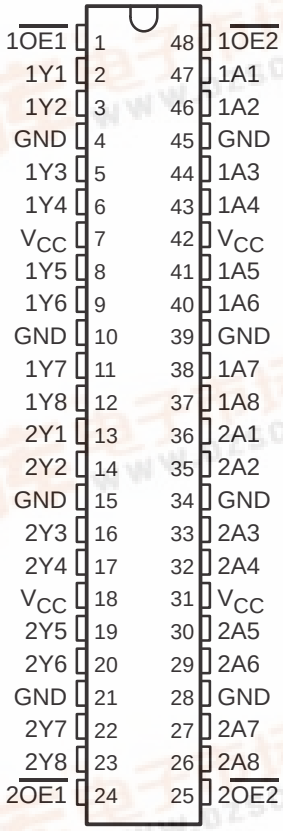
16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCLS339H – MARCH 1996 – REVISED JANUARY 2000

- Members of the Texas Instruments *Widebus*™ Family
- *EPIC*™ (Enhanced-Performance Implanted CMOS) Process
- Inputs Are TTL-Voltage Compatible
- Distributed V_{CC} and GND Pins Minimize High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- Package Options Include Plastic Shrink Small-Outline (DL), Thin Shrink Small-Outline (DGG), and Thin Very Small-Outline (DGV) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings

SN54AHCT16541 . . . WD PACKAGE
SN74AHCT16541 . . . DGG, DGV, OR DL PACKAGE
(TOP VIEW)



description

The ’AHCT16541 devices are noninverting 16-bit buffers composed of two 8-bit sections with separate output-enable signals. For either 8-bit buffer section, the two output-enable (1$\overline{OE1}$ and 1$\overline{OE2}$ or 2$\overline{OE1}$ and 2$\overline{OE2}$) inputs must both be low for the corresponding Y outputs to be active. If either output-enable input is high, the outputs of that 8-bit buffer section are in the high-impedance state.

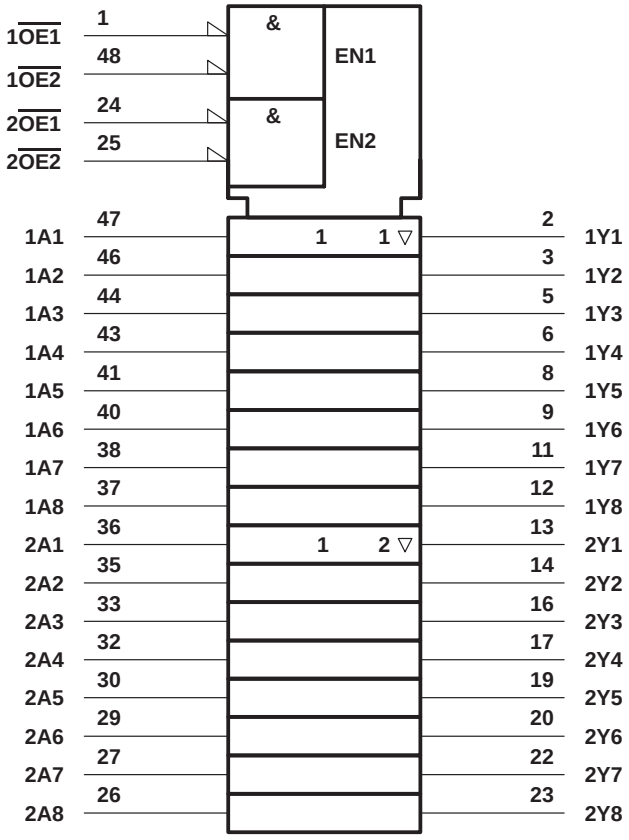
To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN54AHCT16541 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74AHCT16541 is characterized for operation from –40°C to 85°C.

FUNCTION TABLE
(each 8-bit buffer/driver)

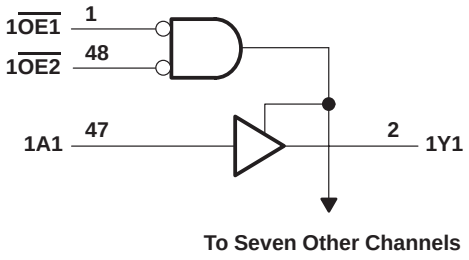
INPUTS			OUTPUT
$\overline{OE1}$	$\overline{OE2}$	A	Y
L	L	L	L
L	L	H	H
H	X	X	Z
X	H	X	Z

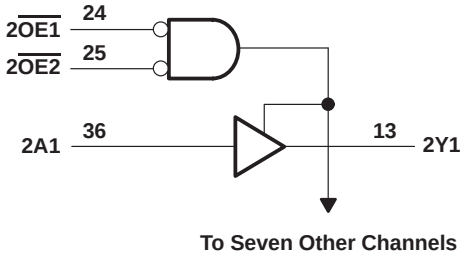
logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)





absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC} . . . . . –0.5 V to 7 V
Input voltage range, V_I (see Note 1) . . . . . –0.5 V to 7 V
Output voltage range, V_O (see Note 1) . . . . . –0.5 V to V_{CC} + 0.5 V
Input clamp current, I_{IK} (V_I < 0) . . . . . –20 mA
Output clamp current, I_{OK} (V_O < 0 or V_O > V_{CC}) . . . . . ±20 mA
Continuous output current, I_O (V_O = 0 to V_{CC}) . . . . . ±25 mA
Continuous current through each V_{CC} or GND . . . . . ±75 mA
Package thermal impedance, θ_{JA} (see Note 2): DGG package . . . . . 70°C/W
DGV package . . . . . 58°C/W
DL package . . . . . 63°C/W
Storage temperature range, T_{stg} . . . . . –65°C to 150°C

† 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.

NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions (see Note 3)

		SN54AHCT16541		SN74AHCT16541		UNIT
		MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage	4.5	5.5	4.5	5.5	V
V_{IH}	High-level input voltage	2		2		V
V_{IL}	Low-level input voltage		0.8		0.8	V
V_I	Input voltage	0	5.5	0	5.5	V
V_O	Output voltage	0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current		–8		–8	mA
I_{OL}	Low-level output current		8		8	mA
$\Delta t/\Delta v$	Input transition rise or fall rate		20		20	ns/V
T_A	Operating free-air temperature	–55	125	–40	85	°C

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

PARAMETER	TEST CONDITIONS	V_{CC}	T_A = 25°C			SN54AHCT16541		SN74AHCT16541		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}	I_{OH} = –50 μA	4.5 V	4.4	4.5		4.4		4.4		V
	I_{OH} = –8 mA		3.94			3.8		3.8		
V_{OL}	I_{OL} = 50 μA	4.5 V			0.1		0.1		0.1	V
	I_{OL} = 8 mA				0.36		0.44		0.44	
I_I	$V_I = V_{CC}$ or GND	0 V to 5.5 V			±0.1		±1*		±1	μA
I_{OZ}	$V_O = V_{CC}$ or GND	5.5 V			±0.25		±2.5		±2.5	μA
I_{CC}	$V_I = V_{CC}$ or GND, I_O = 0	5.5 V			4		40		40	μA
ΔI_{CC}†	One input at 3.4 V, Other inputs at V_{CC} or GND	5.5 V			1.35		1.5		1.5	mA
C_i	$V_I = V_{CC}$ or GND	5 V		2	10				10	pF
C_o	$V_O = V_{CC}$ or GND	5 V		3						pF

* On products compliant to MIL-PRF-38535, this parameter is not production tested at V_{CC} = 0 V.
† This is the increase in supply current for each input at one of the specified TTL voltage levels rather than 0 V or V_{CC}.

switching characteristics over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T_A = 25°C			SN54AHCT16541		SN74AHCT16541		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	A	Y	C_L = 15 pF		5.4**	8.5**	1**	10**	1	9.5	ns
t_{PHL}					5.4**	8.5**	1**	10**	1	9.5	
t_{PZH}	$\overline{OE}$	Y	C_L = 15 pF		7.7**	10.4**	1**	12**	1	12	ns
t_{PZL}					7.7**	10.4**	1**	12**	1	12	
t_{PHZ}	$\overline{OE}$	Y	C_L = 15 pF		4.5**	10.4**	1**	12**	1	12	ns
t_{PLZ}					4.5**	10.4**	1**	12**	1	12	
t_{PLH}	A	Y	C_L = 50 pF		6.2	9.5	1	11	1	10.5	ns
t_{PHL}					6	9.5	1	11	1	10.5	
t_{PZH}	$\overline{OE}$	Y	C_L = 50 pF		7.5	11.4	1	13	1	13	ns
t_{PZL}					7.5	11.4	1	13	1	13	
t_{PHZ}	$\overline{OE}$	Y	C_L = 50 pF		7	11.4	1	13	1	13	ns
t_{PLZ}					7	11.4	1	13	1	13	
$t_{sk(o)}$			C_L = 50 pF			1***				1	ns

** On products compliant to MIL-PRF-38535, this parameter is not production tested.
*** On products compliant to MIL-PRF-38535, this parameter does not apply.

noise characteristics, V_{CC} = 5 V, C_L = 50 pF, T_A = 25°C (see Note 4)

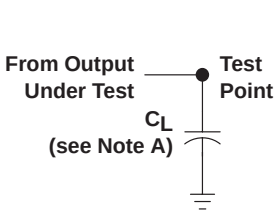
PARAMETER		SN74AHCT16541			UNIT
		MIN	TYP	MAX	
$V_{OL(P)}$	Quiet output, maximum dynamic V_{OL}		0.6		V
$V_{OL(V)}$	Quiet output, minimum dynamic V_{OL}		–0.3		V
$V_{OH(V)}$	Quiet output, minimum dynamic V_{OH}		4.6		V
$V_{IH(D)}$	High-level dynamic input voltage	2			V
$V_{IL(D)}$	Low-level dynamic input voltage			0.8	V

NOTE 4: Characteristics are for surface-mount packages only.

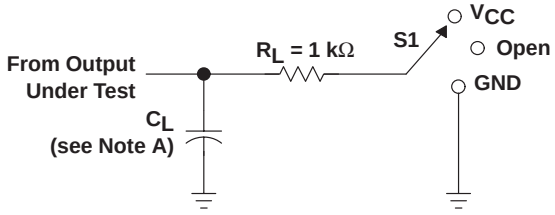
operating characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load, f = 1 MHz	12	pF

PARAMETER MEASUREMENT INFORMATION

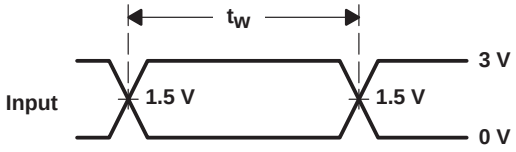


LOAD CIRCUIT FOR
TOTEM-POLE OUTPUTS

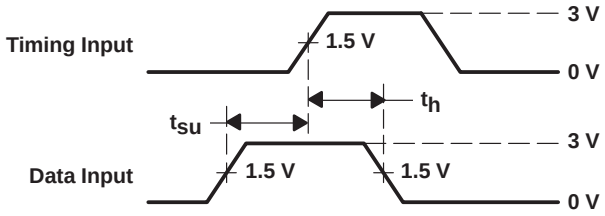


LOAD CIRCUIT FOR
3-STATE AND OPEN-DRAIN OUTPUTS

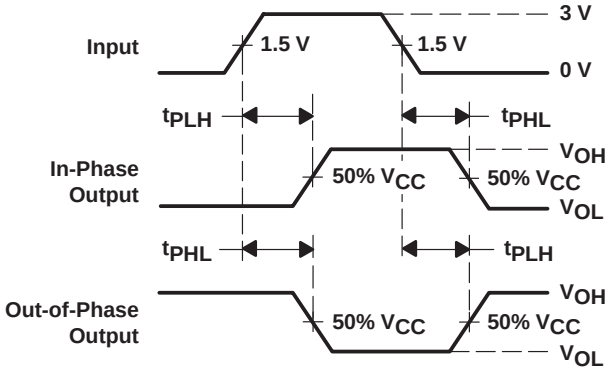
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{CC}
t_{PHZ}/t_{PZH}	GND
Open Drain	V_{CC}



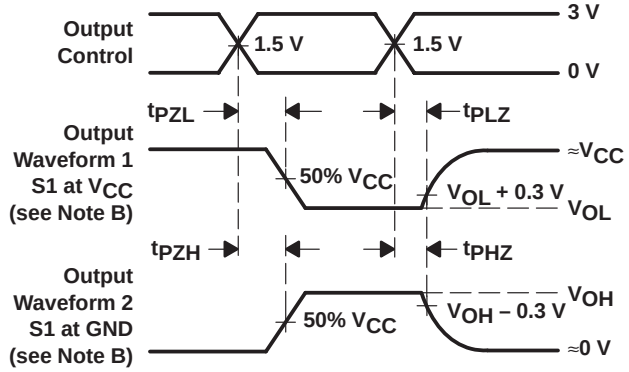
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



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

NOTES: 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, t_r ≤ 3 ns, t_f ≤ 3 ns.
D. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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