



## NINE OUTPUT 3.3V CLOCK BUFFER

**IDT2309NZ**

### FEATURES:

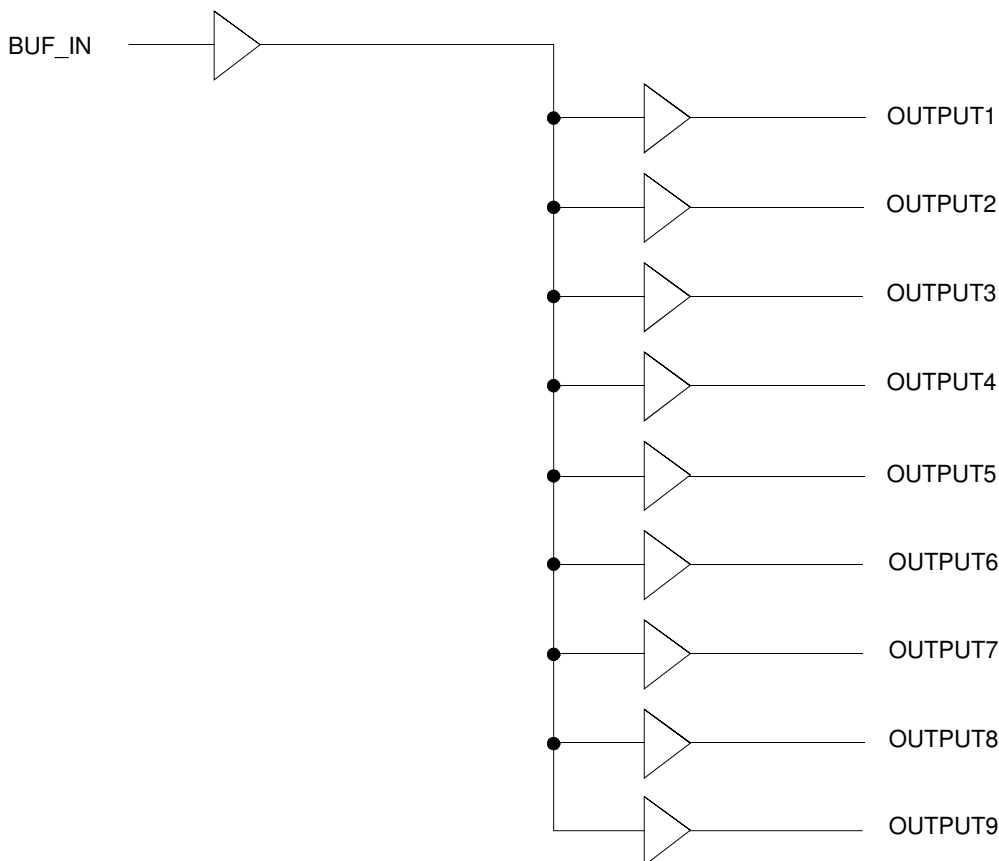
- One input to nine output buffer/driver
- Supports two DIMMs or four SO-DIMMs with one additional output for feedback to an external or chipset PLL
- Low power consumption for mobile applications: less than 32mA at 66.6MHz with unloaded outputs
- 8.7ns input-output delay
- Buffers all frequencies from DC to 133.33MHz
- Output-output skew < 250ps
- Multiple V<sub>DD</sub> and V<sub>SS</sub> pins for noise and EMI reduction
- 3.3V operation
- High drive capability
- Available in SOIC and TSSOP packages

### DESCRIPTION:

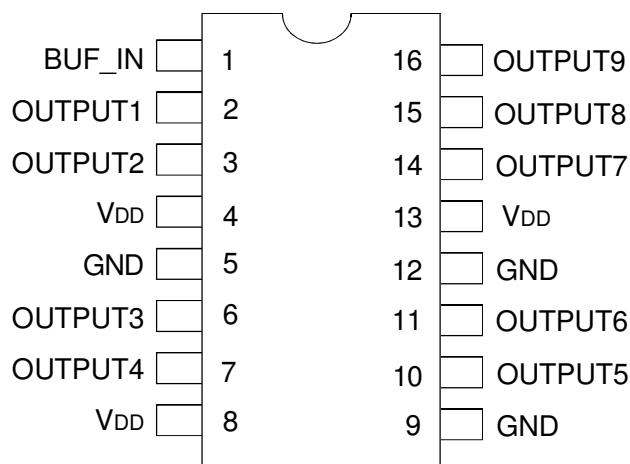
The IDT2309NZ is a low-cost buffer designed to distribute high-speed clocks in mobile PC systems and desktop PC systems with SDRAM support. This part has nine outputs, eight of which can be used to drive two DIMMs or four SO-DIMMs, and the remaining can be used for external feedback to a PLL. The IDT2309NZ operates at 3.3V and outputs can run up to 133.33MHz.

The IDT2309NZ is designed for low EMI and power optimization. It has multiple V<sub>DD</sub> and V<sub>SS</sub> pins for noise optimization and consumes less than 32mA at 66.6MHz, making it ideal for the low power requirements of mobile systems.

### FUNCTIONAL BLOCK DIAGRAM



## PIN CONFIGURATION



## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol                                                  | Rating                           | Max.                         | Unit |
|---------------------------------------------------------|----------------------------------|------------------------------|------|
| V <sub>DD</sub>                                         | Supply Voltage Range             | −0.5 to +4.6                 | V    |
| V <sub>I</sub> <sup>(2)</sup>                           | Input Voltage Range (REF)        | −0.5 to +5.5                 | V    |
| V <sub>I</sub>                                          | Input Voltage Range (except REF) | −0.5 to V <sub>DD</sub> +0.5 | V    |
| I <sub>IK</sub> (V <sub>I</sub> < 0)                    | Input Clamp Current              | −50                          | mA   |
| I <sub>O</sub> (V <sub>O</sub> = 0 to V <sub>DD</sub> ) | Continuous Output Current        | ±50                          | mA   |
| V <sub>DD</sub> or GND                                  | Continuous Current               | ±100                         | mA   |
| T <sub>A</sub> = 55°C (in still air) <sup>(3)</sup>     | Maximum Power Dissipation        | 0.7                          | W    |
| T <sub>STG</sub>                                        | Storage Temperature Range        | −65 to +150                  | °C   |
| Operating Temperature                                   | Commercial Temperature Range     | 0 to +70                     | °C   |
| Operating Temperature                                   | Industrial Temperature Range     | −40 to +85                   | °C   |

### NOTES:

1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

## PIN DESCRIPTION

| Pin Name        | Pin Number                     | Functional Description      |
|-----------------|--------------------------------|-----------------------------|
| V <sub>DD</sub> | 4, 8, 13                       | 3.3V Digital Voltage Supply |
| GND             | 5, 9, 12                       | Ground                      |
| BUF_IN          | 1                              | Input clock                 |
| OUTPUT[1:9]     | 2, 3, 6, 7, 10, 11, 14, 15, 16 | Outputs                     |

## OPERATING CONDITIONS - COMMERCIAL

| Symbol             | Parameter                                              | Min. | Max.   | Unit |
|--------------------|--------------------------------------------------------|------|--------|------|
| V <sub>DD</sub>    | Supply Voltage                                         | 3    | 3.6    | V    |
| T <sub>A</sub>     | Operating Temperature (Ambient Temperature)            | 0    | 70     | °C   |
| C <sub>L</sub>     | Load Capacitance, F <sub>OUT</sub> < 100MHz            | —    | 30     | pF   |
|                    | Load Capacitance 100MHz < F <sub>OUT</sub> < 133.33MHz | —    | 15     |      |
| C <sub>IN</sub>    | Input Capacitance                                      | —    | 7      | pF   |
| BUF_IN, SDRAM[1:9] | Operating Frequency                                    | DC   | 133.33 | MHz  |

## OPERATING CONDITIONS - INDUSTRIAL

| Symbol             | Parameter                                              | Min. | Max.   | Unit |
|--------------------|--------------------------------------------------------|------|--------|------|
| V <sub>DD</sub>    | Supply Voltage                                         | 3    | 3.6    | V    |
| T <sub>A</sub>     | Operating Temperature (Ambient Temperature)            | -40  | +85    | °C   |
| C <sub>L</sub>     | Load Capacitance, F <sub>OUT</sub> < 100MHz            | —    | 30     | pF   |
|                    | Load Capacitance 100MHz < F <sub>OUT</sub> < 133.33MHz | —    | 15     |      |
| C <sub>IN</sub>    | Input Capacitance                                      | —    | 7      | pF   |
| BUF_IN, SDRAM[1:9] | Operating Frequency                                    | DC   | 133.33 | MHz  |

## DC ELECTRICAL CHARACTERISTICS - COMMERCIAL

| Symbol          | Parameter                          | Conditions                        | Min. | Max. | Unit |
|-----------------|------------------------------------|-----------------------------------|------|------|------|
| V <sub>IL</sub> | Input LOW Voltage <sup>(1)</sup>   |                                   | —    | 0.8  | V    |
| V <sub>IH</sub> | Input HIGH Voltage <sup>(1)</sup>  |                                   | 2    | —    | V    |
| I <sub>IL</sub> | Input LOW Current                  | V <sub>IN</sub> = 0V              | —    | 50   | μA   |
| I <sub>IH</sub> | Input HIGH Current                 | V <sub>IN</sub> = V <sub>DD</sub> | —    | 100  | μA   |
| V <sub>OL</sub> | Output LOW Voltage <sup>(2)</sup>  | I <sub>OL</sub> = 8mA             | —    | 0.4  | V    |
| V <sub>OH</sub> | Output HIGH Voltage <sup>(2)</sup> | I <sub>OH</sub> = -8mA            | 2.4  | —    | V    |
| I <sub>DD</sub> | Supply Current                     | Unloaded Outputs at 66.66MHz      | —    | 32   | mA   |

### NOTES:

1. BUF\_IN input has a threshold voltage of V<sub>DD</sub>/2.
2. Parameter is guaranteed by design but not production tested.

## DC ELECTRICAL CHARACTERISTICS - INDUSTRIAL

| Symbol          | Parameter                          | Conditions                        | Min. | Max. | Unit |
|-----------------|------------------------------------|-----------------------------------|------|------|------|
| V <sub>IL</sub> | Input LOW Voltage <sup>(1)</sup>   |                                   | —    | 0.8  | V    |
| V <sub>IH</sub> | Input HIGH Voltage <sup>(1)</sup>  |                                   | 2    | —    | V    |
| I <sub>IL</sub> | Input LOW Current                  | V <sub>IN</sub> = 0V              | —    | 50   | μA   |
| I <sub>IH</sub> | Input HIGH Current                 | V <sub>IN</sub> = V <sub>DD</sub> | —    | 100  | μA   |
| V <sub>OL</sub> | Output LOW Voltage <sup>(2)</sup>  | I <sub>OL</sub> = 8mA             | —    | 0.4  | V    |
| V <sub>OH</sub> | Output HIGH Voltage <sup>(2)</sup> | I <sub>OH</sub> = -8mA            | 2.4  | —    | V    |
| I <sub>DD</sub> | Supply Current                     | Unloaded Outputs at 66.66MHz      | —    | 35   | mA   |

### NOTES:

1. BUF\_IN input has a threshold voltage of V<sub>DD</sub>/2.
2. Parameter is guaranteed by design but not production tested.

## SWITCHING CHARACTERISTICS - COMMERCIAL<sup>(1)</sup>

| Symbol         | Parameter <sup>(2)</sup>                                    | Conditions                     | Min. | Typ. | Max. | Unit |
|----------------|-------------------------------------------------------------|--------------------------------|------|------|------|------|
| t <sub>R</sub> | Rise Time                                                   | Measured between 0.8V and 2V   | —    | —    | 1.5  | ns   |
| t <sub>F</sub> | Fall Time                                                   | Measured between 0.8V and 2V   | —    | —    | 1.5  | ns   |
| t <sub>S</sub> | Output to Output Skew                                       | All outputs equally loaded     | —    | —    | 250  | ps   |
| t <sub>6</sub> | Propagation Delay, BUF_IN Rising Edge to OUTPUT Rising Edge | Measured at V <sub>DD</sub> /2 | 1    | 5    | 8.7  | ns   |

### NOTES:

1. All parameters specified with loaded outputs.
2. Parameter is guaranteed by design but not production tested.

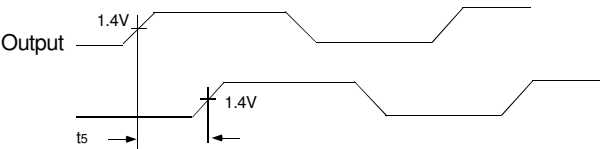
SWITCHING CHARACTERISTICS - INDUSTRIAL<sup>(1)</sup>

| Symbol         | Parameter <sup>(2)</sup>                                    | Conditions                     | Min. | Typ. | Max. | Unit |
|----------------|-------------------------------------------------------------|--------------------------------|------|------|------|------|
| t <sub>3</sub> | Rise Time                                                   | Measured between 0.8V and 2V   | —    | —    | 1.5  | ns   |
| t <sub>4</sub> | Fall Time                                                   | Measured between 0.8V and 2V   | —    | —    | 1.5  | ns   |
| t <sub>5</sub> | Output to Output Skew                                       | All outputs equally loaded     | —    | —    | 250  | ps   |
| t <sub>6</sub> | Propagation Delay, BUF_IN Rising Edge to OUTPUT Rising Edge | Measured at V <sub>DD</sub> /2 | 1    | 5    | 8.7  | ns   |

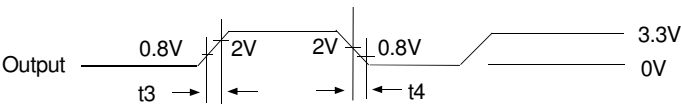
NOTES:

- All parameters specified with loaded outputs.
- Parameter is guaranteed by design but not production tested.

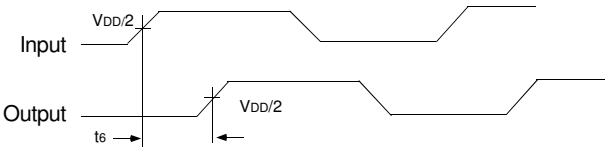
SWITCHING WAVEFORMS



Output to Output Skew

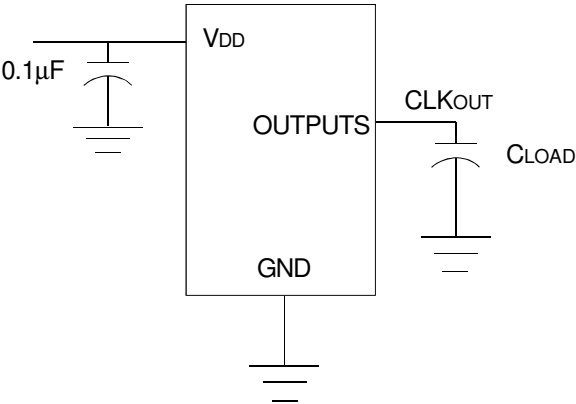


All Outputs Rise/Fall Time



Input to Output Propagation Delay

TEST CIRCUIT



## ORDERING INFORMATION

| IDT | XXXXX       | XX      | X       |           |                                                          |
|-----|-------------|---------|---------|-----------|----------------------------------------------------------|
|     | Device Type | Package | Process |           |                                                          |
|     |             |         |         | Blank     | Commercial (0°C to +70°C)<br>Industrial (-40°C to +85°C) |
|     |             |         |         | DCG       | SOIC - Green                                             |
|     |             |         |         | PGG       | TSSOP - Green                                            |
|     |             |         |         | 2309NZ-1H | Nine Output 3.3V Clock Buffer                            |

| Part / Order Number | Shipping Packaging | Package      | Temperature    |
|---------------------|--------------------|--------------|----------------|
| 2309NZ-1HDCG        | Tubes              | 16-pin SOIC  | 0° to +70° C   |
| 2309NZ-1HDCG8       | Tape and Reel      | 16-pin SOIC  | 0° to +70° C   |
| 2309NZ-1HDCGI       | Tubes              | 16-pin SOIC  | -40° to +85° C |
| 2309NZ-1HDCGI8      | Tape and Reel      | 16-pin SOIC  | -40° to +85° C |
| 2309NZ-1HPGG        | Tubes              | 16-pin TSSOP | 0° to +70° C   |
| 2309NZ-1HPGG8       | Tape and Reel      | 16-pin TSSOP | 0° to +70° C   |
| 2309NZ-1HPGGI       | Tubes              | 16-pin TSSOP | -40° to +85° C |
| 2309NZ-1HPGGI8      | Tape and Reel      | 16-pin TSSOP | -40° to +85° C |



**CORPORATE HEADQUARTERS**  
6024 Silver Creek Valley Road  
San Jose, CA 95138

**for SALES:**  
800-345-7015 or 408-284-8200  
fax: 408-284-2775  
www.idt.com

**for Tech Support:**  
clockhelp@idt.com