

# CLOCK DIVIDER

# ICS542

## Description

The ICS542 is cost effective way to produce a high-quality clock output divided from a clock input. The chip accepts a clock input up to 156 MHz at 3.3 V and produces a divide by 2, 4, 6, 8, 12, or 16 of the input clock. There are two outputs on the chip, one being a low-skew divide by two of the other.

For instance, if an 100 MHz input clock is used, the ICS542 can produce low-skew 50 MHz and 25 MHz clocks, or low skew 25 MHz and 12.5 MHz clocks. The chip has an all-chip power-down mode that stops the outputs low, and an OE pin that tri-states the outputs.

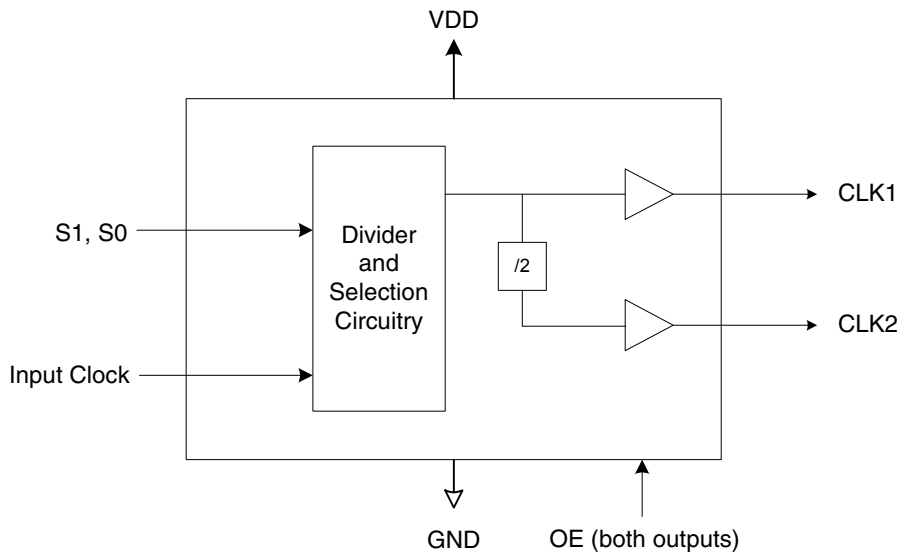
See the ICS541 and ICS543 for other clock dividers, and the ICS501, 502, 511, 512, and 525 for clock multipliers.

## Features

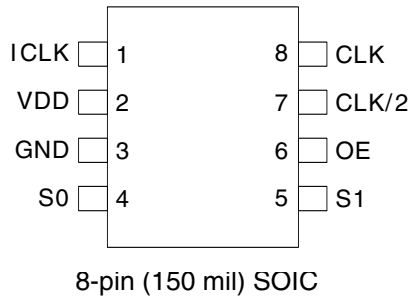
- 8-pin SOIC package
- Available in RoHS compliant package
- IDT's lowest cost clock divider
- Low skew (500 ps) outputs. One is /2 of the other
- Easy to use with other generators and buffers
- Input clock frequency up to 156 MHz
- Output clock duty cycle of 45/55
- Power-down turns off chip
- Output Enable
- Advanced, low-power CMOS process
- Operating voltage of 3.3 V or 5 V
- Does not degrade phase noise - no PLL
- Available in industrial and commercial temperature ranges

**NOTE: EOL for non-green parts to occur on 5/13/10 per PDN U-09-01**

## Block Diagram



## Pin Assignment



## Clock Decoding Table

| S1 | S0 | CLK            | CLK/2    |
|----|----|----------------|----------|
| 0  | 0  | Power Down All |          |
| 0  | 1  | Input/6        | Input/12 |
| 1  | 0  | Input/8        | Input/16 |
| 1  | 1  | Input/2        | Input/4  |

0 = connect directly to ground

1 = connect directly to VDD

## Pin Descriptions

| Pin Number | Pin Name | Pin Type | Pin Description  |
|------------|----------|----------|--|
| 1          | ICLK     | XI       | Clock input.   |
| 2          | VDD      | Power    | Connect to +3.3 V or +5 V.   |
| 3          | GND      | Power    | Connect to ground.   |
| 4          | S0       | Input    | Select 0 for output clock. Connect to GND or VDD, per decoding table above. Internal pull-up resistor. |
| 5          | S1       | Input    | Select 1 for output clock. Connect to GND or VDD, per decoding table above. Internal pull-up resistor. |
| 6          | OE       | Input    | Output Enable. Tri-states both output clocks when low. Internal pull-up resistor.                      |
| 7          | CLK/2    | Output   | Clock output per table above. Low skew divide by two of pin 8 clock.                                   |
| 8          | CLK      | Output   | Clock output per table above.  |

## External Components

### Series Termination Resistor

Clock output traces over one inch should use series termination. To series terminate a 50Ω trace (a commonly used trace impedance), place a 33Ω resistor in series with the clock line, as close to the clock output pin as possible. The nominal impedance of the clock output is 20Ω

### Decoupling Capacitor

As with any high-performance mixed-signal IC, the ICS542 must be isolated from system power supply noise to perform optimally.

A decoupling capacitor of 0.01μF must be connected between VDD and the PCB ground plane.

### PCB Layout Recommendations

For optimum device performance and lowest output phase noise, the following guidelines should be observed.

- 1) The 0.01μF decoupling capacitor should be mounted on the component side of the board as close to the VDD pin as possible. No vias should be used between decoupling capacitor and VDD pin. The PCB trace to VDD pin should be kept as short as possible, as should the PCB trace to the ground via. Distance of the ferrite bead and bulk decoupling from the device is less critical.
- 2) To minimize EMI, the 33Ω series termination resistor (if needed) should be placed close to the clock output.
- 3) An optimum layout is one with all components on the

same side of the board, minimizing vias through other signal layers (the ferrite bead and bulk decoupling capacitor can be mounted on the back). Other signal traces should be routed

away from the ICS542. This includes signal traces just underneath the device, or on layers adjacent to the ground plane layer used by the device.

## Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS542. 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                        | 7 V                 |
| All Inputs and Outputs                     | -0.5 V to VDD+0.5 V |
| Ambient Operating Temperature (commercial) | 0 to +70° C         |
| Ambient Operating Temperature (industrial) | -40 to +85° C       |
| Storage Temperature                        | -65 to +150° C      |
| Junction Temperature                       | 125° C              |
| Soldering Temperature                      | 260° C              |

## Recommended Operation Conditions

| Parameter   | Min. | Typ. | Max. | Units |
|---|------|------|------|-------|
| Ambient Operating Temperature (commercial)        | 0    |      | +70  | °C    |
| Ambient Operating Temperature (industrial)        | -40  |      | +85  | °C    |
| Power Supply Voltage (measured in respect to GND) | 3.0  |      | 5.5  | V     |

## DC Electrical Characteristics

Unless stated otherwise, **VDD = 3.3 V ±5%**, Ambient Temp. 0 to +70°C (commercial), -40 to +85°C (industrial)

| Parameter                | Symbol          | Conditions                | Min.    | Typ.  | Max.    | Units |
|--------------------------|-----------------|---------------------------|---------|-------|---------|-------|
| Operating Voltage        | VDD             |                           | 3.0     |       | 5.5     | V     |
| Input High Voltage,      | V <sub>IH</sub> | ICLK (pin 1)              | VDD/2+1 | VDD/2 |         | V     |
| Input Low Voltage        | V <sub>IL</sub> | ICLK (pin 1)              |         | VDD/2 | VDD/2-1 | V     |
| Input High Voltage       | V <sub>IH</sub> | S0, S1, OE                | 2       |       |         | V     |
| Input Low Voltage        | V <sub>IL</sub> | S0, S1, OE                |         |       | 0.8     | 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     |
| Operating Supply Current | I <sub>DD</sub> | No Load, 5.0 V,<br>11 sel |         | 11    |         | mA    |
| Operating Supply Current | I <sub>DD</sub> | No Load, 3.3 V,<br>11 sel |         | 7     |         | mA    |
| Short Circuit Current    | I <sub>OS</sub> |                           |         | ±40   |         | mA    |
| Input Capacitance        | C <sub>IN</sub> | S0, S1, OE                |         | 4     |         | pF    |
| Nominal Output Impedance | Z <sub>O</sub>  | at VDD/2                  |         | 20    |         | Ω     |

## AC Electrical Characteristics

Unless stated otherwise, **VDD = 3.3 V ±5%**, Ambient Temp. 0 to +70°C (commercial), -40 to +85°C (industrial)

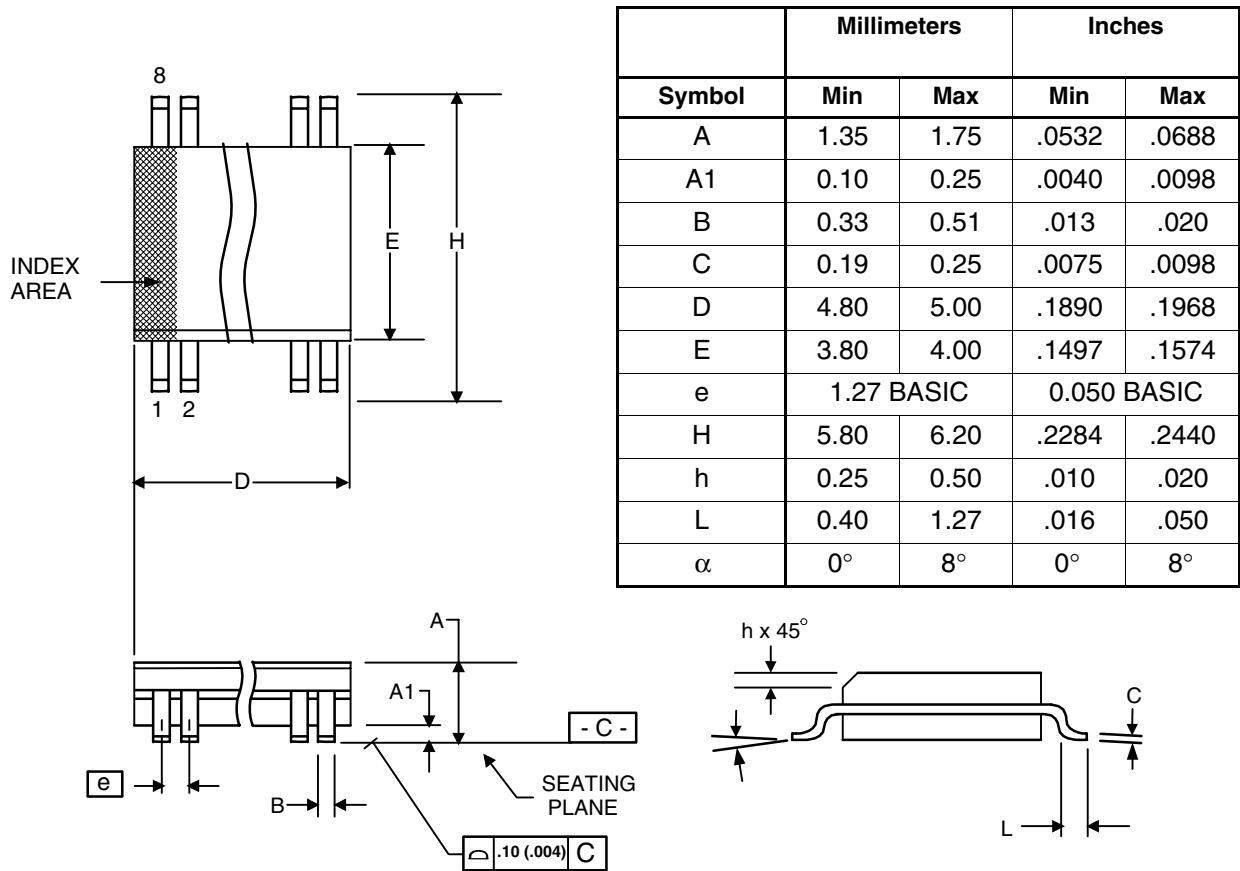
| Parameter                    | Symbol          | Conditions            | Min. | Typ.     | Max. | Units |
|------------------------------|-----------------|-----------------------|------|----------|------|-------|
| Input Frequency, clock input |                 | VDD = 5 V             | 0    |          | 156  | MHz   |
| Input Frequency, clock input |                 | VDD = 3.3 V           | 0    |          | 156  | MHz   |
| Output Rise Time             | t <sub>OR</sub> | 0.8 to 2.0 V          |      | 1        |      | ns    |
| Output Fall Time             | t <sub>OF</sub> | 2.0 to 0.8 V          |      | 1        |      | ns    |
| Duty Cycle                   |                 | at VDD/2              | 45   | 49 to 51 | 55   | %     |
| Skew of Output Clocks        |                 | rising edges at VDD/2 |      |          | 500  | ps    |
| Propagation Delay            |                 | ICLK to CLK           |      |          | 15   | ns    |

## Thermal Characteristics

| Parameter                              | Symbol          | Conditions     | Min. | Typ. | Max. | Units |
|--|-----------------|----------------|------|------|------|-------|
| Thermal Resistance Junction to Ambient | θ <sub>JA</sub> | Still air      |      | 150  |      | °C/W  |
|  | θ <sub>JA</sub> | 1 m/s air flow |      | 140  |      | °C/W  |
|  | θ <sub>JA</sub> | 3 m/s air flow |      | 120  |      | °C/W  |
| Thermal Resistance Junction to Case    | θ <sub>JC</sub> |                |      | 40   |      | °C/W  |

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

Package dimensions are kept current with JEDEC Publication No. 95



## Ordering Information

| Part / Order Number | Marking  | Shipping Packaging | Package    | Temperature   |
|---------------------|----------|--------------------|------------|---------------|
| 542M*               | ICS542M  | Tubes              | 8-pin SOIC | 0 to +70° C   |
| 542MT*              | ICS542M  | Tape and Reel      | 8-pin SOIC | 0 to +70° C   |
| 542MLF              | 542MLF   | Tubes              | 8-pin SOIC | 0 to +70° C   |
| 542MLFT             | 542MLF   | Tape and Reel      | 8-pin SOIC | 0 to +70° C   |
| 542MI*              | ICS542MI | Tubes              | 8-pin SOIC | -40 to +85° C |
| 542MIT*             | ICS542MI | Tape and Reel      | 8-pin SOIC | -40 to +85° C |
| 542MILF             | 542MILF  | Tubes              | 8-pin SOIC | -40 to +85° C |
| 542MILFT            | 542MILF  | Tape and Reel      | 8-pin SOIC | -40 to +85° C |

\*NOTE: EOL for non-green parts to occur on 5/13/10 per PDN U-09-01

Parts that are ordered with a “LF” suffix to the part number are the Pb-Free configuration and are RoHS compliant.

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