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QUADRACLOCK QUADRATURE DELAY BUFFER

ICS672-01/02

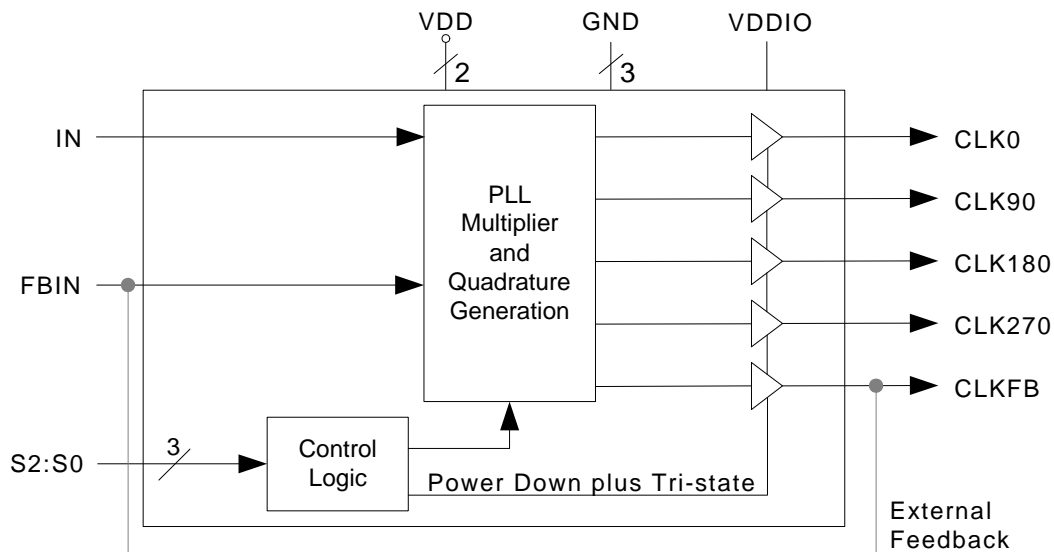
Description

The ICS672-01/02 are zero delay buffers that generate four output clocks whose phases are spaced at 90° intervals. Based on IDT's 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.

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

Features

- Packaged in 16-pin SOIC
- Pb (lead) free package, RoHS compliant
- Input clock range from 5 MHz to 150 MHz (depends on multiplier)
- 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 2.5 V to 5 V
- 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


Pin Assignment

| | | | | | |
|--------|--------------------------|---|----|--------------------------|-------|
| ICLK | <input type="checkbox"/> | 1 | 16 | <input type="checkbox"/> | FBIN |
| CLK90 | <input type="checkbox"/> | 2 | 15 | <input type="checkbox"/> | FBCLK |
| CLK180 | <input type="checkbox"/> | 3 | 14 | <input type="checkbox"/> | CLK0 |
| CLK270 | <input type="checkbox"/> | 4 | 13 | <input type="checkbox"/> | VDD |
| VDDIO | <input type="checkbox"/> | 5 | 12 | <input type="checkbox"/> | GND |
| GND | <input type="checkbox"/> | 6 | 11 | <input type="checkbox"/> | VDD |
| GND | <input type="checkbox"/> | 7 | 10 | <input type="checkbox"/> | S2 |
| S0 | <input type="checkbox"/> | 8 | 9 | <input type="checkbox"/> | S1 |

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

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

External Components

The ICS672-01/02 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, and 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 33Ω 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.

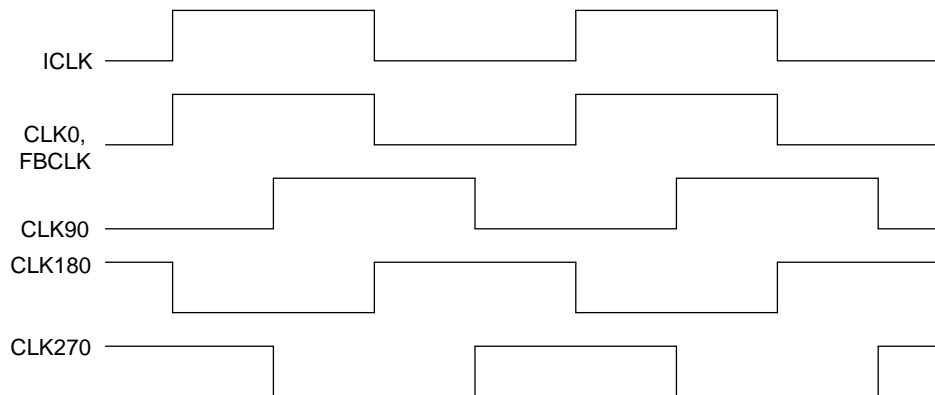


Figure 1. Phase alignment of input and output clocks (x1 multiplier)

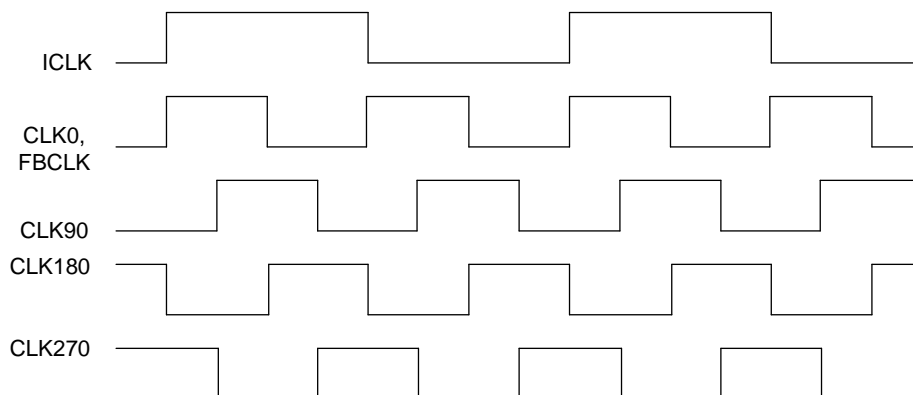


Figure 2. Phase alignment of input and output clocks (x2 multiplier)

Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS672-01/02. These ratings, which are standard values for IDT 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 | -0.5 V to 7 V |
| All Inputs and Outputs | -0.5 V to VDD+0.5 V |
| Electrostatic Discharge (MIL-STD-883) | 2000 V |
| Ambient Operating Temperature (commercial) | 0 to +70° C |
| Ambient Operating Temperature (industrial, -02 only) | -40 to +85° C |
| Storage Temperature | -65 to +150° C |
| Junction Temperature | 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) | +3.13 | | +5.5 | V |

DC Electrical Characteristics

VDD = VDDIO = 3.3 V, Ambient temperature 0 to +70° C, unless stated otherwise

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units |
|---------------------------------|-----------------|-----------------------------------|-------------|------|-------------|-------|
| Operating Voltage | VDD | | 3.13 | | 5.50 | V |
| Operating Voltage | VDDIO | | 2.375 | | VDD | V |
| Input High Voltage | V _{IH} | ICLK only | VDDIO/2+0.5 | | | V |
| Input Low Voltage | V _{IL} | ICLK only | | | VDDIO/2-0.5 | V |
| Input High Voltage | V _{IH} | | 2 | | | V |
| Input Low Voltage | V _{IL} | | | | 0.8 | V |
| Output High Voltage | V _{OH} | I _{OH} = -12 mA | 2.4 | | | V |
| Output Low Voltage | V _{OL} | I _{OL} = 12 mA | | | 0.4 | V |
| Output High Voltage, CMOS level | V _{OH} | I _{OH} = -8 mA | VDDIO-0.4 | | | V |
| Operating Supply Current | IDD | No Load, S1=1, S0=0, S2=0, Note 1 | | 11 | | mA |

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units |
|--------------------------|-----------------|---------------------------------------|------|------|------|-------|
| Operating Supply Current | IDD | No Load, S1=1, S0=0, S2=0, Notes 2, 6 | | 22 | | mA |
| | | No Load, S1=1, S0=0, S2=0, Notes 2, 7 | | 66 | | mA |
| Short Circuit Current | I _{OS} | Each output | | ±50 | | mA |
| Input Capacitance | C _{IN} | OE, select pins | | 7 | | pF |

AC Electrical Characteristics

VDD = VDDIO = 3.3 V, Ambient Temperature 0 to +70° C, unless stated otherwise

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units |
|--|-----------------|---|------|------|------|-------|
| Input Clock Frequency | f _{IN} | Note 3 | 5 | | 150 | MHz |
| Output Clock Frequency | | ICS672-01 | 15 | | 84 | MHz |
| Output Clock Frequency | | ICS672-02 | 15 | | 135 | MHz |
| Output Rise Time | t _{OR} | 0.8 to 2.0 V, no load, C _L = 15 pF | | | 1.0 | ns |
| Output Fall Time | t _{OF} | 2.0 to 0.8 V, no load, C _L = 15 pF | | | 1.0 | ns |
| Output Clock Duty Cycle, VDDIO = 3.3 V | t _{DC} | At VDDIO/2 | 45 | 50 | 55 | % |
| Phased Outputs Accuracy | | Rising edges at VDDIO/2, Note 4 | -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 |

Note 1: With ICLK = 20 MHz, FBCLK to FBIN, all outputs at 40 MHz.

Note 2: With ICLK = 66.5 MHz, FBCLK to FBIN, all outputs at 133 MHz.

Note 3: Value depends on multiplier. Must also meet output clock frequency.

Note 4: With CLK0CLK270 equally loaded, and output frequency > 60 MHz.

Note 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.

Note 6: Commercial grade.

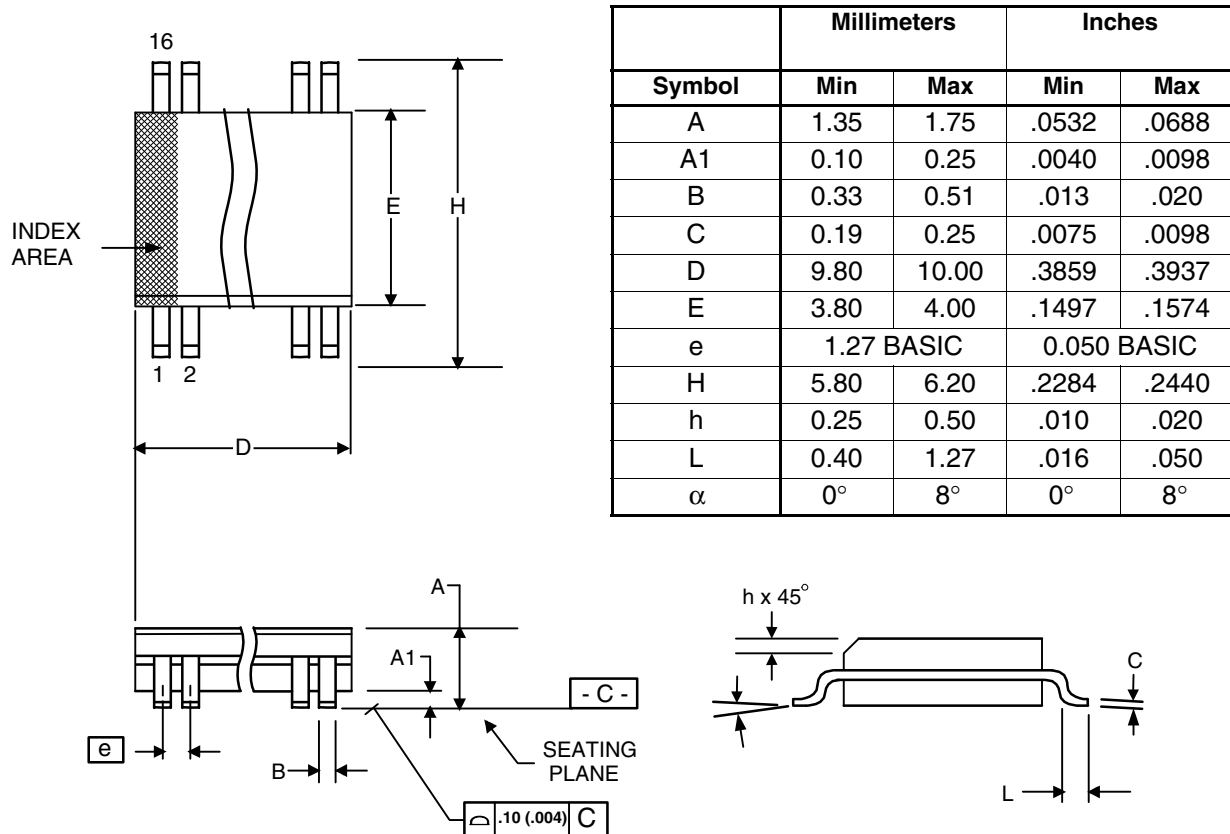
Note 7: Industrial grade.

Thermal Characteristics

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units |
|--|-----------------|----------------|------|------|------|-------|
| Thermal Resistance Junction to Ambient | θ _{JA} | Still air | | 120 | | °C/W |
| | θ _{JA} | 1 m/s air flow | | 115 | | °C/W |
| | θ _{JA} | 3 m/s air flow | | 105 | | °C/W |
| Thermal Resistance Junction to Case | θ _{JC} | | | 58 | | °C/W |

Package Outline and Package Dimensions (16-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 |
|---------------------|--------------|--------------------|-------------|---------------|
| 672M-01LF | ICS672M-01LF | Tubes | 16-pin SOIC | 0 to +70° C |
| 672M-01LFT | ICS672M-01LF | Tape and Reel | 16-pin SOIC | 0 to +70° C |
| 672M-02LF | ICS672M-02LF | Tubes | 16-pin SOIC | 0 to +70° C |
| 672M-02LFT | ICS672M-02LF | Tape and Reel | 16-pin SOIC | 0 to +70° C |
| 672M-02ILF | 672M-02ILF | Tubes | 16-pin SOIC | -40 to +85° C |
| 672M-02ILFT | 672M-02ILF | Tape and Reel | 16-pin SOIC | -40 to +85° C |

“LF” denotes Pb (lead) free package.

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