

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 V_{CC}' terminal can be left open.

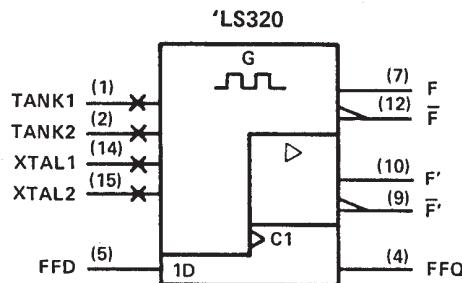
The 'LS321 is identical to the 'LS320 except it additionally features two count-down outputs, F/2 and F/4.

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 μ 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 OR W PACKAGE
SN74LS320 . . . N PACKAGE
(TOP VIEW)

TANK1	1	16	V _{CC}
TANK2	2	15	XTAL2
GND1	3	14	XTAL1
FFQ	4	13	NC
FFD	5	12	F
NC	6	11	V _{CC} '
F	7	10	F'
GND2	8	9	F'

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

TANK1	1	16	V _{CC}
TANK2	2	15	XTAL2
GND1	3	14	XTAL1
FFQ	4	13	F/2
FFD	5	12	F
F/4	6	11	V _{CC} '
F	7	10	F'
GND2	8	9	F'

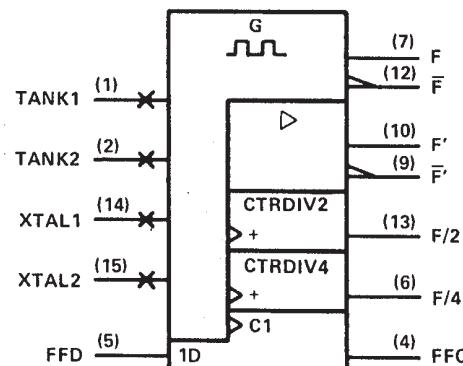
NC – No internal connection.

For chip carrier information,
contact the factory.

FREQUENCY LIMITS

OUTPUTS IN USE	V _{CC}	V _{CC} '	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



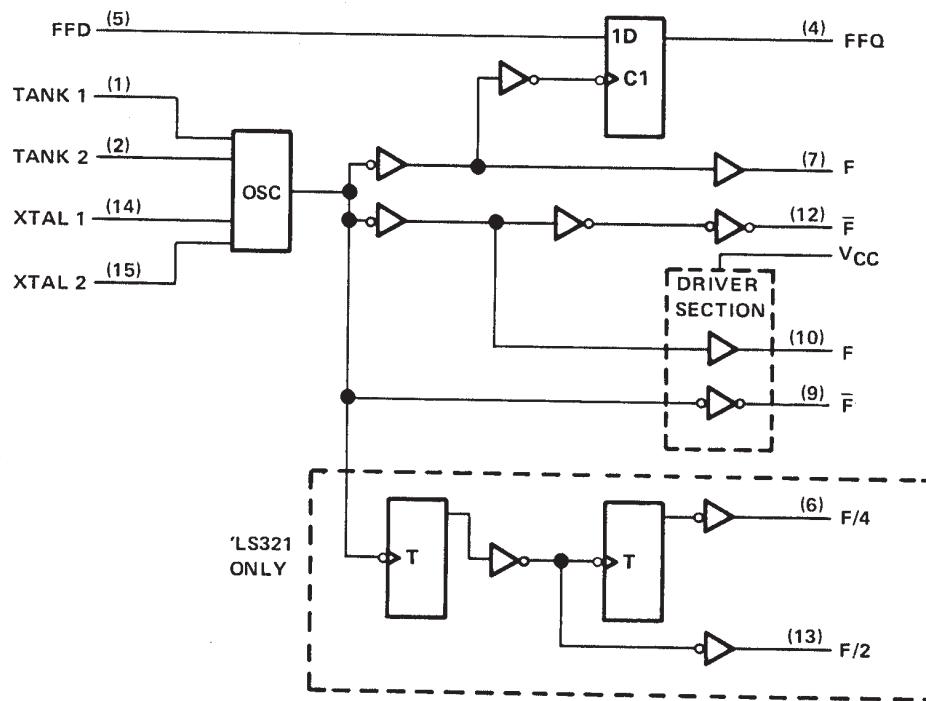
†The value of the inductor is selected from the graph in Figure 2. Use the next higher standard inductor value if the selected value is not available. If a third overtone crystal is used, a tuned tank is necessary. The center frequency of the tuned tank is determined by the equation $f = \frac{1}{2}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

‡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)

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
	F , \bar{F} , $F/2$, $F/4$			-0.4			-0.4
Low-level output current, I_{OL}	F' or \bar{F}'			12			24
	F , \bar{F} , $F/2$, $F/4$			4			8
Output frequency, f_{out}	$F/2$ ('LS321)	0.5	10	0.5	10		
	$F/4$ ('LS321)	0.25	5	0.25	5		
	F or \bar{F}	1	20	1	20		
Operating free-air temperature, T_A	-55		125	0		70	°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	
					MIN	TYP [‡]		
V _{IH}	High-level input voltage				2		V	
V _{IL}	Low-level input voltage					0.7	V	
V _{IK}	Input clamp voltage	V _{CC} = MIN, V _{CC'} = MIN, I _I = -18 mA				-1.5	V	
V _{OH}	High-level output voltage	V _{CC} = 4.5 V, V _{CC'} = 4.5 V, I _{OH} = -12 mA		2.4	3.3		V	
		V _{CC} = 4.75 V, V _{CC'} = 4.75 V, I _{OH} = -24 mA				2.7		
		Others V _{CC} = MIN, V _{IH} = 2 V, I _{OH} = -400 μ A		2.4	3.4	2.7		
V _{OL}	Low-level output voltage	V _{CC} = MIN, V _{CC'} = MIN	I _{OL} = 12 mA	0.25	0.4	0.25	V	
			I _{OL} = 24 mA			0.35		
		Others V _{CC} = MIN, V _{IL} = V _{IL} max	I _{OL} = 4 mA	0.25	0.4	0.25		
			I _{OL} = 8 mA			0.35		
I _I	Input current at maximum input voltage	V _{CC} = MAX, V _I = 7 V			0.1		mA	
I _{IH}	High-level input current	V _{CC} = MAX, V _I = 2.7 V			20		μ A	
I _{IL}	Low-level input current	V _{CC} = MAX, V _I = 0.4 V			-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 \bar{F}' 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		
f _{max}	Maximum operating frequency	F/2	C _L = 100 pF	R _L = 667 Ω			10	15	MHz	
		F/4					5	7.5		
		All others		R _L = 2 k Ω	20	30		20		
t _r	Rise time, 1 V to 3 V	C _L = 50 pF	F', F'	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	
		C _L = 50 pF	Others	R _L = 2 k Ω		11	22	11	22	
		C _L = 100 pF				25	40	25	40	
		C _L = 200 pF				45	70	45	70	
		C _L = 50 pF	F', F'	R _L = 667 Ω		5	10	5	10	
		C _L = 100 pF				5	10	5	10	
		C _L = 200 pF				6	12	6	12	
t _r	Fall time, 3 V to 1 V	C _L = 50 pF	Others	R _L = 667 Ω		6	12	6	12	ns
		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.

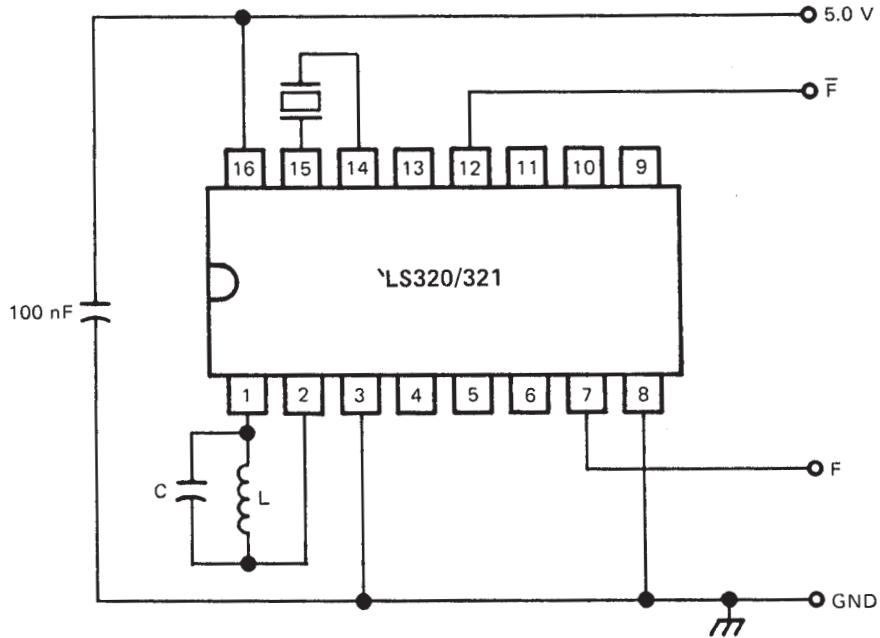


FIGURE 1. CRYSTAL-CONTROLLED OSCILLATOR 'LS320/321

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 20Ω to 75Ω 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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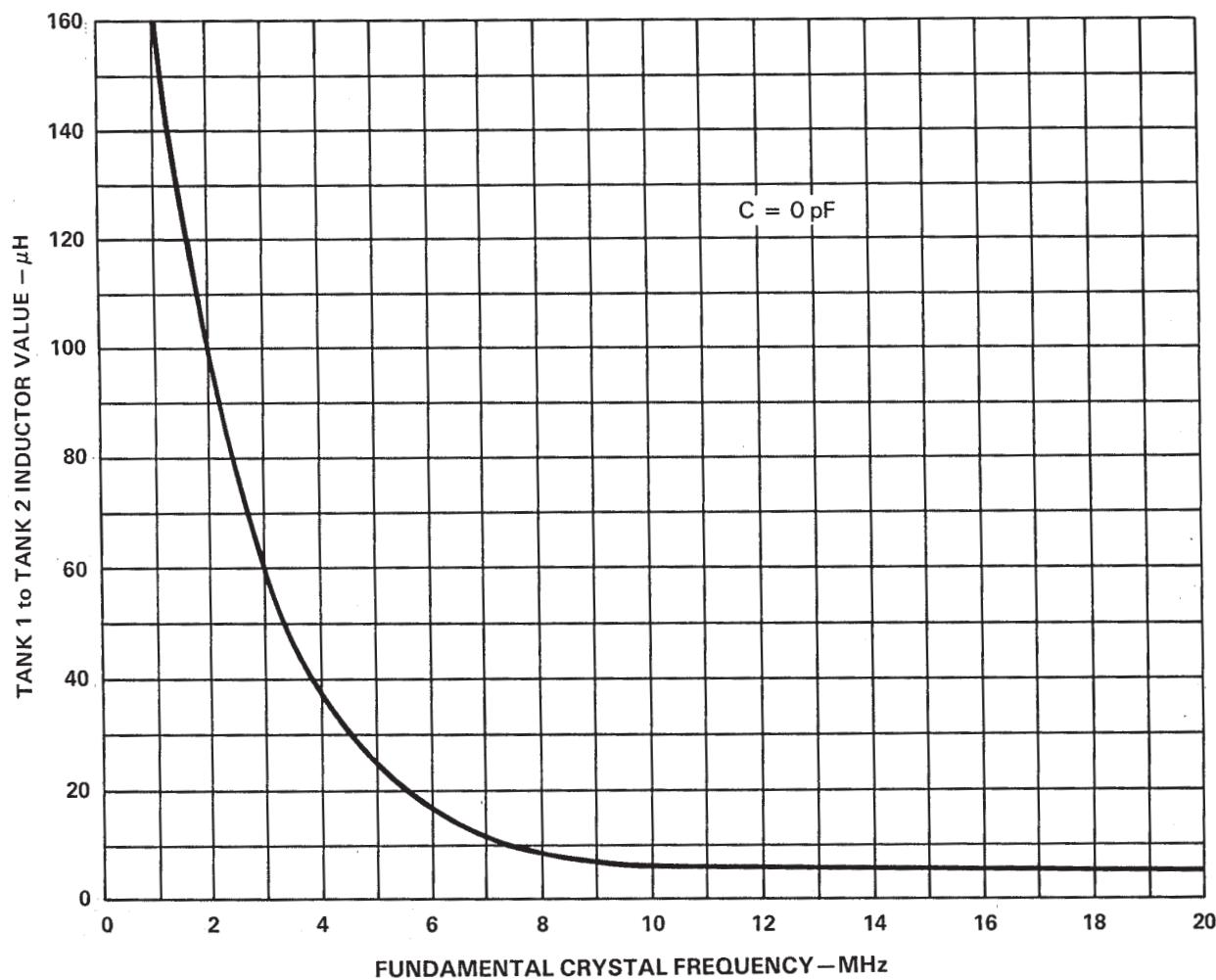


FIGURE 2

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