

74LVC1GX04

One chip crystal oscillator driver



Description

The 74LVC1GX04 combines the functions of the 74LVC1GU04 and 74LVC1G04 into a single package to provide a device optimized for use in crystal oscillator applications. This integration produces the benefits of a compact footprint, lower power dissipation, and stable operation over a wide range of frequency and temperature.

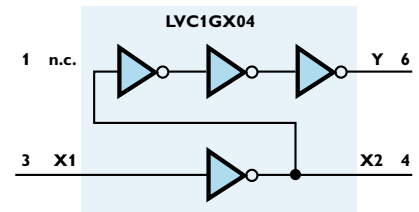
The device is fully specified for partial power-down applications using I_{off} at output Y. This disables the output, preventing damaging backflow current when the device is powered down.

Applications

- Crystal Oscillator
- Astable Multivibrator

Benefits

- Single chip
- Low Power
- Optimized design can be reused regardless of system load



Features

- + / - 24 mA output drive
- Multiple package options
- Wide supply voltage range 1.65 to 5.5 volts
- Wide operating temperature range -40 to +125°C
- Demo board available
- Isolation of the Crystal from system loading
- Astable Multivibrator

Quick reference data

GND = 0V; $T_{amb} = 25^{\circ}\text{C}$

Symbol	Parameter	Conditions	Typical	Unit
τ_{PHL}/τ_{PLH}	propagation delay input X1 to output X2	$V_{CC} = 1.8\text{V}; C_L = 30\text{ pF}; R_L = 1\text{ k}\Omega$	2.1	ns
		$V_{CC} = 2.5\text{V}; C_L = 30\text{ pF}; R_L = 500\ \Omega$	1.7	ns
		$V_{CC} = 2.7\text{V}; C_L = 50\text{ pF}; R_L = 500\ \Omega$	2.5	ns
		$V_{CC} = 3.3\text{V}; C_L = 50\text{ pF}; R_L = 500\ \Omega$	2.1	ns
		$V_{CC} = 5.0\text{V}; C_L = 50\text{ pF}; R_L = 500\ \Omega$	1.6	ns
τ_{PHL}/τ_{PLH}	propagation delay input X1 to output Y	$V_{CC} = 1.8\text{V}; C_L = 30\text{ pF}; R_L = 1\text{ k}\Omega$	4.1	ns
		$V_{CC} = 2.5\text{V}; C_L = 30\text{ pF}; R_L = 500\ \Omega$	2.9	ns
		$V_{CC} = 2.7\text{V}; C_L = 50\text{ pF}; R_L = 500\ \Omega$	3.0	ns
		$V_{CC} = 3.3\text{V}; C_L = 50\text{ pF}; R_L = 500\ \Omega$	2.8	ns
		$V_{CC} = 5.0\text{V}; C_L = 50\text{ pF}; R_L = 500\ \Omega$	2.3	ns
C_I	input capacitance		5	pF
C_{PD}	power dissipation capacitance per buffer	output enabled	35	pF

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In designing a crystal oscillator, the values of C_1 and C_2 as shown in the reference design are dependent on the selected crystal. R_1 is critical to the start up performance and drive level to the crystal. Because the system load is isolated by the internal buffer in the 74LVC1GX04, these calculations can be done once for many different system loads. For the reference design as shown, the crystal load capacitance (C_L) should be equal to the capacitance C_1 and C_2 in parallel in addition to any stray capacitance (C_s)

C_1 and C_2 should be equal and the designer can use the following formula to calculate the value:

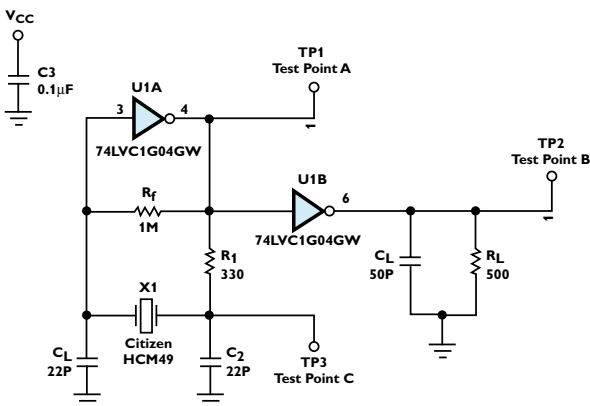
$$C_L = (C_1 * C_2) / (C_1 + C_2) + C_s$$

Where:

C_L is the load capacitance as specified by the crystal manufacturer; C_s is the stray capacitance of the circuit which is equal to the input capacitance of the 74LVC1GX04 of 5 pF. The feedback resistor (R_f) provides negative feedback and sets a bias point for the un-buffered inverter. This value is not critical and is typically 1 Meg.

The starting value for R_1 should be equal to the reactance of C_2 at the crystal frequency. ($R_1 = X_{C2}$)

Evaluation Board reference design schematic



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This will result in an input to the crystal of 50% of the rail to rail output of X2. Usually this keeps the drive level into the crystal within the specifications of the crystal but the designer should verify this. Overdriving the crystal can cause damage.

After the calculations are performed for a particular crystal, the oscillator circuit should be tested. The following simple checks will verify the prototype design of a crystal controlled oscillator:

- Test the oscillator over worse case conditions of min-max operating voltage and temperature. You can also simulate worse case crystal variations by adding series and parallel resistors.
- Insure that the circuit does not oscillate when the crystal is removed.
- Check the frequency stability over a supply range slightly greater than which is likely to occur during normal operation.
- Check that the start up time is within system requirements.

Ordering information

Part Number	Temp. Range	Pins	Packages			
			Package	Material	Code	Marking
74LVC1GX04GW	-40° to +125° C	6	SC-88	plastic	SOT363	VX
74LVC1GX04GV	-40° to +125° C	6	SC-74	plastic	SOT457	VX4

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