

# TYPES SN54LS324 THRU SN54LS327, SN74LS324 THRU SN74LS327 VOLTAGE-CONTROLLED OSCILLATORS

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- 'LS325, 'LS326 and 'LS327 Have Two Independent VCO's in a Single Package
- Output Frequency Set by Single External Component:  
Crystal for High-Stability Fixed-Frequency Operation  
Capacitor for Fixed- or Variable-Frequency Operation
- Separate Supply Voltage Pins for Isolation of Frequency Control Inputs and Oscillators from Output Circuitry
- Highly Stable Operation over Specified Temperature and/or Supply Voltage Ranges

## description

With the exception of 'LS324, all of these devices feature two independent voltage-controlled oscillators (VCO) in a single monolithic chip. The 'LS324, 'LS325 and 'LS326 have complementary outputs. The output frequency of each VCO is established by a single external component, either a capacitor or a crystal, in combination with the voltage-sensitive inputs, one for frequency control and on the 'LS324, another one for frequency range. These inputs can be used to vary the output frequency by changing the voltage applied to them. These highly stable oscillators can be set to operate at any frequency typically between 0.12 Hz and 30 MHz. With 2 volts applied to the frequency control input and also to the range input of the 'LS324, the output frequency can be approximated as follows:

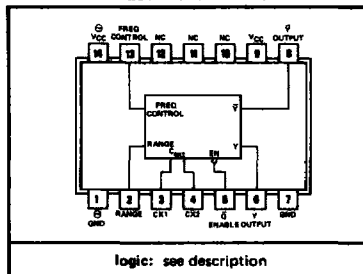
$$f_o = \frac{1 \times 10^{-4}}{C_{ext}}$$

where:  $f_o$  = output frequency in hertz

$C_{ext}$  = external capacitance in farads.

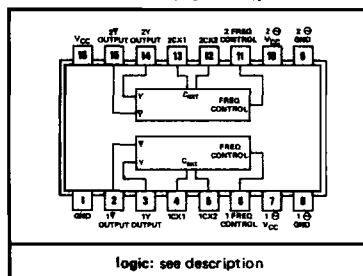
These devices can operate from a single 5-volt supply. However, one set of supply-voltage and ground pins ( $V_{CC}$  and  $GND$ ) is provided for the enable, synchronization-gating, and output sections, and a separate set ( $\ominus V_{CC}$  and  $\ominus GND$ ) is provided for the oscillator and associated frequency-control circuits so that effective isolation can be accomplished in the system. Disabling either VCO of the 'LS325 and 'LS327 can be accomplished by removing the appropriate  $\ominus V_{CC}$ . An enable input is provided on the 'LS324 and 'LS326. While this input is low, the output is enabled. While the enable input is high, Y is high and  $\bar{Y}$  is low.

SN54LS' ... J OR W PACKAGE  
SN74LS' ... J OR N PACKAGE  
'LS324 (TOP VIEW)



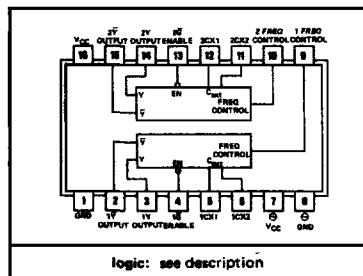
logic: see description

'LS325 (TOP VIEW)



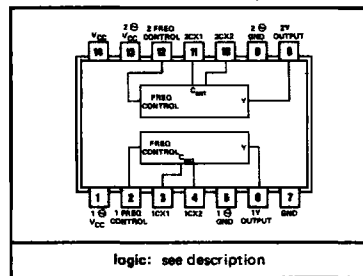
logic: see description

'LS326 (TOP VIEW)



logic: see description

'LS327 (TOP VIEW)



logic: see description

# TYPES SN54LS324 THRU SN54LS327, SN74LS324 THRU SN74LS327 VOLTAGE-CONTROLLED OSCILLATORS

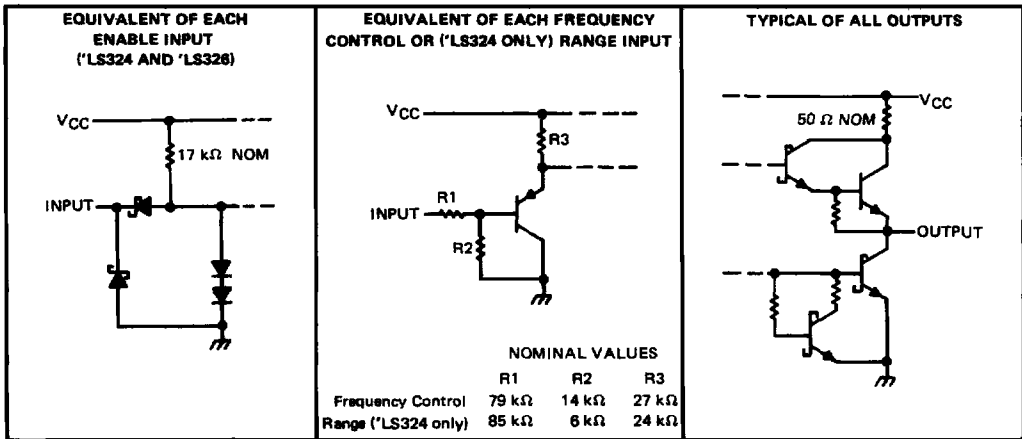
## description (continued)

The internal oscillator runs continuously even while the output is disabled via the enable input. The enable input is one standard load, and it and the buffered output operate at standard Schottky-clamped TTL levels.

The pulse synchronization-gating section ensures that the first output pulse is neither clipped nor extended. Duty cycle of the square-wave output is fixed at approximately 50 percent. Simultaneous operation of both VCO's in the same package is not recommended.

The SN54LS324 thru SN54LS327 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ ; the SN74LS324 thru SN74LS327 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

## schematics of inputs and outputs



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

Supply voltage, $V_{CC}$ (see Notes 1 and 2)	7 V
Input voltage: Enable input ('LS324 and 'LS326)	7 V
Frequency control or range input	$V_{CC}$
Operating free-air temperature range: SN54LS' Circuits	$-55^{\circ}\text{C}$ to $125^{\circ}\text{C}$
SN74LS' Circuits	$0^{\circ}\text{C}$ to $70^{\circ}\text{C}$
Storage temperature range	$-85^{\circ}\text{C}$ to $150^{\circ}\text{C}$

NOTES: 1. Voltage values are with respect to the appropriate ground terminal.

2. Throughout this data sheet, the symbol  $V_{CC}$  is used for the voltage applied to both the  $V_{CC}$  and  $\ominus V_{CC}$  terminals, unless otherwise noted.

# TYPES SN54LS324 THRU SN54LS327, SN74LS324 THRU SN74LS327 VOLTAGE-CONTROLLED OSCILLATORS

## recommended operating conditions

	SN54LS <sup>†</sup>			SN74LS <sup>†</sup>			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, $V_{CC}$	4.5	5	5.5	4.75	5	5.25	V
Input voltage at frequency control or range input, $V_{I(freq)}$ or $V_{I(rng)}$ $\Delta$	0		5	0		5	V
High-level output current, $I_{OH}$			-1.2			-1.2	mA
Low-level output current, $I_{OL}$			12			24	mA
Output frequency (enabled), $f_o$	1			1			Hz
			20			20	MHz
Operating free-air temperature, $T_A$	-55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS <sup>†</sup>	SN54LS <sup>†</sup>			SN74LS <sup>†</sup>			UNIT
			MIN	TYP <sup>‡</sup>	MAX	MIN	TYP <sup>‡</sup>	MAX	
$V_{IH}$	High-level input voltage at enable <sup>§</sup>		2			2			V
$V_{IL}$	Low-level input voltage at enable <sup>§</sup>				0.7			0.8	V
$V_{IK}$	Input clamp voltage at enable <sup>§</sup>	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$			-1.5			-1.5	V
$V_{OH}$	High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, I_{OH} = -1.2 \text{ mA}$ , See Note 3	2.5	3.4		2.7	3.4		V
$V_{OL}$	Low-level output voltage	$V_{CC} = \text{MIN}, \ominus V_{CC} \text{ open}, I_{OL} = 12 \text{ mA}$ $V_{IL} = V_{IL \text{ max}}$	$I_{OL} = 12 \text{ mA}$		0.25	0.4	0.25	0.4	V
			$I_{OL} = 24 \text{ mA}$				0.35	0.5	
$I_I$	Input current	Freq control or range $\Delta$	$V_{CC} = \text{MAX}$						$\mu\text{A}$
			$V_I = 5 \text{ V}$	50	250	50	250		
			$V_I = 1 \text{ V}$	10	50	10	50		
$I_{I1}$	Input current at maximum input voltage	Enable <sup>¶</sup>	$V_{CC} = \text{MAX}, V_I = 7 \text{ V}$				0.1	0.1	mA
$I_{IH}$	High-level input current	Enable <sup>¶</sup>	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$				20	20	$\mu\text{A}$
$I_{IL}$	Low-level input current	Enable <sup>¶</sup>	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$				-0.4	-0.4	mA
$I_{OS}$	Short-circuit output current <sup>§</sup>	$V_{CC} = \text{MAX}$	-40		-225	-40		-225	mA
$I_{CC}$	Supply current, total into $V_{CC}$ and $\ominus V_{CC}$ pins	$V_{CC} = \text{Max}$ See Note 4	'LS324, 'LS326		18	30	18	30	mA
			'LS325, 'LS327		30	50	30	50	

<sup>†</sup>For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

<sup>‡</sup>All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

<sup>§</sup>Not more than one output should be shorted at a time and duration of the short-circuit should not exceed one second.

<sup>¶</sup>The characteristics involving an enable input are applicable to 'LS324 and 'LS326 only.

NOTES: 3.  $V_{OH}$  is measured for Y outputs by connecting a 1-k $\Omega$  resistor from CX1 to  $V_{CC}$  and another 1-k $\Omega$  resistor from CX2 to GND. This procedure is reversed for testing  $V_{OH}$  of  $\bar{Y}$  outputs (not applicable to 'LS327). That is, a 1-k $\Omega$  resistor is connected from CX2 to  $V_{CC}$  and another 1-k $\Omega$  resistor from CX1 to GND. During the  $V_{OH}$  tests of 'LS324 and 'LS326, the enable pin should be at  $V_{IL \text{ max}}$ .

4. For 'LS324 and 'LS326,  $I_{CC}$  is measured with the outputs disabled and open, and  $\ominus V_{CC} = \text{MAX}$ . For 'LS325 and 'LS327,  $I_{CC}$  is measured with one  $\ominus V_{CC} = \text{MAX}$ , and with the other  $\ominus V_{CC}$  and outputs open.

switching characteristics,  $V_{CC} = 5 \text{ V}$  (unless otherwise noted),  $R_L = 667 \Omega$ ,  $C_L = 45 \text{ pF}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$f_o$	Output frequency	$C_{ext} = 2 \text{ pF}$	$V_{I(freq)} = 5 \text{ V}, V_{I(rng)} = 0 \text{ V}$	20	30		MHz
$f_o$	Output frequency (crystal controlled)		$V_{I(freq)} = 0 \text{ V}, V_{I(rng)} = 5 \text{ V}$	11	20		
	Output duty cycle	$C_{ext} = 8.3 \text{ pF}$ to 500 $\mu\text{F}$			50%		
$t_{PHL}$	Propagation delay time, high-to-low-level output from enable	$f_o > 1 \text{ Hz}$			30+*		ns

\*The range input is provided only on the 'LS324.

\*The delay will typically be 30 ns pulse up to one period of one cycle (i.e.  $30 \text{ ns} + \frac{1 \times 10^9}{f_o(\text{Hz})} \text{ ns}$ ) depending upon the timing of the enable pulse with respect to the signal generated by the internal oscillator.