



### Description

The ICS501B LOCO™ is the most cost effective way to generate a high-quality clock output from a lower frequency crystal or clock input. The name LOCO stands for Low Cost Oscillator, as it is designed to replace crystal oscillators in most electronic systems. Using Phase-Locked Loop (PLL) techniques, the device uses a standard fundamental mode, inexpensive crystal to produce output clocks up to 20 MHz.

Stored in the chip's ROM is the ability to generate nine different multiplication factors, allowing one chip to output many common frequencies (see table on page 2).

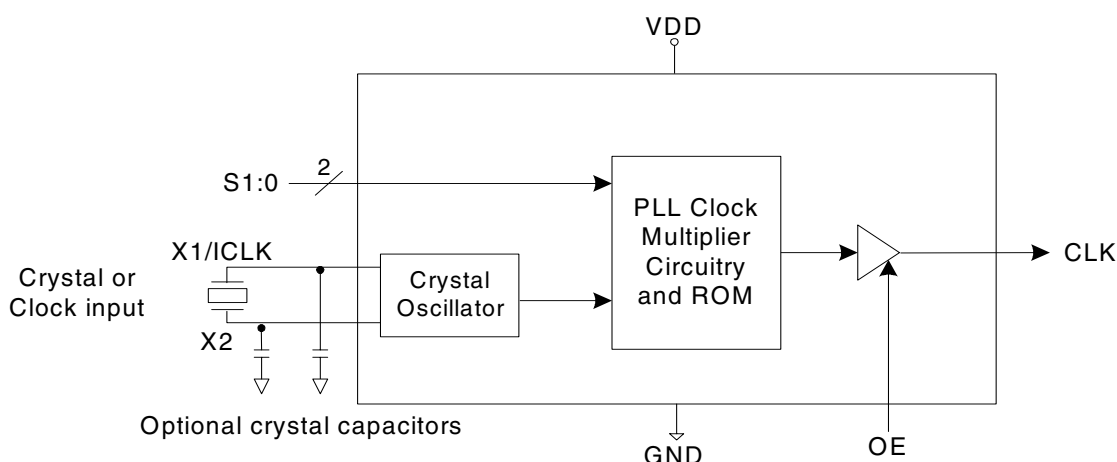
The device also has an output enable pin which tri-states the clock output when the OE pin is taken low.

This product is intended for clock generation. It has low output jitter (variation in the output period), but input to output skew and jitter are not defined or guaranteed. For applications which require defined input to output skew, use the ICS570B.

### Features

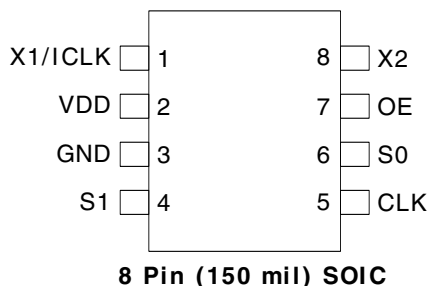
- Packaged as 8 pin SOIC or die
- Available in Pb (lead) free package
- ICS' lowest cost PLL clock
- Zero ppm multiplication error
- Input crystal frequency of 5 – 10 MHz
- Input clock frequency of 2 – 10 MHz
- Output clock frequencies up to 20 MHz
- Extremely low jitter of 25 ps (one sigma)
- Compatible with popular CPUs
- Duty cycle of 45/55 up to 20 MHz
- Nine selectable frequencies
- Operating voltage of 3.3 V or 5.5 V
- Tri-state output for board level testing
- 25 mA drive capability at TTL levels
- Ideal for oscillator replacement
- Industrial temperature version available
- Advanced, low-power CMOS process

### Block Diagram





## Pin Assignment



## Clock Output Table

S1	S0	CLK	Minimum Input
0	0	4X input	per page 5
0	M	5.3125X input	20 MHz
0	1	5X input	per page 5
M	0	6.25X input	4 MHz
M	M	2X input	per page 5
M	1	3.125X input	8 MHz
1	0	6X input	per page 5
1	M	3X input	per page 5
1	1	8X input	per page 5

0 = connect directly to ground

1 = connect directly to VDD

M = leave unconnected (floating)

## Pin Descriptions

Pin Number	Pin Name	Pin Type	Pin Description
1	XI/ICLK	Input	Crystal connection or clock input.
2	VDD	Power	Connect to +3.3 V or +5 V.
3	GND	Power	Connect to ground.
4	S1	Tri-level Input	Select 1 for output clock. Connect to GND or VDD or float.
5	CLK	Output	Clock output per table above.
6	S0	Tri-level Input	Select 0 for output clock. Connect to GND or VDD or float.
7	OE	Input	Output enable. Tri-states CLK output when low. Internal pull-up.
8	X2	Output	Crystal connection. Leave unconnected for clock input.



## External Components

### Decoupling Capacitor

As with any high-performance mixed-signal IC, the ICS501B must be isolated from system power supply noise to perform optimally.

A decoupling capacitor of 0.01 $\mu$ F must be connected between VDD and the GND. It must be connected close to the ICS501B to minimize lead inductance. No external power supply filtering is required for the ICS501B.

### Series Termination Resistor

A 33 $\Omega$  terminating resistor can be used next to the CLK pin for trace lengths over one inch.

### Crystal Load Capacitors

The total on-chip capacitance is approximately 12 pF. A parallel resonant, fundamental mode crystal should be used. The device crystal connections should include pads for small capacitors from X1 to ground and from X2 to ground. These capacitors are used to adjust the stray capacitance of the board to match the nominally required crystal load capacitance. Because load capacitance can only be increased in this trimming process, it is important to keep stray capacitance to a minimum by using very short PCB traces (and no vias) between the crystal and device. Crystal capacitors, if needed, must be connected from each of the pins X1 and X2 to ground.

The value (in pF) of these crystal caps should equal  $(C_L - 12 \text{ pF}) \times 2$ . In this equation,  $C_L$  = crystal load capacitance in pF. Example: For a crystal with a 16 pF load capacitance, each crystal capacitor would be 8 pF  $[(16 - 12) \times 2] = 8$ .



## Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS501B. These ratings, which are standard values for ICS commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

Item	Rating
Supply Voltage, VDD	7 V
All Inputs and Outputs	-0.5 V to VDD+0.5 V
Ambient Operating Temperature	-40 to +85°C
Storage Temperature	-65 to +150°C
Soldering Temperature	260°C

## Recommended Operation Conditions

Parameter	Min.	Typ.	Max.	Units
Ambient Operating Temperature	0		+70	°C
Power Supply Voltage (measured in respect to GND)	+3.14		+5.25	V

## DC Electrical Characteristics

VDD=5.0 V  $\pm$ 5% , Ambient temperature 0 to +70°C, unless stated otherwise

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Operating Voltage	VDD		3.14		5.25	V
Input High Voltage, ICLK only	V <sub>IH</sub>	ICLK (pin 1)	(VDD/2)+1			V
Input Low Voltage, ICLK only	V <sub>IL</sub>	ICLK (pin 1)			(VDD/2)-1	V
Input High Voltage	V <sub>IH</sub>	OE (pin 7)	2.0			V
Input Low Voltage	V <sub>IL</sub>	OE (pin 7)			0.8	V
Input High Voltage	V <sub>IH</sub>	S0, S1	VDD-0.5			V
Input Low Voltage	V <sub>IL</sub>	S0, S1			0.5	V
Output High Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -25 mA	2.4			V
Output Low Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 25 mA			0.4	V
IDD Operating Supply Current		No load		20		mA
Short Circuit Current		CLK output		$\pm$ 70		mA
On-Chip Pull-up Resistor		Pin 7		270		k $\Omega$
Input Capacitance, S1, S0, and OE		Pins 4, 6, 7		4		pF
Nominal Output Impedance				20		$\Omega$



## AC Electrical Characteristics

VDD = 5.0 V  $\pm$ 5%, Ambient Temperature 0 to +70° C, unless stated otherwise

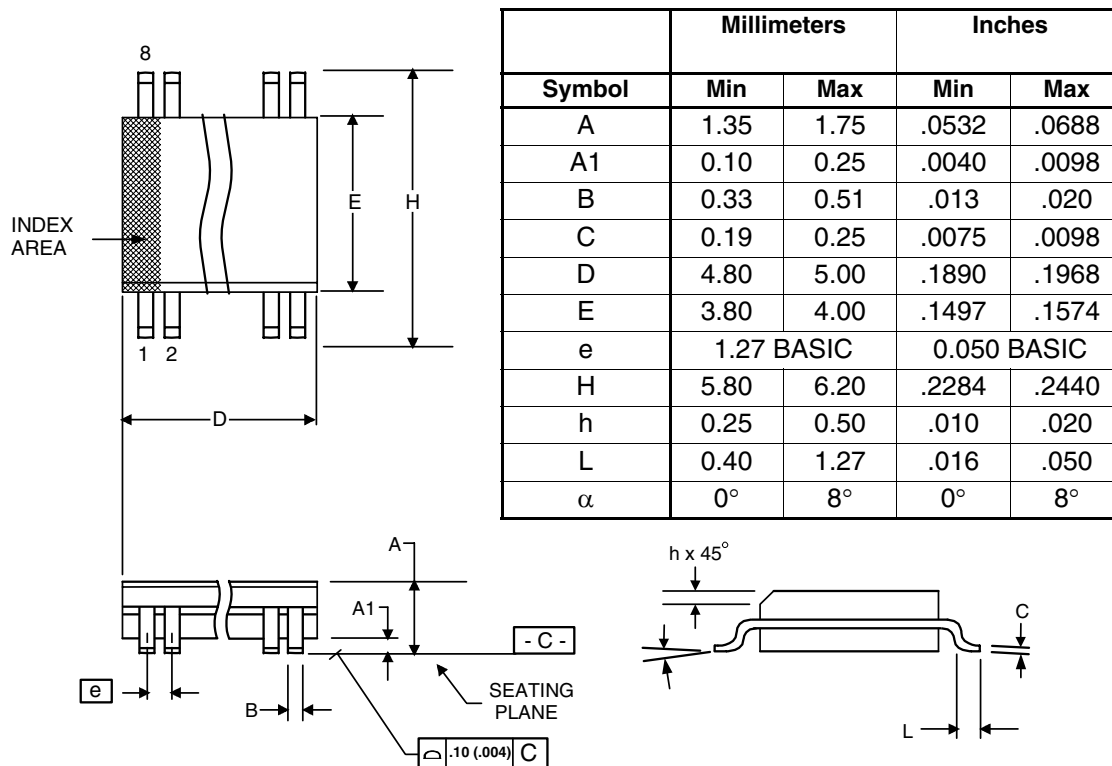
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Frequency, crystal input	F <sub>IN</sub>		5		10	MHz
Input Frequency, clock input	F <sub>IN</sub>		2		10	MHz
Output Frequency, VDD = 5.0 V $\pm$ 5%	F <sub>OUT</sub>	0°C to +70°C	4		20	MHz
		-40°C to +85°C	4		20	MHz
Output Frequency, VDD = 3.3 V $\pm$ 5%	F <sub>OUT</sub>	0°C to +70°C	4		14	MHz
		-40°C to +85°C	4		14	MHz
Output Clock Rise Time	t <sub>OR</sub>	0.8 to 2.0 V, Note 1		1		ns
Output Clock Fall Time	t <sub>OF</sub>	2.0 to 8.0 V, Note 1		1		ns
Output Clock Duty Cycle	t <sub>OD</sub>	1.5 V, up to 25 MHz	45	49-51	55	%
PLL Bandwidth			10			kHz
Output Enable Time, OE high to output on				50		ns
Output Disable Time, OE low to tri-state				50		ns
Absolute Clock Period Jitter	t <sub>ja</sub>	Deviation from mean, Note 1		$\pm$ 70		ps
One Sigma Clock Period Jitter	t <sub>js</sub>	Note 1		25		ps

Note 1: Measured with 15 pF load.



## Package Outline and Package Dimensions (8-pin SOIC, 150 Mil. Narrow Body)

Package dimensions are kept current with JEDEC Publication No. 95



## Ordering Information

Part / Order Number	Marking	Shipping Packaging	Package	Temperature
ICS501BM	501BM	Tubes	8-pin SOIC	0 to +70° C
ICS501BMT	501BM	Tape and Reel	8-pin SOIC	0 to +70° C
ICS501BMI	501BMI	Tubes	8-pin SOIC	-40 to +85° C
ICS501BMIT	501BMI	Tape and Reel	8-pin SOIC	-40 to +85° C
ICS501BMLF	501BML	Tubes	8-pin SOIC	0 to +70° C
ICS501BMLFT	501BML	Tape and Reel	8-pin SOIC	0 to +70° C
ICS501BMILF	501BMIL	Tubes	8-pin SOIC	-40 to +85° C
ICS501BMILFT	501BMIL	Tape and Reel	8-pin SOIC	-40 to +85° C
ICS501-DWF	-	Die on uncut, probed wafers		0 to +70° C
ICS501-DPK	-	Tested die in waffle pack		0 to +70° C

“LF” denotes Pb (lead) free package.

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