



# ICS672-01/02

## Delay Buffer

## Description

The ICS672-01 and ICS672-02 are zero delay buffers that generate four output clocks whose phases are spaced at 90° intervals. Based on ICS' proprietary low jitter Phase Locked Loop (PLL) techniques, each device provides five low skew outputs, with clock rates up to 84 MHz for the ICS672-01 and up to 135 MHz for the ICS672-02. By providing outputs delayed one quarter clock cycle, the device is useful for systems requiring early or late clocks.

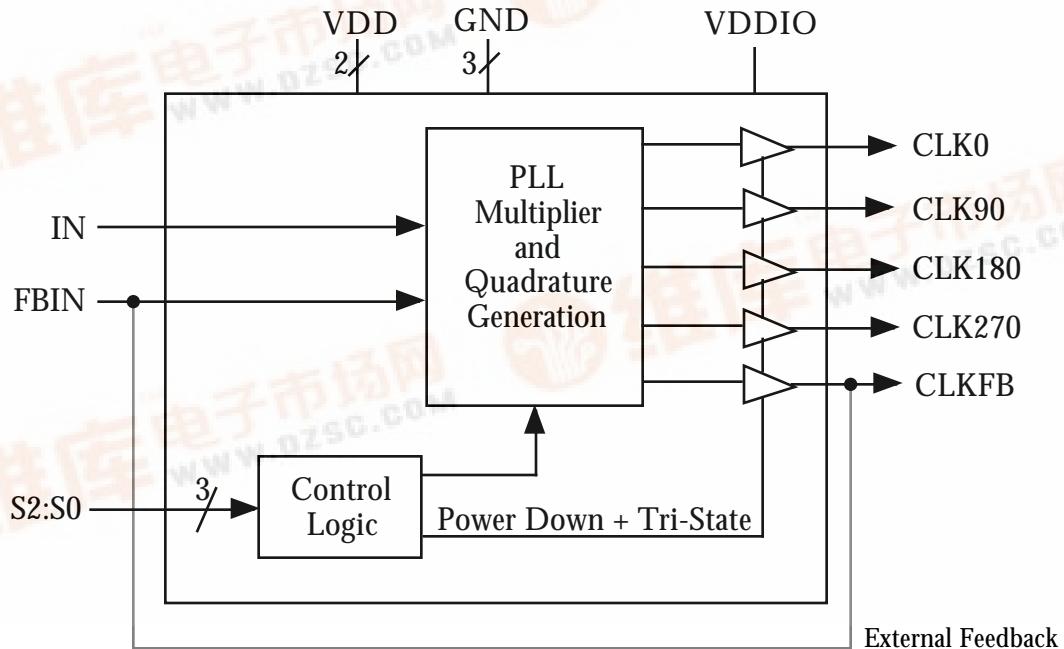
The ICS672-01/02 include multiplier selections of x0.5, x1, x2, x3, x4, x5, or x6. They also offer a mode to power down all internal circuitry and tri state the outputs. In normal operation, output clock FBCLK is tied to the FBIN pin.

ICS manufactures the largest variety of clock generators and buffers, and is the largest clock supplier in the world.

## Features

- Packaged in 16 pin narrow SOIC
- Input clock range from 10 MHz to 150 MHz
- Clock outputs from up to 84 MHz (ICS672-01) and up to 135 MHz (ICS672-02)
- Zero input-output delay
- Integrated x0.5, x1, x2, x3, x4, x5, or x6 selections
- Four accurate (<250 ps) outputs with 0°, 90°, 180°, and 270° phase shift from ICLK, and one FBCLK (0°)
- Separate supply for output clocks from 2.5V to 5V
- Full CMOS outputs (TTL compatible)
- Tri state mode for board-level testing
- Includes Power Down for power savings
- Advanced, low power, sub-micron CMOS process
- 3.3 V to 5 V operating voltage
- Industrial temperature version available

## Block Diagram





# ICS672-01/02

## QuadraClock™ Quadrature Delay Buffer

### Pin Assignment

ICS672-01/02

ICLK	1	16	FBIN
CLK90	2	15	FBCLK
CLK180	3	14	CLK0
CLK270	4	13	VDD
VDDIO	5	12	GND
GND	6	11	VDD
GND	7	10	S2
S0	8	9	S1

16 pin narrow (150 mil) SOIC

### Output Clock Mode Select Table

S2	S1	S0	Output Clocks
0	0	0	Power Down + Tri State
0	0	1	x1
0	1	0	x2
0	1	1	x3
1	0	0	x4
1	0	1	x5
1	1	0	x6
1	1	1	x0.5

### Pin Descriptions

Number	Name	Type	Description
1	ICLK	I	Clock Input.
2	CLK90	O	Clock Output (90° delayed from CLK0).
3	CLK180	O	Clock Output (180° delayed from CLK0).
4	CLK270	O	Clock Output (270° delayed from CLK0).
5	VDDIO	P	Supply voltage for input and output clocks. Must not exceed VDD.
6, 7, 12	GND	P	Connect to ground.
8	S0	I	Select input 0. See table above.
9	S1	I	Select input 1. See table above.
10	S2	I	Select input 2. See table above.
11, 13	VDD	P	Connect to +3.3 V or +5.0 V.
14	CLK0	O	Clock Output phase aligned to ICLK.
15	FBCLK	O	Feedback Clock Output (0° phase shift from CLK0).
16	FBIN	I	Feedback Clock Input. In normal operation, connect to FBCLK

Key: I = Input; O = output; P = power supply connection.

### External Components

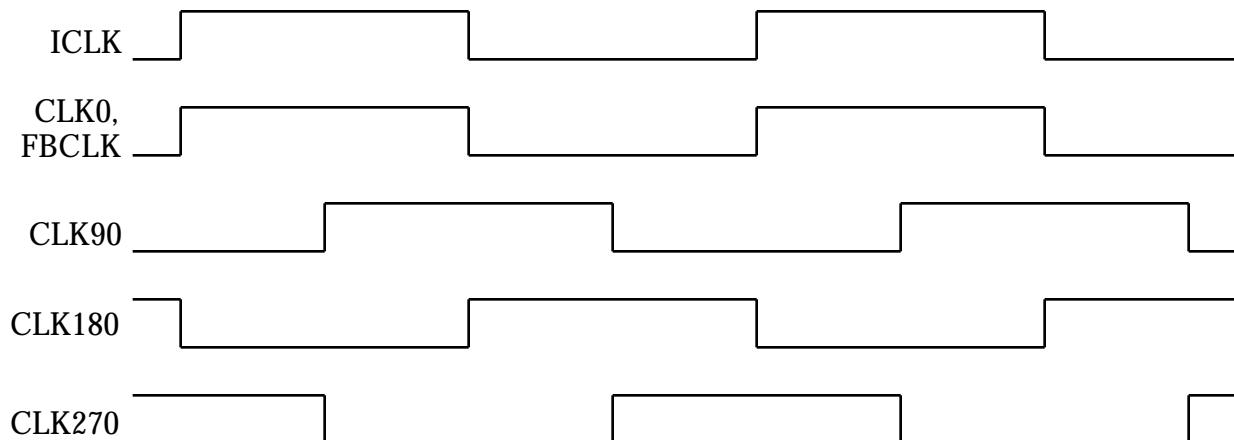
The ICS672-01/01 requires a minimum number of external components for proper operation. Decoupling capacitors of  $0.01\mu\text{F}$  should be connected between VDD and GND on pins 11 and 12, VDD and GND on pins 13 and 12, and VDDIO and GND on pins 5 and 6, as close to the device as possible. A series termination resistor of  $33\text{ }\Omega$  may be used close to each clock output pin to reduce reflections.



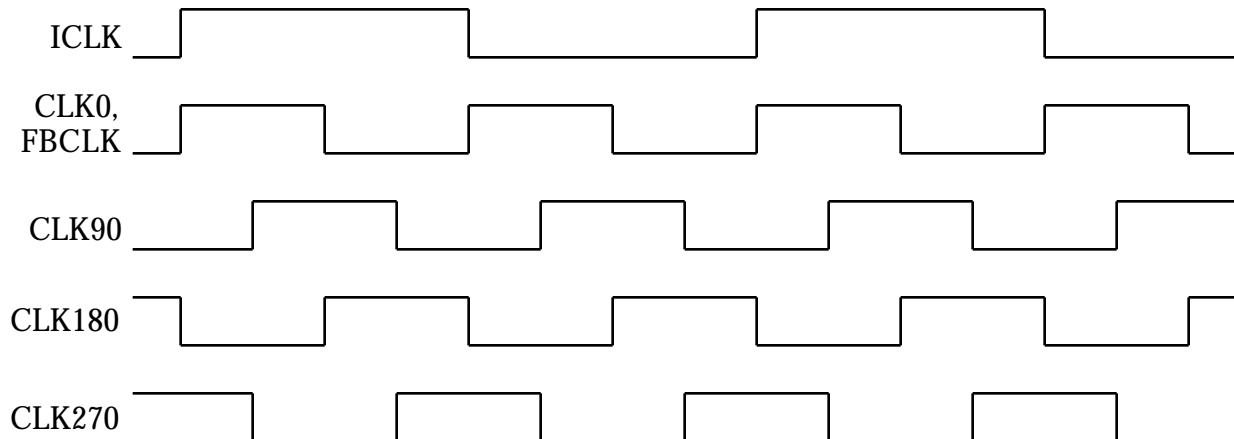
## Operation and Applications

The ICS672-01/02 each provide a total of five output clocks with multiple phase shifts relative to the input clock (ICLK). Phase shifts of 0° (CLK0), 90° (CLK90), 180° (CLK180), and 270° (CLK270) are provided, plus one feedback clock (FBCLK). All output clocks will be a multiple of the input clock, as determined by the table on page 2. Refer to the illustrations in Figure 1 and Figure 2.

FBCLK is connected to the feedback input (FBIN) to provide a zero delay through the ICS672-01/02. FBCLK has a 0° phase shift from ICLK.



**Figure 1. Phase alignment of input and output clocks. (x1 multiplier)**



**Figure 2. Phase alignment of input and output clocks. (x2 multiplier)**



ICS672-01/02

## QuadraClock™ Quadrature Delay Buffer

## Electrical Specifications

Parameter	Conditions	Minimum	Typical	Maximum	Units
<b>ABSOLUTE MAXIMUM RATINGS (note 1)</b>					
Supply voltage, VDD & VDDIO	Referenced to GND	-0.5		7	V
Inputs and Clock Outputs	Referenced to GND	-0.5		VDD+0.5	V
Electrostatic Discharge	MIL-STD-883	2000			V
Ambient Operating Temperature		0		70	°C
Ambient Operating Temperature, Industrial	Available on -02 only	-40		85	°C
Soldering Temperature	Max of 10 seconds			260	°C
Junction temperature				150	°C
Storage temperature		-65		150	°C
<b>DC CHARACTERISTICS (VDD =VDDIO = 3.3 V unless specified otherwise)</b>					
Operating Voltage, VDD		3.13		5.50	V
Operating Voltage, VDDIO		2.375		VDD	V
Input High Voltage, VIH, ICLK only		VDD/2+1			V
Input Low Voltage, VIL, ICLK only				VDD/2-1	V
Input High Voltage, VIH		2			V
Input Low Voltage, VIL				0.8	V
Output High Voltage, VOH	IOH=-12 mA	2.4			V
Output Low Voltage, VOL	IOL=12 mA			0.4	V
Output High Voltage, VOH, CMOS level	IOH=-8mA	VDDIO-0.4			V
Operating Supply Current, IDD (Note 2)	No Load, S1=1, S0=0, S2=0		11		mA
Operating Supply Current, IDD (Note 3)	No Load, S1=1, S0=0, S2=0		22		mA
Short Circuit Current	Each output		±50		mA
Input Capacitance			7		pF
<b>AC CHARACTERISTICS (VDD = VDDIO = 3.3 V unless specified otherwise)</b>					
Input Clock Frequency		15		150	MHz
Output Clock Frequency	ICS672-01	15		84	MHz
Output Clock Frequency	ICS672-02	15		135	MHz
Output Clock Rise Time, CL = 15 pF	0.8 to 2.0V			1.5	ns
Output Clock Fall Time, CL = 15 pF	2.0 to 0.8V			1.5	ns
Output Clock Duty Cycle, VDDIO=3.3V	At VDDIO/2	45	50	55	%
Phased Outputs Accuracy (Note 4)	rising edges at VDDIO/2	-250		250	ps
Input to Output Skew, ICLK to CLK0 (Note 5)		-300		300	ps
Maximum Absolute Jitter			75		ps
Cycle to Cycle Jitter, 15 pF loads			150		ps

Notes:

1. Stresses beyond those listed under Absolute Maximum Ratings could cause permanent damage to the device. Prolonged exposure to levels above the operating limits but below the Absolute Maximums may affect device reliability.
2. With ICLK = 20 MHz, FBCLK to FBIN, all outputs at 40 MHz.
3. With ICLK = 66.5 MHz, FBCLK to FBIN, all outputs at 133 MHz.
4. With CLK0:CLK270 equally loaded, and output frequency > 60 MHz.
5. Rising edge of ICLK compared with rising edge of CLK0, with FBCLK connected to FBIN, 15 pF load on CLK0, and CLK0 > 60 MHz.



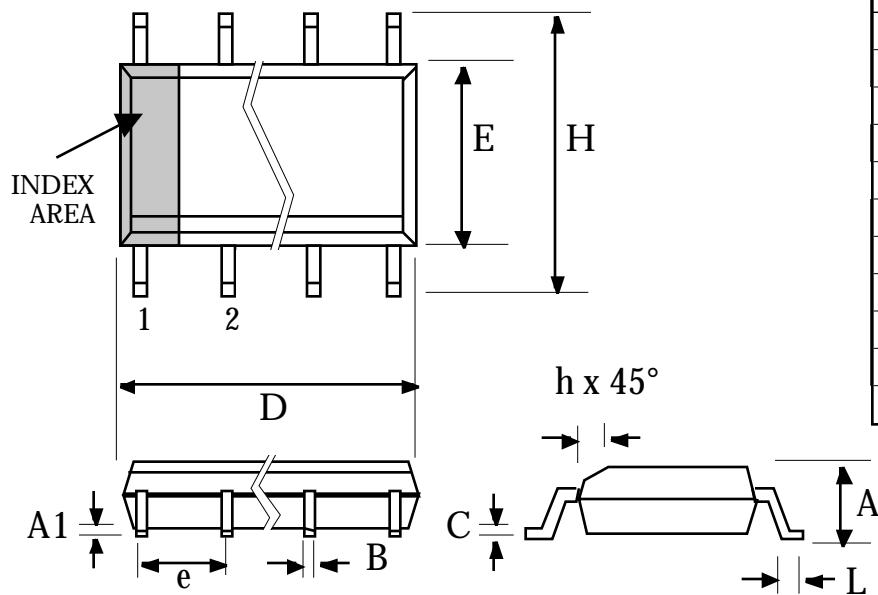
# ICS672-01/02

## QuadraClock™ Quadrature Delay Buffer

### Package Outline and Package Dimensions

(For current dimensional specifications, see JEDEC Publication No. 95.)

16 pin SOIC narrow



Symbol	Inches		Millimeters	
	Min	Max	Min	Max
A	0.0532	0.0688	1.35	1.75
A1	0.0040	0.0098	0.10	0.24
B	0.0130	0.0200	0.33	0.51
C	0.0075	0.0098	0.19	0.24
D	0.3859	0.3937	9.80	10.00
E	0.1497	0.1574	3.80	4.00
e	.050 BSC		1.27 BSC	
H	0.2284	0.2440	5.80	6.20
h	0.0099	0.0195	0.25	0.50
L	0.0160	0.0500	0.41	1.27

### Ordering Information

Part/Order Number	Marking	Shipping packaging	Package	Temperature
ICS672M-01	ICS672M-01	tubes	16 pin SOIC	0 to 70 °C
ICS672M-01T	ICS672M-01	tape and reel	16 pin SOIC	0 to 70 °C
ICS672M-02	ICS672M-02	tubes	16 pin SOIC	0 to 70 °C
ICS672M-02T	ICS672M-02	tape and reel	16 pin SOIC	0 to 70 °C
ICS672M-02I	ICS672M-02I	tubes	16 pin SOIC	-40 to 85 °C
ICS672M-02IT	ICS672M-02I	tape and reel	16 pin SOIC	-40 to 85 °C

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