

## 3.3 VOLT ZERO DELAY, LOW SKEW BUFFER

**MK2308-1H**

### Description

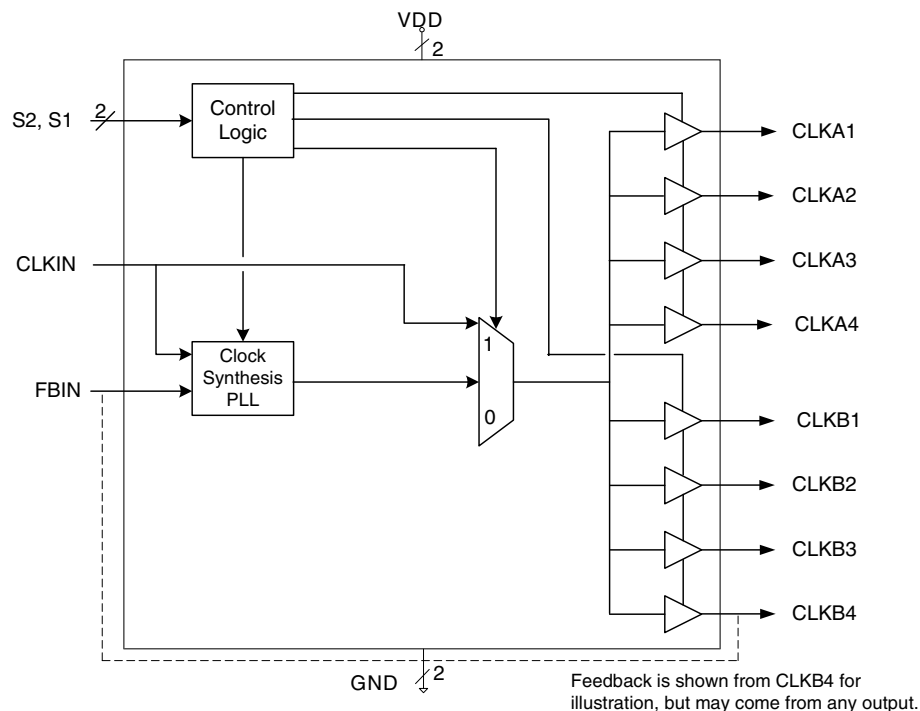
The MK2308-1H is a low phase noise, high-speed PLL based, 8-output, low skew zero delay buffer. Based on IDT's proprietary low jitter Phase Locked Loop (PLL) techniques, the device provides eight low skew outputs at speeds up to 133 MHz at 3.3 V. The outputs can be generated from the PLL (for zero delay), or directly from the input (for testing), and can be set to tri-state mode or to stop at a low level. For normal operation as a zero delay buffer, any output clock is tied to the FBIN pin.

IDT manufactures a large variety of clock generators and buffers.

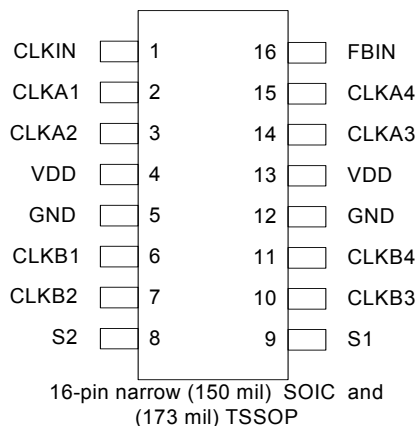
### Features

- Clock outputs from 10 to 133 MHz
- Zero input-output delay
- Eight low skew (<200 ps) outputs
- Device-to-device skew <700 ps
- Full CMOS outputs with 25 mA output drive capability at TTL levels
- 5 V tolerant FBIN and CLKIN pins
- Tri-state mode for board-level testing
- Advanced, low-power, sub-micron CMOS process
- Operating voltage of 3.3 V
- Industrial temperature range available
- Packaged in 16-pin SOIC and TSSOP packages
- Pb (lead) free package
- Industrial and commercial temp operation

### Block Diagram



## Pin Assignment



## Output Clock Mode Select Table

| S2 | S1 | CLKA1:A4           | CLKB1:B4           | A & B Source   | PLL Status |
|----|----|--------------------|--------------------|----------------|------------|
| 0  | 0  | Tri-state (note 1) | Tri-state (note 1) | PLL            | OFF        |
| 0  | 1  | Running            | Tri-state (note 1) | PLL            | ON         |
| 1  | 0  | Running            | Running            | CLKIN (note 2) | OFF        |
| 1  | 1  | Running            | Running            | PLL            | ON         |

Note 1. Outputs are in high impedance state

Note 2. Buffer mode only; not zero delay between input and output

## Pin Descriptions

| Pin Number | Pin Name | Pin Type | Pin Description                                                              |
|------------|----------|----------|------------------------------------------------------------------------------|
| 1          | CLKIN    | Input    | Clock input (5 V tolerant).                                                  |
| 2 - 3      | CLKA1:A4 | Output   | Clock outputs A1:A4. See table above.                                        |
| 4          | VDD      | Power    | Power supply. Connect to 3.3 V.                                              |
| 5          | GND      | Power    | Connect to ground.                                                           |
| 6 - 7      | CLKB1:B4 | Output   | Clock outputs B1:B4. See table above.                                        |
| 8          | S2       | Input    | Select input 2. See table above. Internal pull-up.                           |
| 9          | S1       | Input    | Select input 1. See table above. Internal pull-up.                           |
| 10 - 11    | CLKB1:B4 | Output   | Clock outputs B1:B4. See table above.                                        |
| 12         | GND      | Power    | Connect to ground.                                                           |
| 13         | VDD      | Power    | Power supply. Connect to 3.3 V.                                              |
| 14 - 15    | CLKA1:A4 | Output   | Clock outputs A1:A4. See table above.                                        |
| 16         | FBIN     | Input    | Feedback input. Connect to any output under normal operation (5 V tolerant). |

## External Components

The MK2308-1H requires a minimum number of external components for proper operation. Decoupling capacitors of 0.01 mF should be connected between VDD and GND on pins 4 and 5, and VDD and GND on pins 13 and 12, as close to the device as possible. A series termination resistor of 33 $\Omega$  may be used to each clock output pin to reduce reflections.

## Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the MK2308-1H. 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 |
| CLKIN and FBIN inputs         | -0.5 V to 5.5 V     |
| Electrostatic Discharge       | 2000 V              |
| Ambient Operating Temperature | 0 to +70° C         |
| Industrial Temperature        | -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                     | -40  |      | +85  | °C    |
| Power Supply Voltage (measured in respect to GND) | +3.0 |      | +3.6 | V     |

## DC Electrical Characteristics

VDD=3.3 V  $\pm$ 10%, Ambient temperature -40 to +85° C (Industrial), 0 to 70° C (Commercial)

| Parameter           | Symbol          | Conditions               | Min. | Typ. | Max. | Units   |
|---------------------|-----------------|--------------------------|------|------|------|---------|
| Operating Voltage   | VDD             |                          | 3.0  |      | 3.6  | V       |
| Input High Voltage  | V <sub>IH</sub> |                          | 2    |      |      | V       |
| Input Low Voltage   | V <sub>IL</sub> |                          |      |      | 0.8  | V       |
| Input Low Current   | I <sub>IL</sub> | VIN = 0V                 |      |      | 50   | $\mu$ A |
| Input High Current  | I <sub>IH</sub> | VIN = VDD                |      |      | 100  | $\mu$ A |
| Output High Voltage | V <sub>OH</sub> | I <sub>OH</sub> = -12 mA | 2.4  |      |      | V       |
| Output Low Voltage  | V <sub>OL</sub> | I <sub>OL</sub> = 12 mA  |      |      | 0.4  | V       |

| Parameter                       | Symbol     | Conditions                            | Min.         | Typ.     | Max. | Units         |
|---------------------------------|------------|---------------------------------------|--------------|----------|------|---------------|
| Output High Voltage, CMOS level | $V_{OH}$   | $I_{OH} = -4 \text{ mA}$              | $V_{DD}-0.4$ |          |      | V             |
| Operating Supply Current        | $I_{DD}$   | No Load, $S2 = 1$ , $S1 = 1$ , Note 1 |              |          | 70   | mA            |
| Power Down Supply Current       | $I_{DDPD}$ | CLKIN = 0, $S2 = 0$ , $S1 = 1$        |              | 12       |      | $\mu\text{A}$ |
|                                 |            | CLKIN = 0, Note 2                     |              | 12       |      | $\mu\text{A}$ |
| Short Circuit Current           | $I_{OS}$   | Each output                           |              | $\pm 70$ |      | mA            |
| Input Capacitance               | $C_{IN}$   | $S2$ , $S1$ , FBIN                    |              | 5        |      | pF            |

## AC Electrical Characteristics

$V_{DD} = 3.3 \text{ V} \pm 10\%$ , Ambient Temperature  $-40$  to  $+85^\circ \text{C}$  (Industrial),  $0$  to  $70^\circ \text{C}$  (Commercial)

| Parameter               | Symbol   | Conditions                                                               | Min. | Typ. | Max.      | Units |
|-------------------------|----------|--------------------------------------------------------------------------|------|------|-----------|-------|
| Input Clock Frequency   | $f_{IN}$ | See table on page 2                                                      | 10   |      | 133       | MHz   |
| Output Clock Frequency  |          | See table on page 2                                                      | 10   |      | 133       | MHz   |
| Output Rise Time        | $t_{OR}$ | $0.8$ to $2.0 \text{ V}$ , $CL=30 \text{ pF}$                            |      |      | 1.5       | ns    |
| Output Fall Time        | $t_{OF}$ | $2.0$ to $0.8 \text{ V}$ , $CL=30 \text{ pF}$                            |      |      | 1.25      | ns    |
| Output Clock Duty Cycle | $t_{DC}$ | measured at $V_{DD}/2$                                                   | 45   | 50   | 55        | %     |
| Device to Device Skew   |          | rising edges at $V_{DD}/2$                                               |      |      | 700       | ps    |
| Output to Output Skew   |          | rising edges at $V_{DD}/2$                                               |      |      | 200       | ps    |
| Input to Output Skew    |          | rising edges at $V_{DD}/2$ , FBIN to CLKA4, $S1 = 1$ , $S0 = 1$ , Note 1 |      |      | $\pm 250$ | ps    |
| Maximum Absolute Jitter |          | $CL=15 \text{ pF}$ , measured at $66.67 \text{ M}$                       |      | 130  |           | ps    |
| Cycle to Cycle Jitter   |          | $CL=30 \text{ pF}$ , measured at $66.67 \text{ M}$                       |      |      | 200       | ps    |
|                         |          | $CL=15 \text{ pF}$ , measured at $66.67 \text{ M}$                       |      |      | 200       | ps    |
|                         |          | $CL=15 \text{ pF}$ , measured at $133.33 \text{ M}$                      |      |      | 100       | ps    |
| PLL Lock Time           |          | Note 3                                                                   |      |      | 1.0       | ms    |

Note 1: With CLKIN = 100 MHz, FBIN to CLKA4, all outputs at 100 MHz

Note 2: When there is no clock signal present at CLKIN, the MK2308-1H will enter power down mode. The PLL is stopped and the outputs are tri-state.

Note 3: With VDD at a steady rate and valid clocks at CLKIN and FBIN

## Thermal Characteristics 16TSSOP

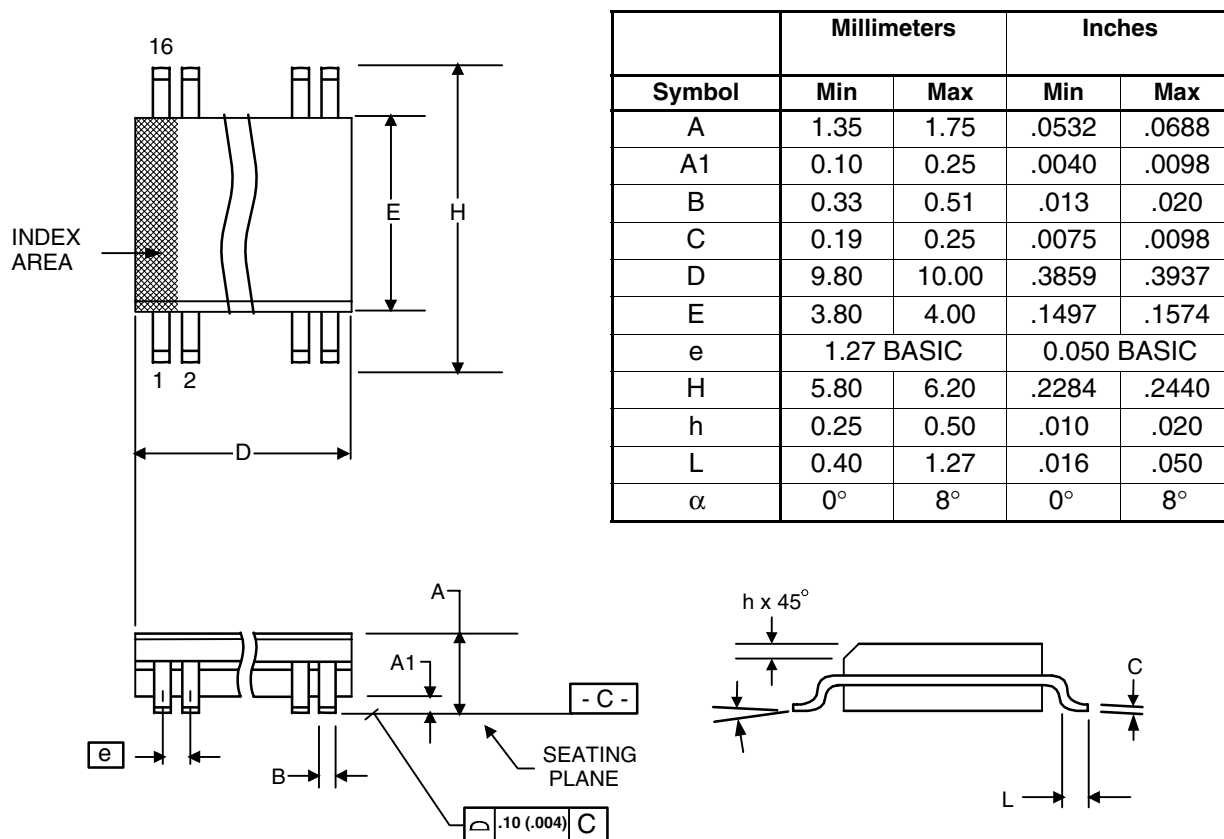
| Parameter                              | Symbol        | Conditions     | Min. | Typ. | Max. | Units               |
|----------------------------------------|---------------|----------------|------|------|------|---------------------|
| Thermal Resistance Junction to Ambient | $\theta_{JA}$ | Still air      |      | 78   |      | $^\circ \text{C/W}$ |
|                                        | $\theta_{JA}$ | 1 m/s air flow |      | 70   |      | $^\circ \text{C/W}$ |
|                                        | $\theta_{JA}$ | 3 m/s air flow |      | 68   |      | $^\circ \text{C/W}$ |
| Thermal Resistance Junction to Case    | $\theta_{JC}$ |                |      | 37   |      | $^\circ \text{C/W}$ |

## Thermal Characteristics 16SOIC

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

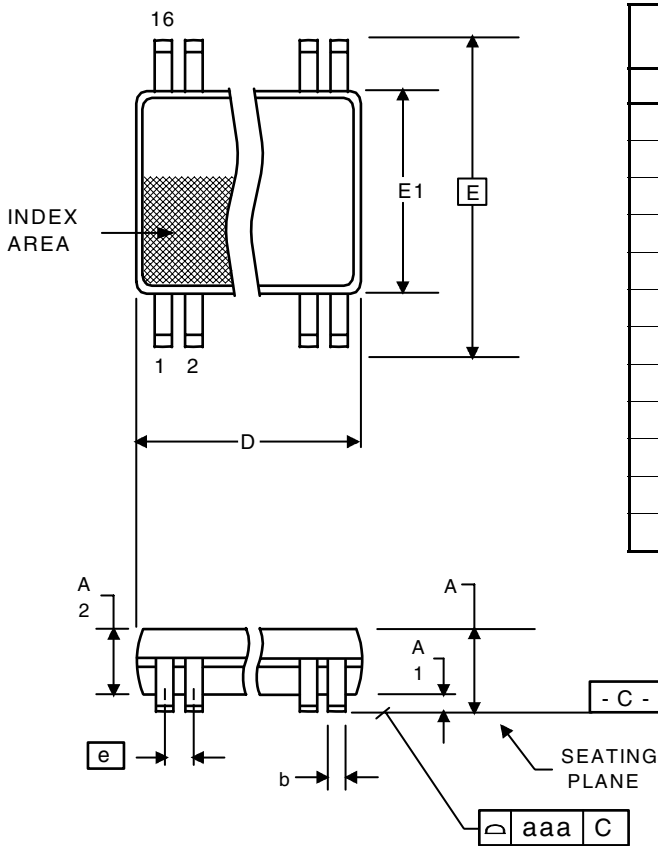
## Package Outline and Package Dimensions (16-pin SOIC, 150 Mil. Narrow Body)

Package dimensions are kept current with JEDEC Publication No. 95



Package Outline and Package Dimensions (16-pin TSSOP, 4.40 mm Body, 0.65 mm Pitch)

Package dimensions are kept current with JEDEC Publication No. 95



| Symbol | Millimeters |      | Inches       |       |
|--------|-------------|------|--------------|-------|
|        | Min         | Max  | Min          | Max   |
| A      | --          | 1.20 | --           | 0.047 |
| A1     | 0.05        | 0.15 | 0.002        | 0.006 |
| A2     | 0.80        | 1.05 | 0.032        | 0.041 |
| b      | 0.19        | 0.30 | 0.007        | 0.012 |
| C      | 0.09        | 0.20 | 0.0035       | 0.008 |
| D      | 4.90        | 5.1  | 0.193        | 0.201 |
| E      | 6.40 BASIC  |      | 0.252 BASIC  |       |
| E1     | 4.30        | 4.50 | 0.169        | 0.177 |
| e      | 0.65 Basic  |      | 0.0256 Basic |       |
| L      | 0.45        | 0.75 | 0.018        | 0.030 |
| α      | 0°          | 8°   | 0°           | 8°    |
| aaa    | --          | 0.10 | --           | 0.004 |

## Ordering Information

| Part / Order Number | Marking      | Shipping Packaging | Package      | Temperature   |
|---------------------|--------------|--------------------|--------------|---------------|
| MK2308S-1HLF        | MK2308S-1HLF | Tubes              | 16-pin SOIC  | 0 to +70° C   |
| MK2308S-1HLFTR      | MK2308S-1HLF | Tape and Reel      | 16-pin SOIC  | 0 to +70° C   |
| MK2308G-1HILF       | 23081HIL     | Tubes              | 16-pin TSSOP | -40 to +85° C |
| MK2308G-1HILFTR     | 23081HIL     | Tape and Reel      | 16-pin TSSOP | -40 to +85° C |
| MK2308G-1HLF        | 2308G1HL     | Tubes              | 16-pin TSSOP | 0 to +70° C   |
| MK2308G-1HLFTR      | 2308G1HL     | Tape and Reel      | 16-pin TSSOP | 0 to +70° C   |

**"LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.**

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