

# 8-Bit Counter SN54/74LS461A

74LS461A

## Features/Benefits

- 8-bit counter for microprogram-counter, DMA-controller and general-purpose counting applications
- 8 bits match byte boundaries
- Bus-structured pinout
- 24-pin SKINNYDIP® saves space
- Three-state outputs drive bus lines
- Low-current PNP Inputs reduce loading
- Expandable in 8-bit increments

## Description

The 'LS461A is an 8-bit synchronous counter with parallel load, clear, and hold capability. Two function select inputs (I0, I1) provide one of four operations which occur synchronously on the rising edge of the clock (CK).

The LOAD operation loads the inputs (D7-D0) into the output register (Q7-Q0). The CLEAR operation resets the output register to all LOWs. The HOLD operation holds the previous value regardless of clock transitions. The INCREMENT operation adds one to the output register when the carry-in input is TRUE ( $\overline{CI}$  = LOW), otherwise the operation is a HOLD. The carry-out ( $\overline{CO}$ ) is TRUE ( $\overline{CO}$  = LOW) when the output register (Q7-Q0) is all HIGHs, otherwise FALSE ( $\overline{CO}$  = HIGH).

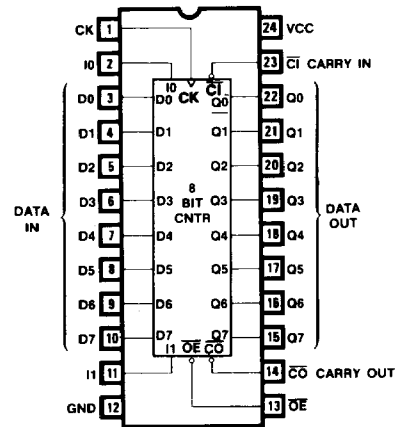
The data output pins are enabled when  $\overline{OE}$  is LOW, and disabled (HI-Z) when  $\overline{OE}$  is HIGH. The output drivers will sink the 24 mA required for many bus interface standards.

Two or more 'LS461A 8-bit counters may be cascaded to provide larger counters. The operation codes were chosen such that when I1 is HIGH, I0 may be used to select between LOAD and INCREMENT as in a program counter (JUMP/INCREMENT).

## Ordering Information

PART NUMBER	PACKAGE	TEMPERATURE
SN54LS461A	JS, W, 28L	Mil
SN74LS461A	NS, JS	Com

## Logic Symbol



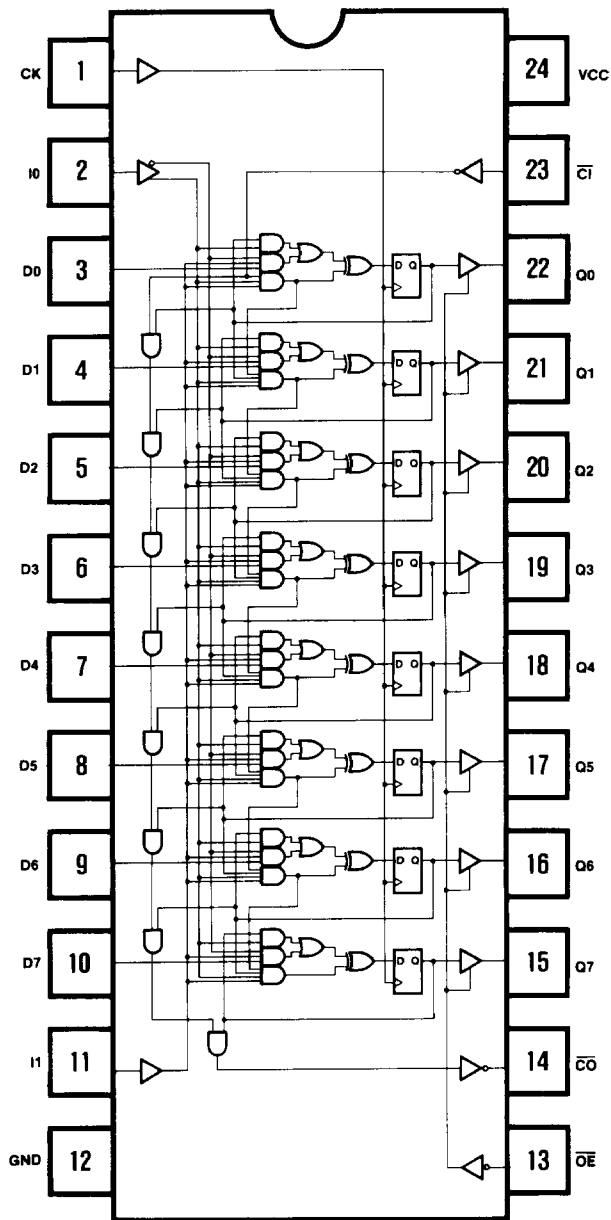
## Function Table

$\overline{OE}$	CK	I1	I0	CI	D7-D0	Q7-Q0	OPERATION
H	*	*	*	*	*	Z	HI-Z*
L	↑	L	L	X	X	L	CLEAR
L	↑	L	H	X	X	Q	HOLD
L	↑	H	L	X	D	D	LOAD
L	↑	H	H	H	X	Q	HOLD
L	↑	H	H	L	X	Q plus 1	INCREMENT

\* When  $\overline{OE}$  is HIGH, the three-state outputs are disabled to the high-impedance states; however, sequential operation of the counter is not affected.

Logic Diagram

8-Bit Counter



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**Absolute Maximum Ratings**

Supply voltage $V_{CC}$ .....	7 V
Input voltage .....	5.5 V
Off-state output voltage .....	5.5 V
Storage temperature .....	-65° to +150° C

**Operating Conditions**

SYMBOL	PARAMETER	MILITARY			COMMERCIAL			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
$V_{CC}$	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
$T_A$	Operating free-air temperature	-55		125*	0		75	°C
$t_w$	Width of clock	Low	35	15	25	15		ns
		High	20	7	15	7		
$t_{su}$	Setup time	40	20		30	20		ns
$t_h$	Hold time	0	-15		0	-15		

\* Case temperature

**Electrical Characteristics Over Operating Conditions**

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP†	MAX	UNIT	
$V_{IL}^{**}$	Low-level input voltage					0.8	V	
$V_{IH}^{**}$	High-level input voltage			2			V	
$V_{IC}$	Input clamp voltage	$V_{CC} = \text{MIN}$	$I_I = -18 \text{ mA}$	-0.8	-1.5		V	
$I_{IL}$	Low-level input current	$V_{CC} = \text{MAX}$	$V_I = 0.4 \text{ V}$	-0.02	0.25		mA	
$I_{IH}$	High-level input current	$V_{CC} = \text{MAX}$	$V_I = 2.4 \text{ V}$		25		$\mu\text{A}$	
$I_I$	Maximum input current	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$		1		mA	
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}$ $V_{IL} = 0.8 \text{ V}$ $V_{IH} = 2 \text{ V}$	Mil	$I_{OL} = 12 \text{ mA}$	0.3	0.5	V	
			Com	$I_{OL} = 24 \text{ mA}$				
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}$ $V_{IL} = 0.8 \text{ V}$ $V_{IH} = 2 \text{ V}$	Mil	$I_{OH} = -2 \text{ mA}$	2.4	2.8	V	
			Com	$I_{OH} = -3.2 \text{ mA}$				
$I_{OZL}$	Off-state output current	$V_{CC} = \text{MAX}$ $V_{IL} = 0.8 \text{ V}$ $V_{IH} = 2 \text{ V}$		$V_O = 0.4 \text{ V}$		-100	$\mu\text{A}$	
$I_{OZH}$				$V_O = 2.4 \text{ V}$		100		
$I_{OS}$	Output short-circuit current*	$V_{CC} = 5.0 \text{ V}$		$V_O = 0 \text{ V}$	-30	-70	-130	mA
$I_{CC}$	Supply current	$V_{CC} = \text{MAX}$			140	180	mA	

\* No more than one output should be shorted at a time and duration of the short-circuit should not exceed one second.

\*\*  $V_{IL}$  and  $V_{IH}$  parameters are, in effect, input conditions of D.C. and functional output † All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ \text{C}$ . tests are not directly tested.  $V_{IL}$  is specified at  $\leq 0.8 \text{ V}$  and  $V_{IH}$  is specified at  $\geq 2.0 \text{ V}$ .

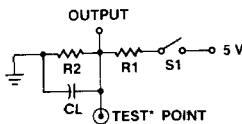
**Switching Characteristics Over Operating Conditions**

SYMBOL	PARAMETER	TEST CONDITIONS (See Test Load/Waveforms)	MILITARY			COMMERCIAL			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
$f_{MAX}$	Maximum clock frequency*	Commercial	16.6			25			MHz
$t_{PD}$	Cl to CO delay	$R_1 = 200 \Omega$ $R_2 = 390 \Omega$	15	35		15	25		ns
			10	25		10	15		
$t_{CLK}$	Clock to Q	Military $R_1 = 390 \Omega$ $R_2 = 750 \Omega$	25	60		25	40		ns
$t_{PD}$	Clock to CO		11	25		11	20		ns
$t_{PZX}$	Output enable delay		10	25		10	20		ns
$t_{PXZ}$	Output disable delay								ns

\*  $f_{MAX}$  is derived from:  $1/\text{MAX} \{ (t_{su} + t_h), t_w (\text{Low}) + t_w (\text{High}), t_{CLK} \}$ .

**Test Load**

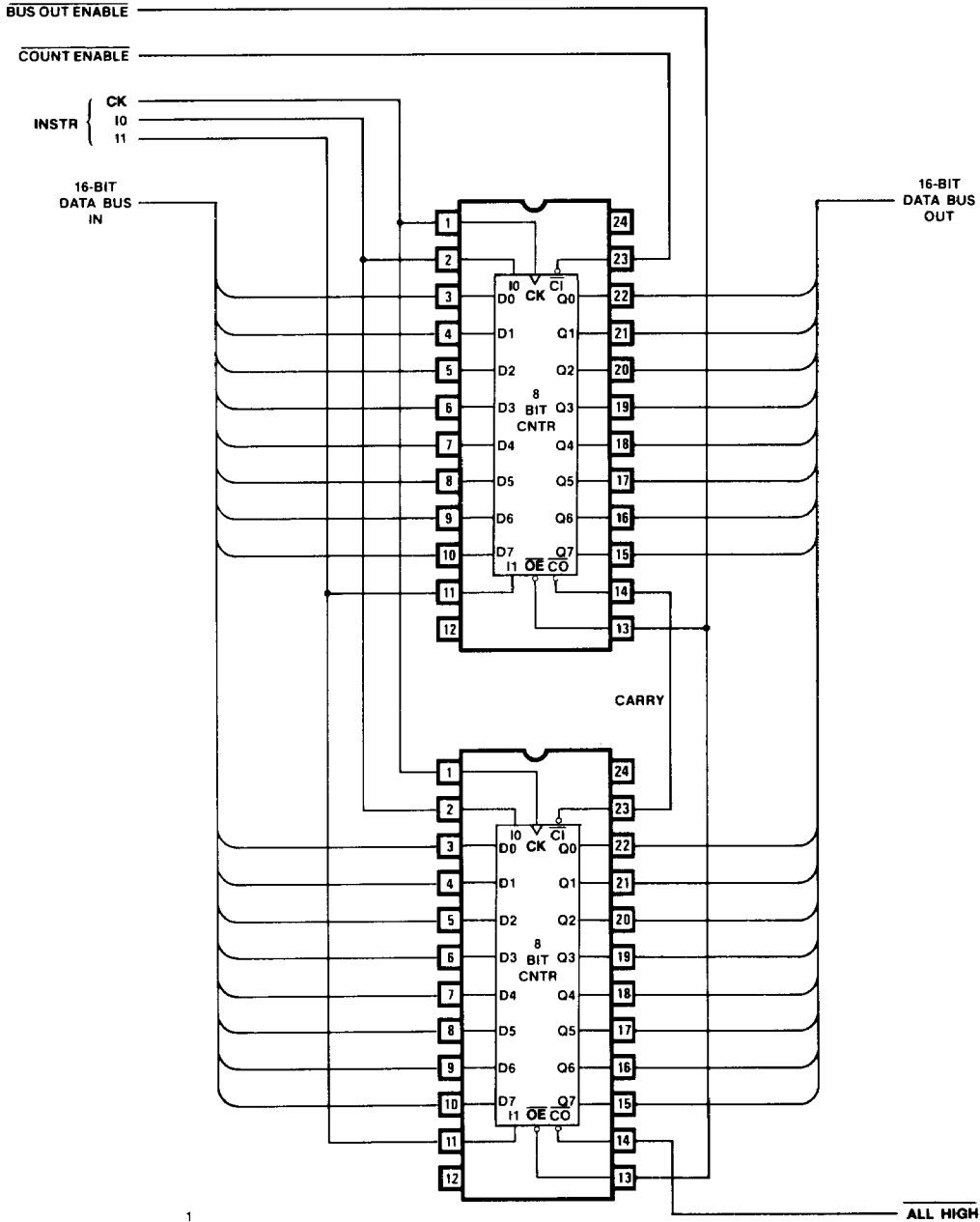
\* The "Test Point" is driven by the outputs under test, and observed by instrumentation



- Notes:
- $t_{PD}$  is tested with switch  $S_1$  closed.  $C_L = 50 \text{ pF}$  and measured at 1.5 V output level.
  - $t_{PZX}$  is measured at the 1.5 V output level with  $C_L = 50 \text{ pF}$ .  $S_1$  is open for high impedance to "1" test, and closed for high impedance to "0" test.
  - $t_{PXZ}$  is tested with  $C_L = 5 \text{ pF}$ .  $S_1$  is open for "1" to high impedance test, measured at  $V_{OH} = 0.5 \text{ V}$  output level;  $S_1$  is closed for "0" to high impedance test measured at  $V_{OL} = 0.5 \text{ V}$  output level.

Application

16-Bit Counter



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NOTE:  $t_{MAX} = \frac{1}{f_{PD CLK TO CO} + t_{SU}}$