

# TYPES SN54LS320, SN54LS321, SN74LS320, SN74LS321 CRYSTAL-CONTROLLED OSCILLATORS

D2418, DECEMBER 1978—REVISED JANUARY 1981

## 'LS320

- Crystal-Controlled Oscillator Operation from 1 MHz to 20 MHz
- 2-Phase Driver Outputs

## 'LS321

- Similar to 'LS320 But Includes f/2 and f/4 Count-Down Outputs

### description

The 'LS320 is a crystal-controlled oscillator/clock driver. It features complementary standard and high-current driver outputs. A synchronization flip-flop is included.

The driver outputs, F' and  $\bar{F}'$  have very-low impedance and can be used to drive highly capacitive TTL-level lines. If the driver outputs are not used, then the VCC' terminal can be left open.

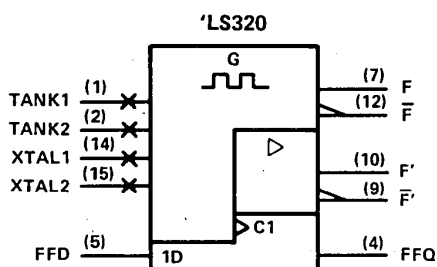
The 'LS321 is identical to the 'LS320 except it additionally features two count-down outputs, F/2 and F/4.

These circuits were designed for crystal control of frequency and capacitive control is not recommended. If a fundamental crystal is used, an inductor of 5 to 160  $\mu$ H is required to be connected between the tank 1 and tank 2 inputs. †

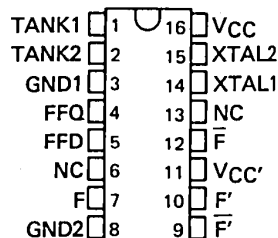
Interaction of the driver outputs with the other outputs limits useful frequencies as shown in the frequency-limits table.

The SN54LS320 and SN54LS321 are characterized for operation over the full military temperature range of -55°C to 125°C. The SN74LS320 and SN74LS321 are characterized for operation from 0°C to 70°C.

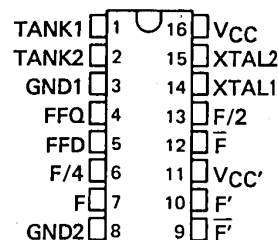
### logic symbols



SN54LS320 ... J PACKAGE  
SN74LS320 ... J OR N PACKAGE  
(TOP VIEW)



SN54LS321 ... J PACKAGE  
SN74LS321 ... J OR N PACKAGE  
(TOP VIEW)



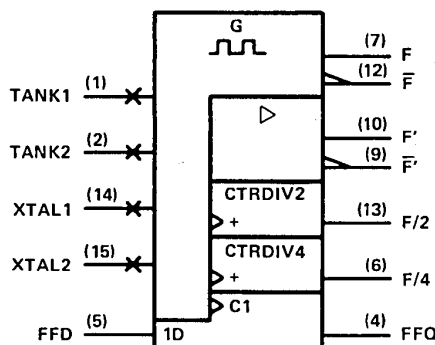
NC - No internal connection.

For chip carrier information,  
contact the factory.

### FREQUENCY LIMITS

OUTPUTS IN USE	V <sub>CC</sub>	V <sub>CC</sub> '	f <sub>max</sub>
Driver outputs only	5 V	5 V	20 MHz
Other outputs only	5 V	Open	20 MHz
Driver and any other outputs	5 V	5 V	10 MHz

### 'LS321



†The value of the inductor is selected from the graph in Figure 2. Use the next higher standard inductor value if the selected value is not available. If a third overtone crystal is used, a tuned tank is necessary. The center frequency of the tuned tank is determined by the equation  $f = \frac{1}{2} \pi \sqrt{LC}$ .

**PRODUCTION DATA**  
This document contains information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

TEXAS  
INSTRUMENTS

POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

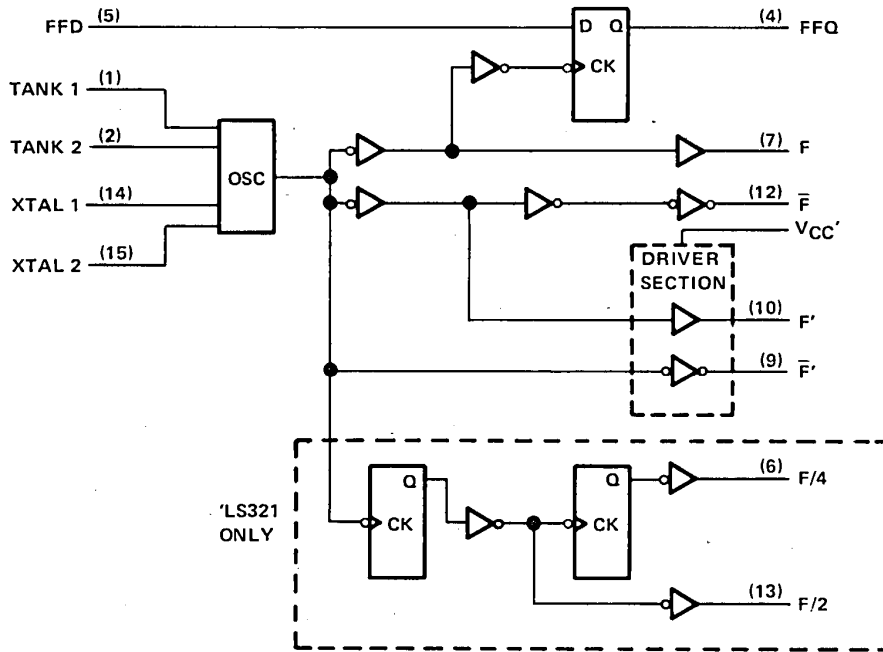
3-963

3

TTL DEVICES

# TYPES SN54LS320, SN54LS321, SN74LS320, SN74LS321 CRYSTAL-CONTROLLED OSCILLATORS

logic diagram (positive logic)



Pin numbers shown on logic notation are for J or N packages.

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

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Supply voltage, $V_{CC}'$	7 V
Input voltage to FFD terminal	-0.5 V to 7 V
Operating free-air temperature range: SN54LS320, SN54LS321	-55°C to 125°C
SN74LS320, SN74LS321	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminals.

## recommended operating conditions

	SN54LS320 SN54LS321			SN74LS320 SN74LS321			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, $V_{CC}$	4.5	5	5.5	4.75	5	5.25	V
Supply voltage, $V_{CC}'$	4.5	5	5.5	4.75	5	5.25	V
High-level output current, $I_{OH}$	F' or F-bar'		-12			-24	mA
	F, F-bar, F/2, F/4		-0.4			-0.4	
Low-level output current, $I_{OL}$	F' or F-bar'		12			24	mA
	F, F-bar, F/2, F/4		4			8	
Output frequency, $f_{out}$	F/2 ('LS321)		0.5	10		10	MHz
	F/4 ('LS321)		0.25	5		5	
	F or F-bar		1	20		20	
Operating free-air temperature, $T_A$	-55		125	0		70	°C

Input and output schematics are similar to those shown for SN74LS326.

## TYPES SN54LS320, SN54LS321, SN74LS320, SN74LS321 CRYSTAL-CONTROLLED OSCILLATORS

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

PARAMETER	TEST CONDITIONS†	SN54LS320 SN54LS321			SN74LS320 SN74LS321			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V <sub>IH</sub> High-level input voltage		2			2			V
V <sub>IL</sub> Low-level input voltage					0.7			V
V <sub>IK</sub> Input clamp voltage	V <sub>CC</sub> = MIN, V <sub>CC'</sub> = MIN, I <sub>I</sub> = -18 mA				-1.5			V
V <sub>OH</sub> High-level output voltage	F', F̄'	V <sub>CC</sub> = 4.5 V, V <sub>CC'</sub> = 4.5 V, I <sub>OH</sub> = -12 mA		2.5		3.3		V
		V <sub>CC</sub> = 4.75 V, V <sub>CC'</sub> = 4.75 V, I <sub>OH</sub> = -24 mA				2.7 3.3		
	Others	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, I <sub>OH</sub> = -400 μA		2.5 3.4		2.7 3.4		
V <sub>OL</sub> Low-level output voltage	F', F̄'	V <sub>CC</sub> = MIN, V <sub>CC'</sub> = MIN	I <sub>OL</sub> = 12 mA	0.25 0.4		0.25 0.4		V
			I <sub>OL</sub> = 24 mA			0.35 0.5		
	Others	V <sub>CC</sub> = MIN, V <sub>IL</sub> = V <sub>IL max</sub>	I <sub>OL</sub> = 4 mA	0.25 0.4		0.25 0.4		
			I <sub>OL</sub> = 8 mA			0.35 0.5		
I <sub>I</sub> Input current at maximum input voltage	V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V				0.1		0.1	mA
I <sub>IH</sub> High-level input current	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V				20		20	μA
I <sub>IL</sub> Low-level input current	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V				-0.4		-0.4	mA
I <sub>OS</sub> Short-circuit output current §	V <sub>CC</sub> = MAX	-20			-100			mA
I <sub>CC</sub> Supply current from V <sub>CC</sub>	V <sub>CC</sub> = MAX, FFD at GND	'LS320		42 70		42 70		mA
		'LS321		47 75		47 75		
I <sub>CC'</sub> Supply current from V <sub>CC'</sub>	V <sub>CC</sub> = MAX, V <sub>CC'</sub> = MAX, FFD at GND	4 8		4 8		4 8		mA

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

‡ All typical values are at V<sub>CC</sub> = 5 V, V<sub>CC'</sub> = 5 V, and T<sub>A</sub> = 25°C.

§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second. Outputs F' and F̄' do not have short-circuit protection and these limits do not apply.

switching characteristics, V<sub>CC</sub> = 5 V, V<sub>CC'</sub> = 5 V, T<sub>A</sub> = 25°C

PARAMETER	OUTPUTS	TEST CONDITIONS	'LS320			'LS321			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
f <sub>max</sub> Maximum operating frequency	F/2	C <sub>L</sub> = 100 pF R <sub>L</sub> = 667 Ω				10 15			MHz
	F/4					5 7.5			
	All others		20 30			20 30			
t <sub>r</sub> Rise time, 1 V to 3 V	F', F̄'	C <sub>L</sub> = 50 pF	6		12		6 12		ns
		C <sub>L</sub> = 100 pF	7		14		7 14		
		C <sub>L</sub> = 200 pF	7		14		7 14		
	Others	C <sub>L</sub> = 50 pF	11		22		11 22		
		C <sub>L</sub> = 100 pF	25		40		25 40		
		C <sub>L</sub> = 200 pF	45		70		45 70		
t <sub>r</sub> Fall time, 3 V to 1 V	F', F̄'	C <sub>L</sub> = 50 pF	5		10		5 10		ns
		C <sub>L</sub> = 100 pF	5		10		5 10		
		C <sub>L</sub> = 200 pF	6		12		6 12		
	Others	C <sub>L</sub> = 50 pF	6		12		6 12		
		C <sub>L</sub> = 100 pF	10		20		10 20		
		C <sub>L</sub> = 200 pF	17		30		17 30		

¶ See General Information Section for load circuits and voltage waveforms.

  
**TEXAS  
INSTRUMENTS**

POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

3-965

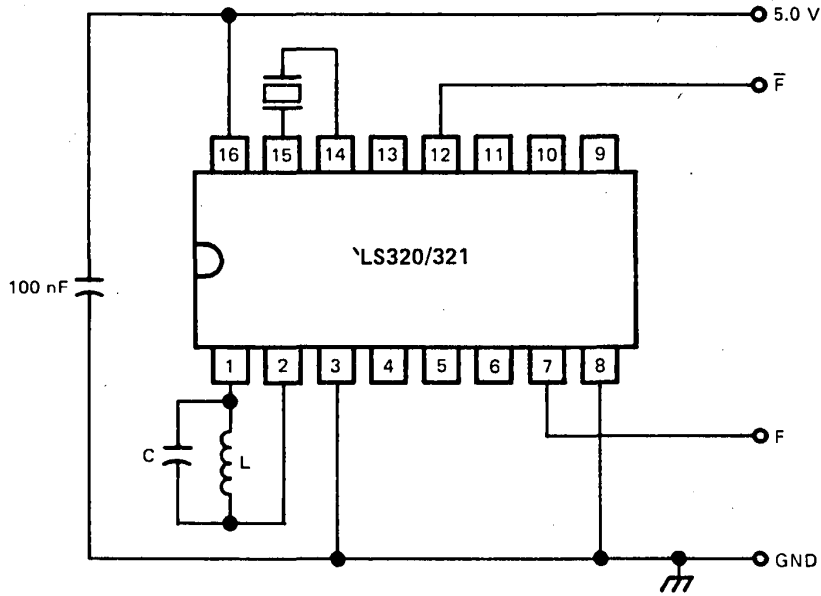


TTL DEVICES

**TYPES SN54LS320, SN54LS321, SN74LS320, SN74LS321  
CRYSTAL-CONTROLLED OSCILLATORS**

**TYPICAL APPLICATION DATA**

The SN54/74LS320 and 'LS321 are crystal-controlled oscillators. Figure 1 shows the device with all required external components.



**FIGURE 1. CRYSTAL-CONTROLLED OSCILLATOR 'LS320/321**

1. Determination of C and L are as follows:
  - a. Inductance L  
Select Inductance L according to Figure 2.
  - b. Capacitor C

$$C = C_S - C_P - C_L$$

- Where:
- $C_P$  = parasitic board capacitance
  - $C_L$  = parasitic capacitance of the inductor
  - L = inductance
  - $C_S$  = required capacitance calculated as follows:

$$C_S = \frac{1}{(2 \cdot \pi \cdot f_q)^2 \cdot L}$$

for  $f_q > 12$  MHz,  $C = 0$  pf

2. Electrical characteristic for the crystal:  
The quartz crystal used as a frequency reference should be designed for series mode operation with a resistance in the  $20 \Omega$  to  $75 \Omega$  range and be capable of a minimum 2 mw power dissipation.  
It is recommended to use a tuned tank also for fundamental crystals.

TYPES SN54LS320, SN54LS321, SN74LS320, SN74LS321  
CRYSTAL-CONTROLLED OSCILLATORS

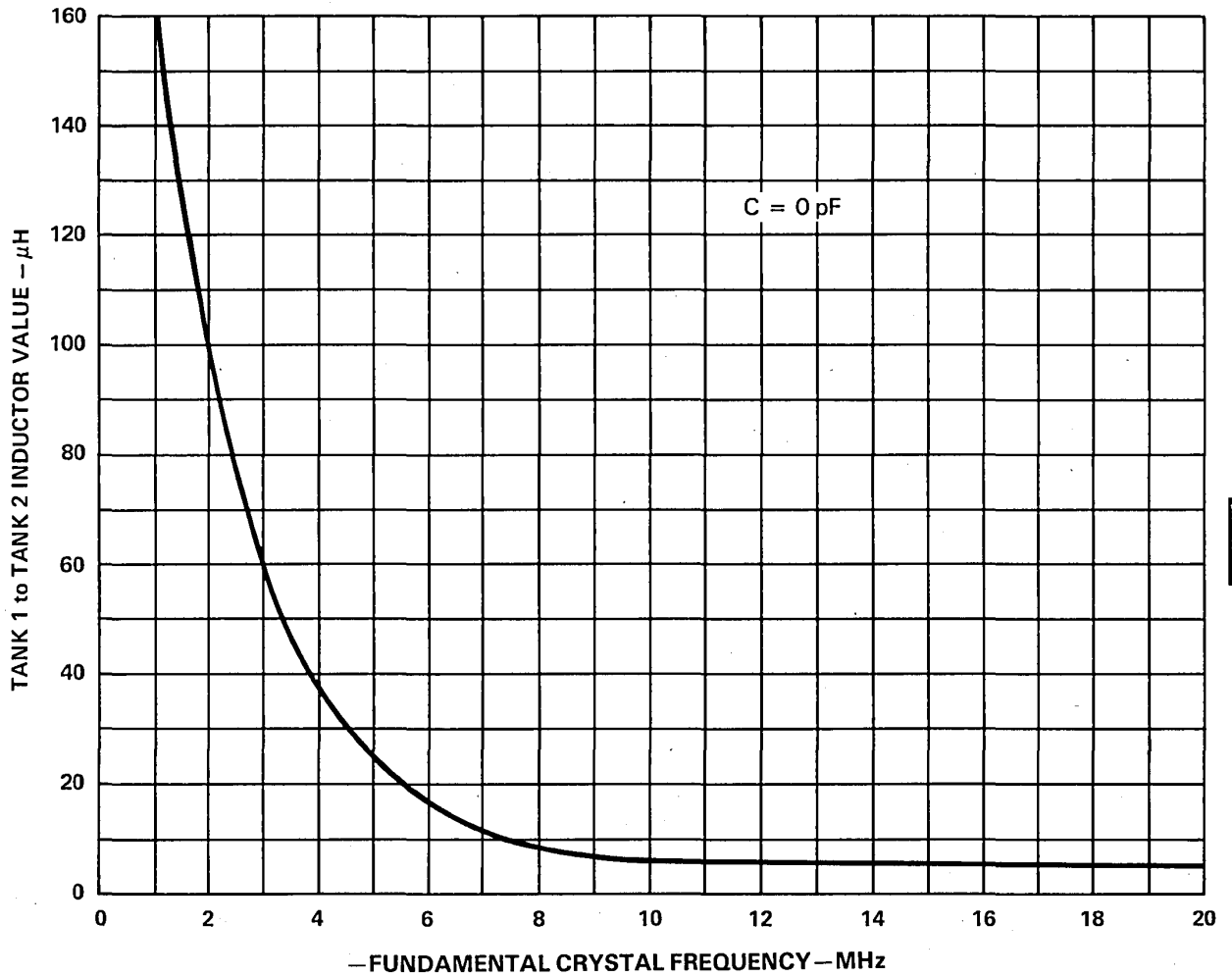


FIGURE 2

3

TTL DEVICES