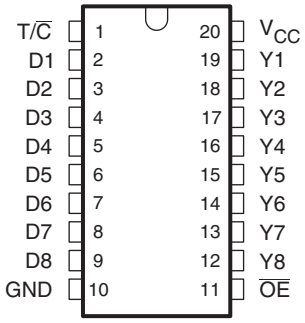
8-BIT INVERTING/NON-INVERTING SCHMITT-TRIGGER BUFFER WITH 3-STATE OUTPUTS

FEATURES

- **Operating Range of 2 V to 5.5 V V_{CC}**
- **8-Bit Inverting/Non-Inverting Outputs**
- **20-Pin Thin Shrink Small-Outline Package [TSSOP (PW)] and 20-Pin Plastic Dual-In-Line Package [PDIP (N)]**

N OR PW PACKAGE
(TOP VIEW)



DESCRIPTION

The SN74AHC8541 8-bit inverting/non-inverting buffers are ideal for driving bus lines or buffer memory address registers. These devices feature inputs and outputs on opposite sides of the package to facilitate printed circuit board layout.

All outputs are in the high-impedance state (disabled) when the output-enable ($\overline{OE}$) input is high. When $\overline{OE}$ is low, the respective gate passes the data from the D input to its Y output.

The T/$\overline{C}$ input selects inverting or non-inverting data transfer. When the T/$\overline{C}$ input is high, it provides non-inverting buffers. When the T/$\overline{C}$ input is low, it provides inverting buffers when they are not in the high-impedance state.

To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

FUNCTION TABLE
(EACH BUFFER)(1)

INPUTS			OUTPUT
$\overline{OE}$	T/$\overline{C}$	D	Y
L	H	H	H
L	H	L	L
L	L	H	L
L	L	L	H
H	X	X	Z

(1) L: Low-level
H: High-level
X: Irrelevant
Z: High-impedance (off)

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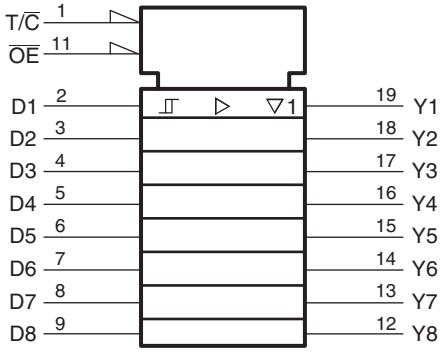
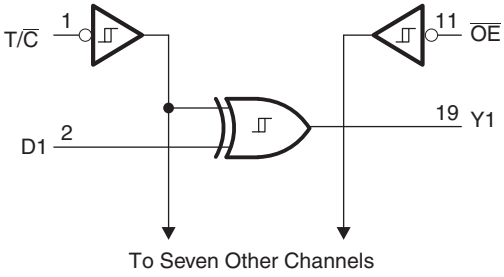
LOGIC SYMBOL



LOGIC DIAGRAM (POSITIVE LOGIC)



ABSOLUTE MAXIMUM RATINGS(1)

			MIN	MAX	UNIT
V_{CC}	Supply voltage range		–0.5	7	V
V_I	Input voltage range(2)		–0.5	7	V
V_O	Voltage range applied to any output in the high-impendance or power-off state(2)		–0.5	7	V
	Output voltage range applied in the high- or low-state(2)(3)		–0.5	V_{CC} + 0.5	V
I_{IK}	Input clamp current	V_I < 0 V		–20	V
I_{OK}	Output clamp current	V_O < 0 V or VO > V_{CC}		±50	mA
I_O	Continuous output current	V_O = 0 V to V_{CC}		±25	mA
	Continuous current through V_{CC} or GND			±50	mA
θ_{JA}	Thermal impedance(4)	N package		69	°C/W
		PW package		83	
T_{stg}	Storage temperature range		–65	150	°C

(1) Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
(3) This value is limited to 5.5 V maximum.
(4) The package thermal impendance is calculatead in accordance with JESD 51-7.

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RECOMMENDED OPERATING CONDITIONS(1)

over operating free-air temperature range (unless otherwise noted)

				MIN	MAX	UNIT
V_{CC}	Supply voltage			2	5.5	V
V_{IH}	High-level input voltage		V_{CC} = 2 V	1.5		V
			V_{CC} = 3.3 V ±0.3 V	V_{CC} × 0.7		
			V_{CC} = 5 V ±0.5 V	V_{CC} × 0.7		
V_{IL}	Low-level input voltage		V_{CC} = 2 V		0.5	V
			V_{CC} = 3.3 V ±0.3 V		V_{CC} × 0.3	
			V_{CC} = 5 V ±0.5 V		V_{CC} × 0.3	
V_I	Input voltage			0	5.5	V
V_O	Output voltage	High or low state		0	V_{CC}	V
		3-state		0	5.5	
I_{OH}	High-level output current		V_{CC} = 2 V		–50	μA
			V_{CC} = 3.3 V ±0.3 V		–6	mA
			V_{CC} = 5 V ±0.5 V		–12	
I_{OL}	Low-level output current		V_{CC} = 2 V		50	μA
			V_{CC} = 3.3 V ±0.3 V		6	mA
			V_{CC} = 5 V ±0.5 V		12	
Δt/ΔV	Input transition rise or fall rate	T/$\overline{C}$, $\overline{OE}$	V_{CC} = 3.3 V ±0.3 V	0	100	ns/V
			V_{CC} = 5 V ±0.5 V	0	20	
		D	V_{CC} = 3.3 V ±0.3 V	0	3	ms/V
			V_{CC} = 5 V ±0.5 V	0	2	
t_{pa}	Pulse reception time(2)		V_{CC} = 3.3 V ±0.3 V	100		ns
			V_{CC} = 5 V ±0.5 V	60		
T_A	Operating free-air temperature			–40	85	°C

(1) All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation.

(2) Buffer inputs D1 to D8 might accept no pulse after t_{pa} period after receiving the first pulse edge. If the input state changes from H to L or L to H in this period, the corresponding output changes from L to H or H to L respectively, in t_{pa} + t_{pd} as delay time in worst-case scenario.
Maximum input frequency, f_{max}, is calculated by the following formula:
f_{max} = input pulse duty cycle/($t_{pa(min)}$ + $t_{pd(max)}$) when input pulse duty cycle <50%
f_{max} = (1 – input pulse duty cycle)/($t_{pa(min)}$ + $t_{pd(max)}$) when input pulse duty cycle >50%

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ELECTRICAL CHARACTERISTICS

over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	V_{CC}	MIN	TYP(1)	MAX	UNIT
V_{T+}	Positive-going input threshold voltage	D	3.3 V			2.31	V
			5 V			3.5	
V_{T-}	Negative-going input threshold voltage	D	3.3 V	0.99			V
			5 V	1.5			
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$)	D	3.3 V	0.33		1.32	V
			5 V	0.5		2	
V_{OH}	High-level output voltage	I_{OH} = –50 µA	2 V	1.9			V
		I_{OH} = –6 µA	3 V	2.48			
		I_{OH} = –12 µA	4.5 V	3.8			
V_{OL}	Low-level output voltage	I_{OL} = 50 µA	2 V			0.1	V
		I_{OL} = 6 µA	3 V			0.44	
		I_{OL} = 12 µA	4.5 V			0.55	
I_I	Input current	V_I = 5.5 V or GND	0 V to 5.5 V			±1	µA
I_{OZ}	OFF-state output current	$V_O = V_{CC}$ or GND	5.5 V			±5	µA
I_{CC}	Supply current	$V_I = V_{CC}$ or GND, IO = 0 A	5.5 V			20	µA
C_I	Input capacitance	$V_I = V_{CC}$ or GND	5 V		3		pF
C_O	Output capacitance	$V_O = V_{CC}$ or GND	5 V		5		pF
C_{pd}	Power disspation capacitance	f = 1 MHz, no load	5 V		15		pF

(1) All typical values are at T_A = 25°C.

SWITCHING CHARACTERISTICS

V_{CC} = 3.3 V ±0.3 V, T_A = –40°C to 85°C, see Figure 1

PARAMETER		FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	MIN	TYP	MAX	UNIT
t_{pd}	Propagation delay time	D	Y	C_L = 15 pF	1	15	29	ns
				C_L = 50 pF	1	18	34	
		T/$\overline{C}$		C_L = 15 pF	1	16	30	
				C_L = 50 pF	1	20	36	
t_{en}	Enable time	$\overline{OE}$	Y	C_L = 15 pF	1	9	16	ns
				C_L = 50 pF	1	11	20	
t_{dis}	Disable time	$\overline{OE}$	Y	C_L = 15 pF	1	8	14	ns
				C_L = 50 pF	1	11	18	

SWITCHING CHARACTERISTICS

V_{CC} = 5 V ±0.5 V, T_A = –40°C to 85°C, see Figure 1

PARAMETER		FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	MIN	TYP	MAX	UNIT
t_{pd}	Propagation delay time	D	Y	C_L = 15 pF	1	10	16	ns
				C_L = 50 pF	1	12	20	
		T/$\overline{C}$		C_L = 15 pF	1	11	17	
				C_L = 50 pF	1	13	21	
t_{en}	Enable time	$\overline{OE}$	Y	C_L = 15 pF	1	6	10.5	ns
				C_L = 50 pF	1	8	12.5	
t_{dis}	Disable time	$\overline{OE}$	Y	C_L = 15 pF	1	6	10	ns
				C_L = 50 pF	1	8	11.5	

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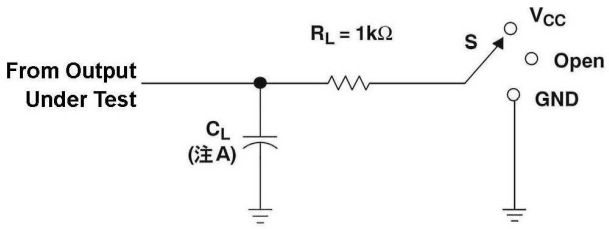
NOISE CHARACTERISTICS(1)

V_{CC} = 5 V, C_L = 50 pF, T_A = –40°C to 85°C

PARAMETER		MIN	TYP	MAX	UNIT
$V_{OL(P)}$	Quiet output, maximum dynamic V_{OL}		0.4		V
$V_{OL(V)}$	Quiet output, minimum dynamic V_{OL}		–0.4		V
$V_{OH(V)}$	Quiet output, minimum dynamic V_{OH}		4.5		V
$V_{IH(D)}$	High-level dynamic input voltage	3.5			V
$V_{IL(D)}$	Low--level dynamic input voltage			1.5	V

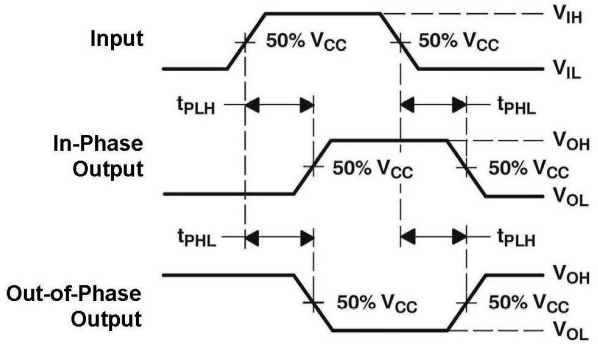
(1) Characteristics are for surface-mount packages only.

PARAMETER MEASUREMENT INFORMATION

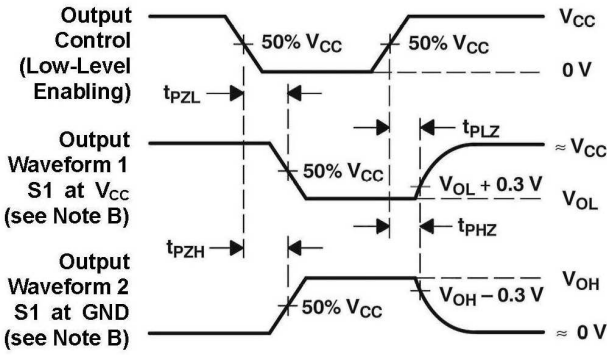


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{CC}
t_{PHZ}/t_{PZH}	GND

LOAD CIRCUIT FOR
3-STATE AND OPEN-DRAIN OUTPUTS



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

A. C_L includes probe and jig capacitance.

B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control.
Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.

C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, tr ≤ 3 ns, t_f ≤3 ns.

D. The outputs are measured one at a time with one transition per measurement.

E. t_{PZL} and t_{PZH} are the same as t_{en}.

F. t_{PLZ} and t_{PHZ} are the same as t_{dis}.

G. t_{PLH} and t_{PHL} are the same as t_{pd}.

Figure 1. Load Circuit and Voltage Waveforms

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PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
SN74AHC8541N	Active	Production	PDIP (N) | 20	20 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	SN74AHC8541N
SN74AHC8541N.A	Active	Production	PDIP (N) | 20	20 | TUBE	Yes	NIPDAU	N/A for Pkg Type	-40 to 85	SN74AHC8541N

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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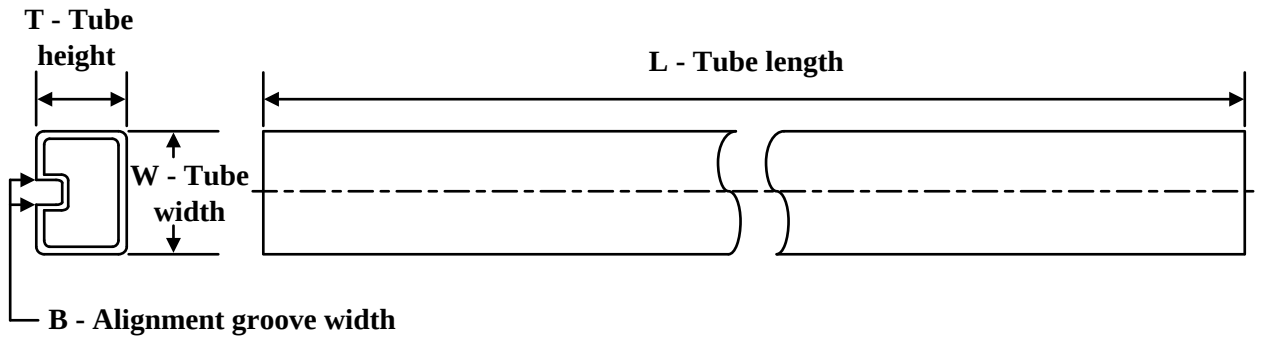
TUBE



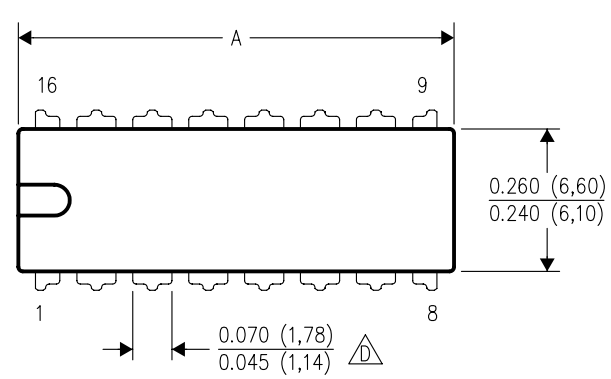
*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
SN74AHC8541N	N	PDIP	20	20	506	13.97	11230	4.32
SN74AHC8541N.A	N	PDIP	20	20	506	13.97	11230	4.32

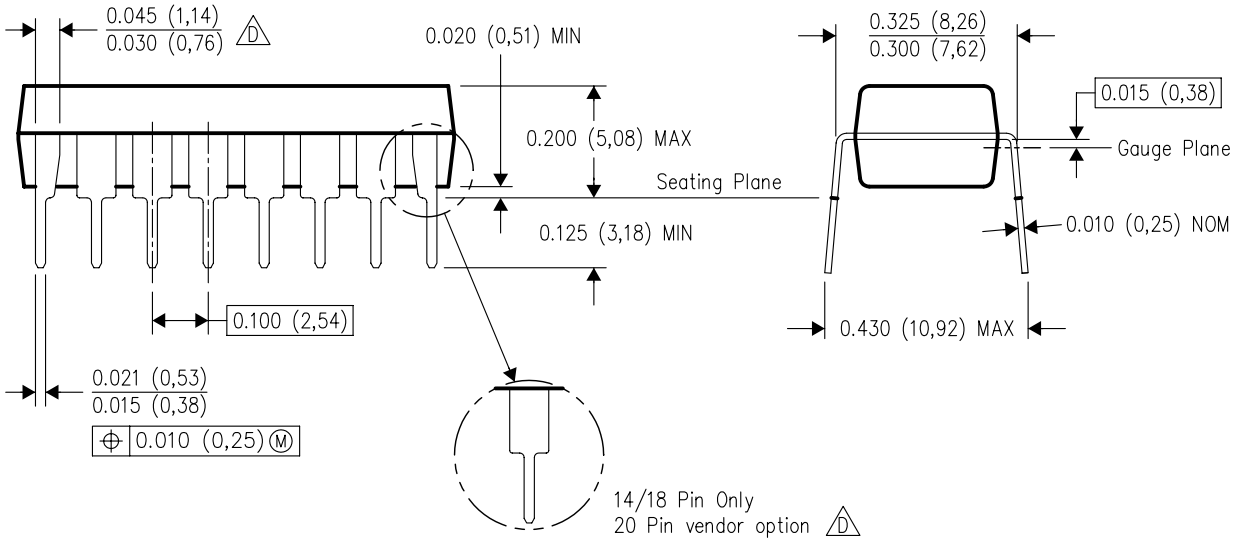
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION (C)	AA	BB	AC	AD



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NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

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Last updated 10/2025