

SN54LS320, SN54LS321, SN74LS320, SN74LS321 CRYSTAL-CONTROLLED OSCILLATORS

SDLS158 – DECEMBER 1978 – REVISED MARCH 1988

'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.

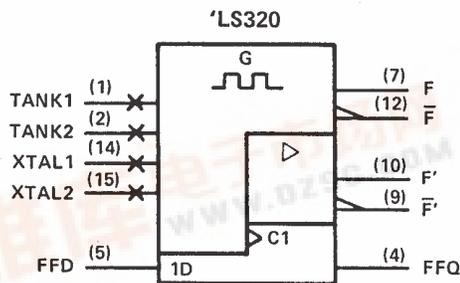
The 'LS321 is identical to the 'LS320 except it additionally features two count-down outputs, F/2 and F/4.

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 μH is required to be connected between the tank 1 and tank 2 inputs. †

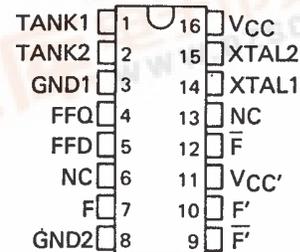
Interaction of the driver outputs with the other outputs limits useful frequencies as shown in the frequency-limits table.

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 .

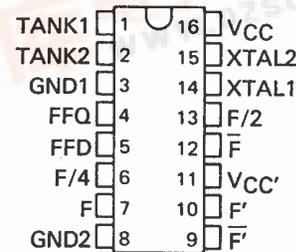
logic symbols†



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



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



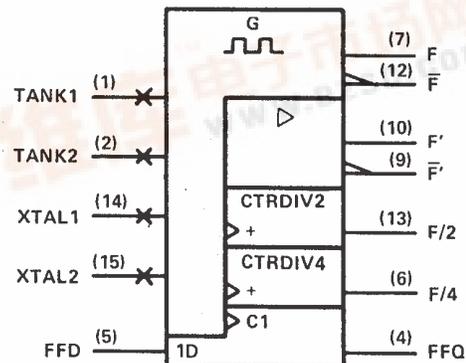
NC – No internal connection.

For chip carrier information, contact the factory.

FREQUENCY LIMITS

OUTPUTS IN USE	VCC	VCC'	f _{max}
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 $f = \frac{1}{2} \pi \sqrt{LC}$.

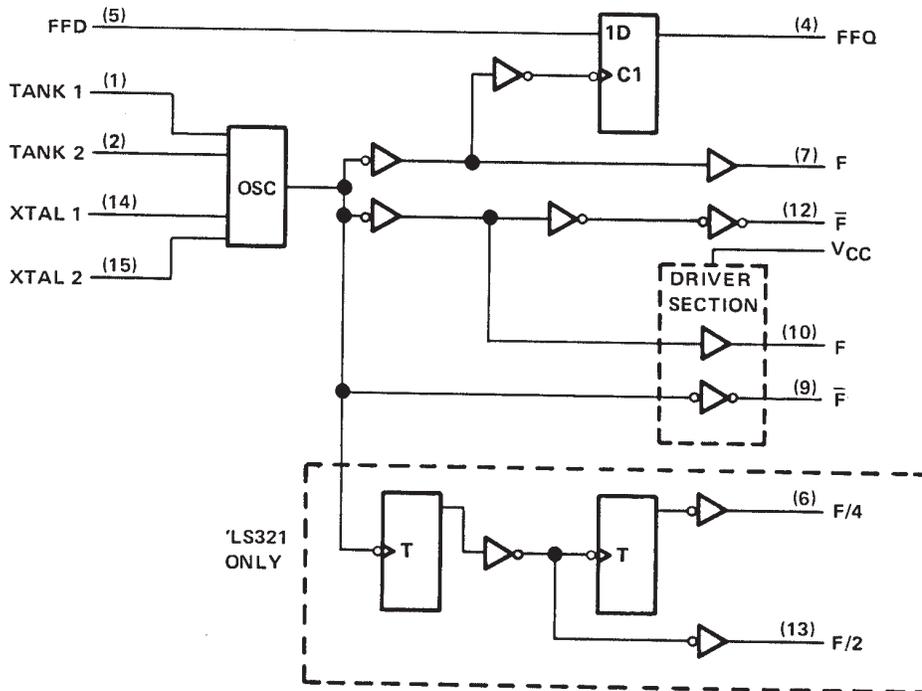
‡These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.



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logic diagram (positive logic)



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 \bar{F}'		-12			-24	mA
	$F, \bar{F}, F/2, F/4$		-0.4			-0.4	
Low-level output current, I_{OL}	F' or \bar{F}'		12			24	mA
	$F, \bar{F}, F/2, F/4$		4			8	
Output frequency, f_{out}	$F/2$ ('LS321)		0.5			10	MHz
	$F/4$ ('LS321)		0.25			5	
	F or \bar{F}		1			20	
Operating free-air temperature, T_A			-55			125	°C

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

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

PARAMETER		TEST CONDITIONS†		SN54LS320		SN74LS320		UNIT	
				SN54LS321		SN74LS321			
				MIN	TYP‡	MAX	MIN	TYP‡	MAX
V _{IH}	High-level input voltage			2		2		V	
V _{IL}	Low-level input voltage					0.7		0.8	
V _{IK}	Input clamp voltage	V _{CC} = MIN, V _{CC'} = MIN, I _I = -18 mA				-1.5		-1.5	
V _{OH}	High-level output voltage	F', F̄'	V _{CC} = 4.5 V, V _{CC'} = 4.5 V, I _{OH} = -12 mA	2.4	3.3				
			V _{CC} = 4.75 V, V _{CC'} = 4.75 V, I _{OH} = -24 mA			2.7	3.3		
		Others	V _{CC} = MIN, V _{IH} = 2 V, I _{OH} = -400 μA	2.4	3.4	2.7	3.4		
V _{OL}	Low-level output voltage	F', F̄'	V _{CC} = MIN, V _{CC'} = MIN	I _{OL} = 12 mA	0.25	0.4	0.25	0.4	V
				I _{OL} = 24 mA			0.35	0.5	
		Others	V _{CC} = MIN, V _{IL} = V _{IL max}	I _{OL} = 4 mA	0.25	0.4	0.25	0.4	
				I _{OL} = 8 mA			0.35	0.5	
I _I	Input current at maximum input voltage	V _{CC} = MAX, V _I = 7 V				0.1	0.1	mA	
I _{IH}	High-level input current	V _{CC} = MAX, V _I = 2.7 V				20	20	μA	
I _{IL}	Low-level input current	V _{CC} = MAX, V _I = 0.4 V				-0.4	-0.4	mA	
I _{OS}	Short-circuit output current §	V _{CC} = MAX		-20	-100	-20	-100	mA	
I _{CC}	Supply current from V _{CC}	V _{CC} = MAX, FFD at GND	'LS320	42	70	42	70	mA	
			'LS321	47	75	47	75		
I _{CC'}	Supply current from V _{CC'}	V _{CC} = MAX, V _{CC'} = MAX, FFD at GND		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_{CC} = 5 V, V_{CC'} = 5 V, and T_A = 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_{CC} = 5 V, V_{CC'} = 5 V, T_A = 25°C

PARAMETER	OUTPUTS	TEST CONDITIONS†		'LS320			'LS321			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f _{max}	F/2	C _L = 100 pF	R _L = 667 Ω				10	15	MHz	
	F/4						5	7.5		
	All others			R _L = 2 kΩ			20	30		
t _r	F', F'	C _L = 50 pF	R _L = 667 Ω	6	12	6	12	ns		
		C _L = 100 pF		7	14	7	14			
		C _L = 200 pF		7	14	7	14			
	Others	C _L = 50 pF	R _L = 2 kΩ	11	22	11	22			
		C _L = 100 pF		25	40	25	40			
		C _L = 200 pF		45	70	45	70			
t _f	F', F'	C _L = 50 pF	R _L = 667 Ω	5	10	5	10	ns		
		C _L = 100 pF		5	10	5	10			
		C _L = 200 pF		6	12	6	12			
	Others	C _L = 50 pF	R _L = 2 kΩ	6	12	6	12			
		C _L = 100 pF		10	20	10	20			
		C _L = 200 pF		17	30	17	30			

† Load circuits and voltage waveforms are shown in Section 1.

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TYPICAL APPLICATION DATA

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

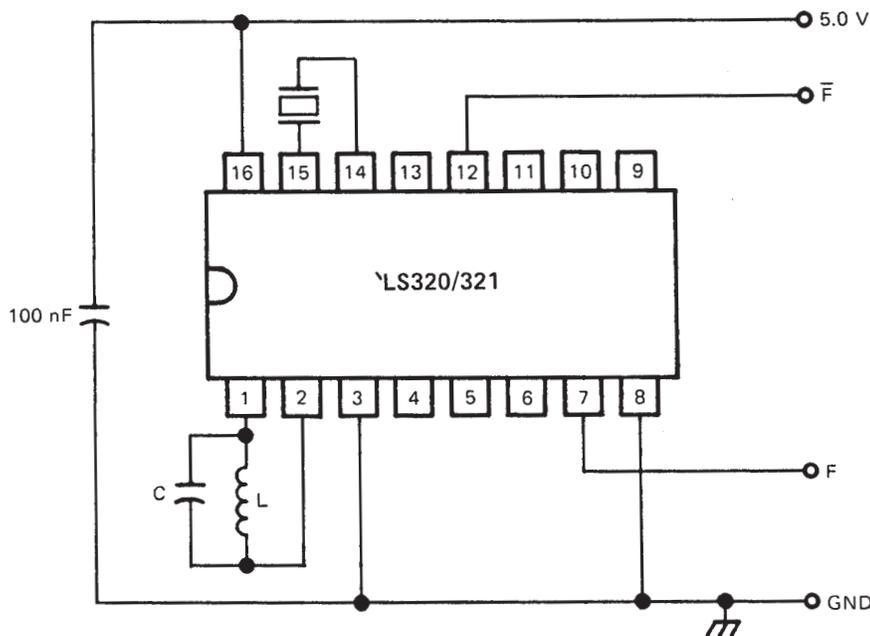


FIGURE 1. CRYSTAL-CONTROLLED OSCILLATOR 'LS320/321

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 Ω to 75 Ω range and be capable of a minimum 2 mw power dissipation.
It is recommended to use a tuned tank also for fundamental crystals.

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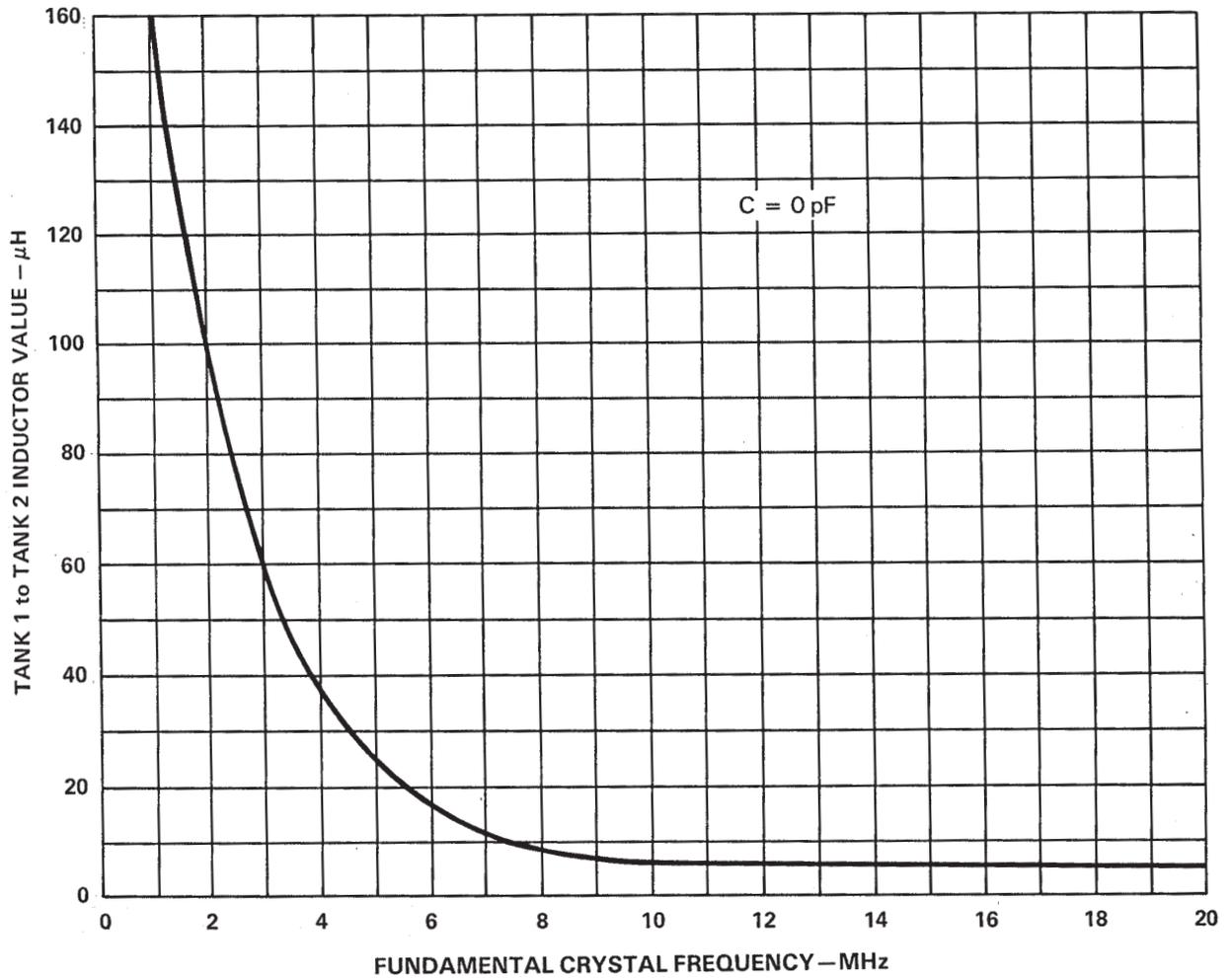


FIGURE 2

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