$V_O = 0 V \text{ to } V_{CC}$		-	±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

Recommended operating conditions 8

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
VI	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
Δt/ΔV	input transition rise and fall rate	V _{CC} = 2.3 V to 2.7 V	-	50	ms/V
		V _{CC} = 3.0 V to 3.6 V	-	20	ms/V
		V _{CC} = 4.5 V to 5.5 V	-	1	ms/V

The minimum input voltage ratings may be exceeded if the input current ratings are observed. The output voltage ratings may be exceeded if the output current ratings are observed. [1] [2] [3] [4]

This value is limited to 7.0 V maximum.

For TSSOP20 package: above 100 °C the value of Ptot derates linearly with 10 mW/K.

9 Static characteristics

Table 6. Static characteristics

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

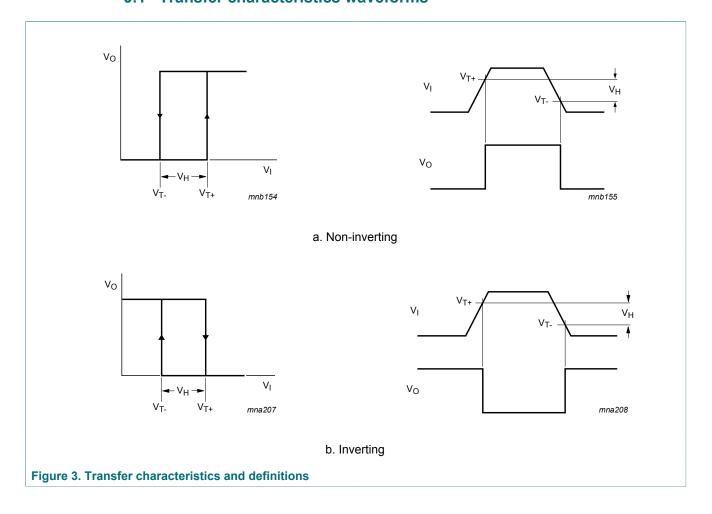
Symbol	Parameter	Conditions		25 °C		-40 °C to	+85 °C	-40 °C to	+125 °C	Un
			Min	Тур	Max	Min	Max	Min	Max	
V _{T+}	positive-going	V _{CC} = 1.8 V	-	-	1.65	-	1.65	-	1.65	٧
	threshold	V _{CC} = 2.3 V	-	-	1.85	-	1.85	-	1.85	V
	voltage	V _{CC} = 3.0 V	-	-	2.2	-	2.2	-	2.2	V
		V _{CC} = 4.5 V	-	-	3.15	-	3.15	-	3.15	٧
		V _{CC} = 5.5 V	-	-	3.85	-	3.85	-	3.85	٧
√ _{T-}	negative-going	V _{CC} = 1.8 V	0.15	-	-	0.15	-	0.15	-	٧
	threshold voltage	V _{CC} = 2.3 V	0.45	-	-	0.45	-	0.45	-	٧
	voitage	V _{CC} = 3.0 V	0.9	-	-	0.9	-	0.9	-	٧
		V _{CC} = 4.5 V	1.35	-	-	1.35	-	1.35	-	٧
		V _{CC} = 5.5 V	1.65	-	-	1.65	-	1.65	-	٧
/ _H	hysteresis	V _{CC} = 1.8 V	0.15	-	1.05	0.15	1.05	0.15	1.05	٧
	voltage	V _{CC} = 2.3 V	0.2	-	1.1	0.2	1.1	0.2	1.1	٧
		V _{CC} = 3.0 V	0.3	-	1.2	0.3	1.2	0.3	1.2	٧
		V _{CC} = 4.5 V	0.4	-	1.4	0.4	1.4	0.4	1.4	٧
		V _{CC} = 5.5 V	0.5	-	1.6	0.5	1.6	0.5	1.6	٧
√oH	HIGH-level output voltage	$V_I = V_{T+}$ or V_{T-}								٧
		V_{CC} = 1.8 V to 5.5 V; I_{O} = -50 μ A	V _{CC} -0.1	V _{CC}	-	V _{CC} -0.1	-	V _{CC} -0.1	-	V
		$I_O = -4 \text{ mA}; V_{CC} = 3.0 \text{ V}$	2.58	-	-	2.48	-	2.40	-	٧
		$I_O = -8 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.94	-	-	3.80	-	3.70	-	
/ _{OL}	LOW-level	$V_I = V_{T+}$ or V_{T-}								
	output voltage	V _{CC} = 1.8 V to 5.5 V; I _O = 50 μA	-	-	0.1	-	0.1	-	0.1	V
		I_{O} = 4 mA; V_{CC} = 3.0 V	-	-	0.36	-	0.44	-	0.55	٧
		I_{O} = 8 mA; V_{CC} = 4.5 V	-	-	0.36	-	0.44	-	0.55	٧
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	μΑ
OFF	power-off leakage current	V_1 or V_0 = GND to 5.5 V; V_{CC} = 0 V	-	-	0.5	-	5	-	5	μΑ
I	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 0$ V to 5.5 V	-	-	±0.1	-	±1	-	±1	μΑ

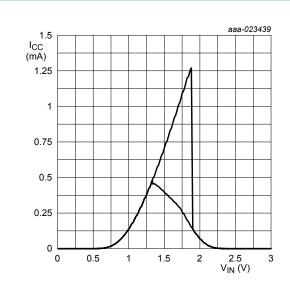
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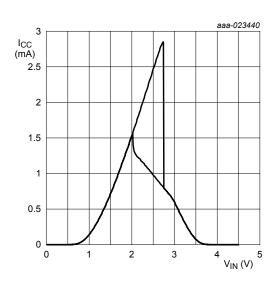
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Symbol	Parameter	Conditions	25 °C		-40 °C to +85 °C		-40 °C to +125 °C		Unit	
			Min	Тур	Max	Min	Max	Min	Max	
I _{CC}		$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V	-	-	2	-	20	-	20	μΑ

9.1 Transfer characteristics waveforms

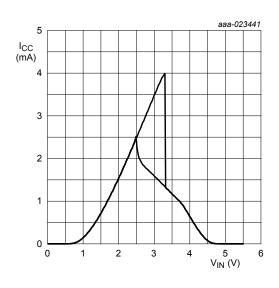






a. $V_{CC} = 3.0 \text{ V}$





c. V_{CC} = 5.5 V

Figure 4. Typical transfer characteristics

10 Dynamic characteristics

Table 7. Dynamic characteristics

GND = 0 V. For test circuit see Figure 7.

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	An to Yn; see Figure 5 [2]								
	delay	V _{CC} = 2.3 V to 2.7 V								
		C _L = 15 pF	-	5.7	11	1	13	1	15	ns
		C _L = 50 pF	-	8.3	17	1	20	1	22	ns
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	4.4	8	1	10	1	11.5	ns
		C _L = 50 pF	-	6.5	12.5	1	15	1	17	ns
		V _{CC} = 4.5 V to 5.5 V								
	C _L = 15 pF	-	3.4	5.5	1	7	1	8	ns	
		C _L = 50 pF	-	5.1	8.5	1	10	1	11	ns
	S to Yn; see Figure 5									
		V _{CC} = 2.3 V to 2.7 V								
		C _L = 15 pF	-	6.6	17	1	19	1	21	ns
		C _L = 50 pF	-	9.2	24	1	27	1	29	ns
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	5.1	11.5	1	13.5	1	15	ns
		C _L = 50 pF	-	7.2	17	1	20.5	1	23	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	3.9	8	1	9.5	1	10.5	ns
		C _L = 50 pF	-	5.6	12.5	1	15	1	17	ns
t _{en}	enable time	OE to Yn; see Figure 6 [2]								
		V_{CC} = 2.3 V to 2.7 V								
		C _L = 15 pF	-	6.2	12	1	14	1	16	ns
		C _L = 50 pF	-	8.9	18	1	20	1	22	ns
		V_{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	4.7	8	1	9.5	1	10.5	ns
		C _L = 50 pF	-	6.8	13.5	1	16.5	1	18.5	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	3.6	5.5	1	6.5	1	7.5	ns
		C _L = 50 pF	-	5.3	10.5	1	12.5	1	14	ns

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Symbol	Parameter	Conditions			25 °C		-40 °C to	o +85 °C	-40 °C to	+125 °C	Unit
				Min	Typ ^[1]	Max	Min	Max	Min	Max	
t _{dis}	disable time	OE to Yn; see Figure 6	[2]								
		V _{CC} = 2.3 V to 2.7 V									
		C _L = 15 pF		-	6.3	13	1	16	1	18	ns
		C _L = 50 pF		-	11.1	18	1	21	1	23	ns
		V _{CC} = 3.0 V to 3.6 V									
		C _L = 15 pF		-	5	10	1	12	1	14	ns
		C _L = 50 pF		-	8.6	13.5	1	16	1	18	ns
		V _{CC} = 4.5 V to 5.5 V									
		C _L = 15 pF		-	3.9	7	1	8	1	9	ns
		C _L = 50 pF		-	6.2	9.5	1	11	1	12	ns
t _{sk(o)}	skew	C _L = 50 pF									
		V _{CC} = 2.3 V to 2.7 V		-	-	2	-	2	-	2	ns
		V _{CC} = 3.0 V to 3.6 V		-	-	1.5	-	1.5	-	1.5	ns
		V _{CC} = 4.5 V to 5.5 V		-	-	1	-	1	-	1	ns
Cı	input capacitance	$V_I = V_{CC}$ or GND; $V_{CC} = 3.3 \text{ V}$		-	2	6	-	6	-	6	pF
Co	output capacitance	$V_O = V_{CC}$ or GND; $V_{CC} = 3.3 \text{ V}$		-	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}	[3]	-	9	-	-	-	-	-	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 $t_{\text{PZH}}.$

 t_{en} is the same as ψ_{ZL} and ψ_{ZH} . t_{dis} is the same as t_{PLZ} and t_{PHZ} .

[3] C_{PD} is used to determine the dynamic power dissipation P_D (μ W). $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$ where: f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

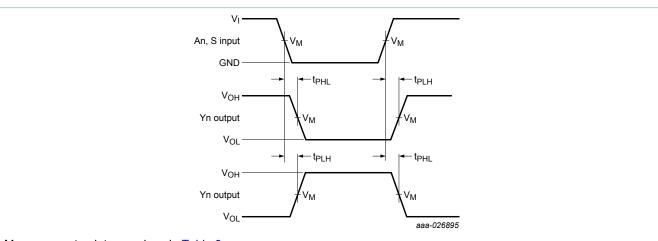
V_{CC} = supply voltage in Volts.

Table 8. Noise characteristics

GND = 0 V. For test circuit see Figure 7.

Symbo	l Parameter	Conditions	Ta	T _{amb} = 25 °C			
			Min	Тур	Max		
V _{CC} = 3.	.3 V; C _L = 50 pF						
$V_{OL(p)}$	LOW-level output voltage (peak)		-	0.2	0.8	V	
$V_{OL(v)}$	LOW-level output voltage (valley)		-0.8	-0.1	-	V	
V _{OH(v)}	HIGH-level output voltage (valley)		-	3.0	-	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)		-	0.5	1.5	V	
$V_{OL(v)}$	LOW-level output voltage (valley)		-1.5	-0.3	-	V	
V _{OH(v)}	HIGH-level output voltage (valley)		-	4.5	-	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



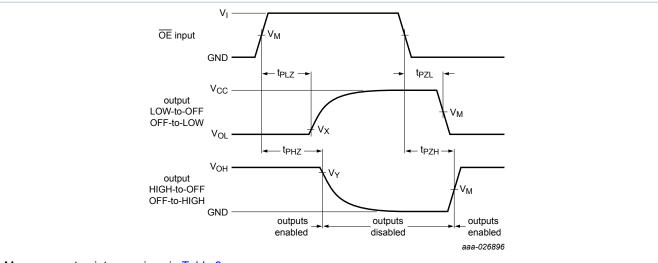
Measurement points are given in Table 9.

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

Figure 5. Propagation delay input (An, S) to output (Yn)

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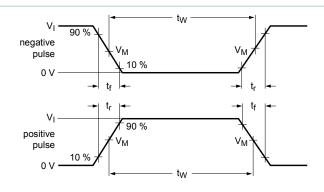
Measurement points are given in Table 9.

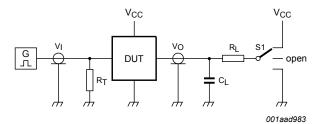
 $\ensuremath{V_{\text{OL}}}$ and $\ensuremath{V_{\text{OH}}}$ are typical voltage output levels that occur with the output load.

Figure 6. Enable and disable times

Table 9. Measurement points

Input	Output		
V _M	V _M	V _X	V _Y
0.5V _{CC}	0.5V _{CC}	V _{OL} + 0.3 V	V _{OH} - 0.3 V





Test data is given in Table 10.

Definitions test circuit:

 R_T = Termination resistance should be equal to output impedance Z_0 of the pulse generator

 C_L = Load capacitance including jig and probe capacitance

R_L = Load resistance

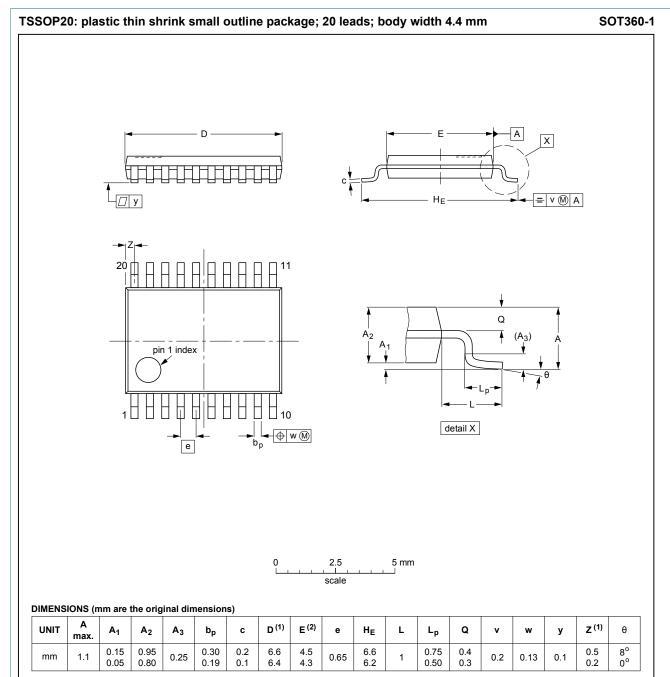
S1 = Test selection switch

Figure 7. Test circuit for measuring switching times

Table 10. Test data

Input Load		S1 position				
VI	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 kΩ	open	GND	V _{CC}

11 Package outline



Notes

- Plastic or metal protrusions of 0.15 mm maximum per side are not included.
- 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN	ISSUE DATE
	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE
SOT360-1		MO-153				-99-12-27 03-02-19

Figure 8. Package outline SOT360-1 (TSSOP20)

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12 Abbreviations

Table 11. Abbreviations

Acronym	Description
CDM	Charge Device Model
DUT	Device Under Test
ESD	ElectroStatic Discharge
НВМ	Human Body Model
MM	Machine Model

13 Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC9541A v.1	20170628	Product data sheet	-	-

14 Legal information

14.1 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.

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- The term 'short data sheet' is explained in section "Definitions".
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Octal buffer/line driver; 3-state

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