

# NB2308A

## 3.3 V Zero Delay Clock Buffer

The NB2308A is a versatile, 3.3 V zero delay buffer designed to distribute high-speed clocks. It is available in a 16 pin package. The part has an on-chip PLL which locks to an input clock presented on the REF pin. The PLL feedback is required to be driven to FBK pin, and can be obtained from one of the outputs. The input-to-output propagation delay is guaranteed to be less than 250 ps, and the output-to-output skew is guaranteed to be less than 200 ps.

The NB2308A has two banks of four outputs each, which can be controlled by the select inputs as shown in the Select Input Decoding Table. If all the output clocks are not required, Bank B can be three-stated. The select input also allows the input clock to be directly applied to the outputs for chip and system testing purposes.

Multiple NB2308A devices can accept the same input clock and distribute it. In this case the skew between the outputs of the two devices is guaranteed to be less than 700 ps.

The NB2308A is available in five different configurations (Refer to NB2308A Configurations Table). The NB2308Ax1\* is the base part, where the output frequencies equal the reference if there is no counter in the feedback path. The NB2308Ax1H is the high-drive version of the -1 and the rise and fall times on this device are much faster.

The NB2308Ax2 allows the user to obtain 2X and 1X frequencies on each output bank. The exact configuration and output frequencies depends on which output drives the feedback pin. The NB2308Ax3 allows the user to obtain 4X and 2X frequencies on the outputs.

The NB2308Ax4 enables the user to obtain 2X clocks on all outputs. Thus, the part is extremely versatile, and can be used in a variety of applications.

The NB2308Ax5H is a high-drive version with REF/2 on both banks.

### Features

- Zero Input – Output Propagation Delay, Adjustable by Capacitive Load on FBK Input
- Multiple Configurations – Refer to NB2308A Configurations Table
- Input Frequency Range: 15 MHz to 133 MHz
- Multiple Low-Skew Outputs
- Output-Output Skew Less than 200 ps
- Device-Device Skew Less than 700 ps
- Two banks of four outputs, three-stateable by two select inputs
- Less than 200 ps Cycle-to-Cycle Jitter
- Available in 16-pin SOIC and TSSOP Packages
- 3.3V operation
- Advanced 0.35  $\mu$  CMOS Technology
- Pb-Free Packages are Available\*\*

\*x = C for Commercial; I for Industrial.

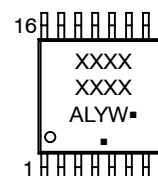
\*\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



**ON Semiconductor®**

<http://onsemi.com>

### MARKING DIAGRAMS\*



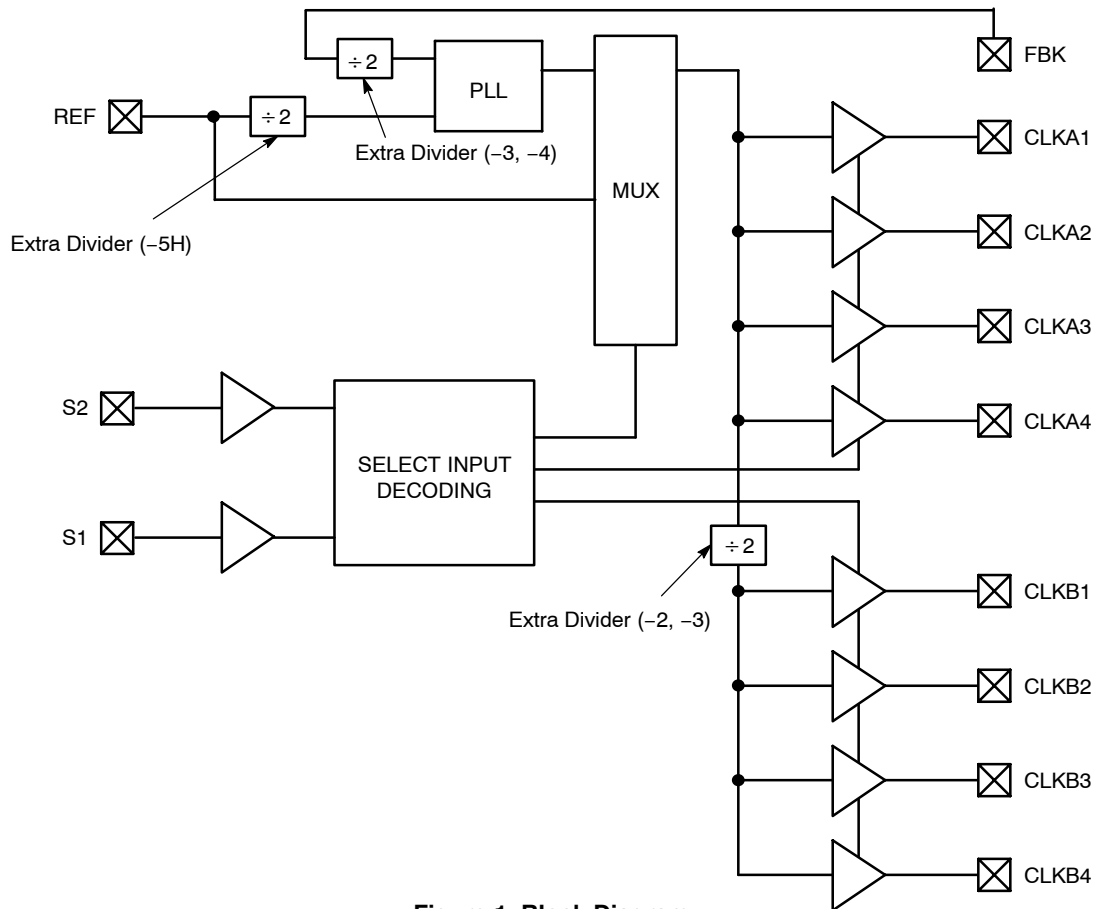
XXXX = Device Code  
A = Assembly Location  
WL, L = Wafer Lot  
Y = Year  
WW, W = Work Week  
G or ■ = Pb-Free Package  
(Note: Microdot may be in either location)

\*For additional marking information, refer to Application Note AND8002/D.

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

## NB2308A



**Figure 1. Block Diagram**  
(see Figures 11, 12, 13, 14 and 15 for device specific Block Diagrams)

**Table 1. CONFIGURATIONS** (x = C for Commercial; I for Industrial)

| Device     | Feedback From    | Bank A Frequency | Bank B Frequency                |
|------------|------------------|------------------|---------------------------------|
| NB2308Ax1  | Bank A or Bank B | Reference        | Reference                       |
| NB2308Ax1H | Bank A or Bank B | Reference        | Reference                       |
| NB2308Ax2  | Bank A           | Reference        | Reference ÷ 2                   |
| NB2308Ax2  | Bank B           | 2 X Reference    | Reference                       |
| NB2308Ax3  | Bank A           | 2 X Reference    | Reference or Reference (Note 1) |
| NB2308Ax3  | Bank B           | 4 X Reference    | 2 X Reference                   |
| NB2308Ax4  | Bank A or Bank B | 2 X Reference    | 2 X Reference                   |
| NB2308Ax5H | Bank A or Bank B | Reference ÷ 2    | Reference ÷ 2                   |

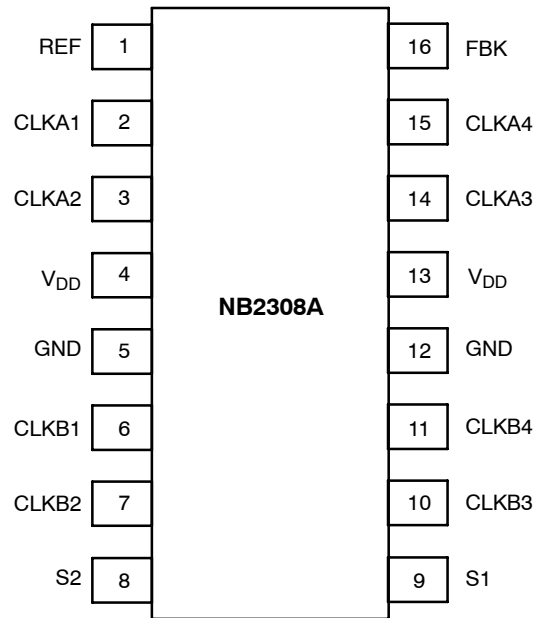
1. Output phase is indeterminant (0° or 180° from input clock). If phase integrity is required, use the NB2308Ax2.

**Table 2. SELECT INPUT DECODING**

| S2 | S1 | Clock A1 – A4   | Clock B1 – B4 | Output Source | PLL ShutDown |
|----|----|-----------------|---------------|---------------|--------------|
| 0  | 0  | Three-state     | Three-state   | PLL           | Y            |
| 0  | 1  | Driven          | Three-state   | PLL           | N            |
| 1  | 0  | Driven (Note 2) | Driven        | Reference     | Y            |
| 1  | 1  | Driven          | Driven        | PLL           | N            |

2. Outputs inverted on 2308-2 and 2308-3 in bypass mode, S2 = 1 and S1 = 0.

## NB2308A



**Figure 2. Pin Configuration**

**Table 3. PIN DESCRIPTION**

| Pin # | Pin Name        | Description                                    |
|-------|-----------------|------------------------------------------------|
| 1     | REF (Note 3)    | Input reference frequency, 5 V tolerant input. |
| 2     | CLKA1 (Note 4)  | Buffered clock output, Bank A.                 |
| 3     | CLKA2 (Note 4)  | Buffered clock output, Bank A.                 |
| 4     | V <sub>DD</sub> | 3.3 V supply.                                  |
| 5     | GND             | Ground.                                        |
| 6     | CLKB1 (Note 4)  | Buffered clock output, Bank B.                 |
| 7     | CLKB2 (Note 4)  | Buffered clock output, Bank B.                 |
| 8     | S2 (Note 5)     | Select input, bit 2.                           |
| 9     | S1 (Note 5)     | Select input, bit 1.                           |
| 10    | CLKB3 (Note 4)  | Buffered clock output, Bank B.                 |
| 11    | CLKB4 (Note 4)  | Buffered clock output, Bank B.                 |
| 12    | GND             | Ground.                                        |
| 13    | V <sub>DD</sub> | 3.3 V supply.                                  |
| 14    | CLKA3 (Note 4)  | Buffered clock output, Bank A.                 |
| 15    | CLKA4 (Note 4)  | Buffered clock output, Bank A.                 |
| 16    | FBK             | PLL feedback input.                            |

3. Weak pulldown.

4. Weak pulldown on all outputs.

5. Weak pullup on these inputs.

**Table 4. MAXIMUM RATINGS**

| Parameter                                               | Min  | Max            | Unit |
|---------------------------------------------------------|------|----------------|------|
| Supply Voltage to Ground Potential                      | -0.5 | +7.0           | V    |
| DC Input Voltage (Except REF)                           | -0.5 | $V_{DD} + 0.5$ | V    |
| DC Input Voltage (REF)                                  | -0.5 | 7              | V    |
| Storage Temperature                                     | -65  | +150           | °C   |
| Maximum Soldering Temperature (10 sec)                  |      | 260            | °C   |
| Junction Temperature                                    |      | 150            | °C   |
| Static Discharge Voltage (per MIL-STD-883, Method 3015) |      | >2000          | V    |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

**Table 5. OPERATING CONDITIONS FOR COMMERCIAL AND INDUSTRIAL TEMPERATURE DEVICES**

| Parameter | Description                                                             | Min      | Max      | Unit |
|-----------|-------------------------------------------------------------------------|----------|----------|------|
| $V_{DD}$  | Supply Voltage                                                          | 3.0      | 3.6      | V    |
| $T_A$     | Operating Temperature (Ambient Temperature)<br>Commercial<br>Industrial | 0<br>-40 | 70<br>85 | °C   |
| $C_L$     | Load Capacitance, below 100 MHz                                         |          | 30       | pF   |
| $C_L$     | Load Capacitance, from 100 MHz to 133 MHz                               |          | 15       | pF   |
| $C_{IN}$  | Input Capacitance (Note 6)                                              |          | 7        | pF   |

6. Applies to both REF Clock and FBK.

**Table 6. ELECTRICAL CHARACTERISTICS FOR COMMERCIAL AND INDUSTRIAL TEMPERATURE DEVICES**

| Parameter | Description             | Test Conditions                                                   | Min | Max   | Unit |
|-----------|-------------------------|-------------------------------------------------------------------|-----|-------|------|
| $V_{IL}$  | Input LOW Voltage       |                                                                   |     | 0.8   | V    |
| $V_{IH}$  | Input HIGH Voltage      |                                                                   | 2.0 |       | V    |
| $I_{IL}$  | Input LOW Current       | $V_{IN} = 0$ V                                                    |     | 50.0  | μA   |
| $I_{IH}$  | Input HIGH Current      | $V_{IN} = V_{DD}$                                                 |     | 100.0 | μA   |
| $V_{OL}$  | Output LOW Voltage      | $I_{OL} = 8$ mA (-1, -2, -3, -4)<br>$I_{OL} = 12$ mA (-1H, -5H)   |     | 0.4   | V    |
| $V_{OH}$  | Output HIGH Voltage     | $I_{OH} = -8$ mA (-1, -2, -3, -4)<br>$I_{OH} = -12$ mA (-1H, -5H) | 2.4 |       | V    |
| $I_{DD}$  | Supply Current (Note 7) | Unloaded outputs 100 MHz REF<br>-2, -3, -4                        |     | 49    | mA   |
|           |                         | Select inputs at $V_{DD}$ or GND<br>-1H, -5H                      |     | 60    | mA   |
|           |                         | Unloaded outputs, 66 MHz REF<br>(-1, -2, -3, -4)                  |     | 34    | mA   |
|           |                         | Unloaded outputs, 33 MHz REF<br>(-1, -2, -3, -4)                  |     | 18    | mA   |

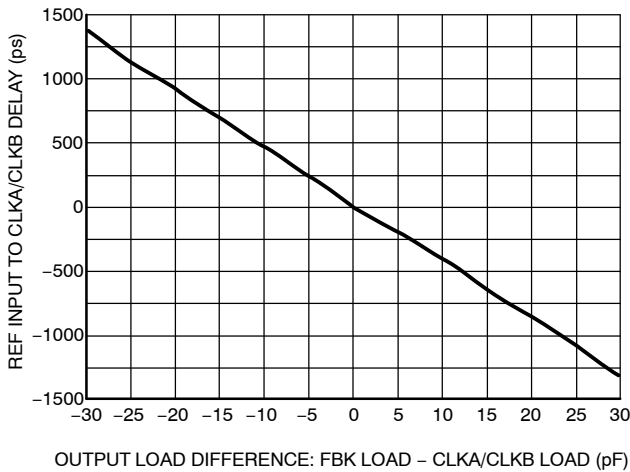
7. Supply currents are measured for PLL-Bypass Mode ( $S_2 = 1$ ,  $S_1 = 0$ ).

Table 7. SWITCHING CHARACTERISTICS FOR COMMERCIAL AND INDUSTRIAL TEMPERATURE DEVICES

| Parameter  | Description                                            | Test Conditions                                                                                                                                                     | Min            | Typ          | Max                   | Unit |
|------------|--------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------|-----------------------|------|
| $t_1$      | Output Frequency                                       | 30 pF load (all devices)<br>15 pF load (-1H, -5H)<br>15 pF load (-1, -2, -3, -4)                                                                                    | 15<br>15<br>15 |              | 100<br>133.3<br>133.3 | MHz  |
| $t_1$      | Duty Cycle = $(t_2 / t_1) * 100$<br>(all devices)      | Measured at 1.4 V, $F_{OUT} = < 66.66$ MHz<br>30 pF load<br>Measured at 1.4 V, $F_{OUT} = < 50$ MHz<br>15 pF load                                                   | 40.0<br>45.0   | 50.0<br>50.0 | 60.0<br>55.0          | %    |
| $t_3$      | Output Rise Time<br>(-1, -2, -3, -4)                   | Measured between 0.8 V and 2.0 V<br>30 pF load<br>Measured between 0.8 V and 2.0 V<br>15 pF load                                                                    |                |              | 2.20<br>1.50          | ns   |
|            | Output Rise Time<br>(-1H, -5H)                         | Measured between 0.8 V and 2.0 V<br>30 pF load                                                                                                                      |                |              | 1.50                  |      |
| $t_4$      | Output Fall Time<br>(-1, -2, -3, -4)                   | Measured between 2.0 V and 0.8 V<br>30 pF load<br>Measured between 0.8 V and 2.0 V<br>15 pF load                                                                    |                |              | 2.20<br>1.50          | ns   |
|            | Output Fall Time<br>(-1H, -5H)                         | Measured between 2.0 V and 0.8 V<br>30 pF load                                                                                                                      |                |              | 1.25                  |      |
| $t_5$      | Output-to-Output Skew on same Bank<br>(-1, -2, -3, -4) | All outputs equally loaded                                                                                                                                          |                |              | 200                   | ps   |
|            | Output-to-Output Skew<br>(-1H, -5H)                    | All outputs equally loaded                                                                                                                                          |                |              | 200                   |      |
|            | Output Bank A-to-Output Bank B Skew<br>(-1, -4, -5H)   | All outputs equally loaded                                                                                                                                          |                |              | 200                   |      |
|            | Output Bank A-to-Output Bank B Skew<br>(-2, -3)        | All outputs equally loaded                                                                                                                                          |                |              | 400                   |      |
| $t_6$      | Delay, REF Rising Edge to FBK<br>Rising Edge           | Measured at $V_{DD}/2$                                                                                                                                              |                | 0            | $\pm 250$             | ps   |
| $t_7$      | Device-to-Device Skew                                  | Measured at $V_{DD}/2$ on the FBK pins of the device                                                                                                                |                | 0            | 700                   | ps   |
| $t_J$      | Cycle-to-Cycle Jitter<br>(-1, -1H, -4, -5H)            | Measured at 66.67 MHz, loaded outputs,<br>15 pF load<br>Measured at 66.67 MHz, loaded outputs,<br>30 pF load<br>Measured at 133.3 MHz, loaded outputs<br>15 pF load |                |              | 200<br>200<br>100     | ps   |
|            | Cycle-to-Cycle Jitter<br>(-2, -3)                      | Measured at 66.67 MHz, loaded outputs,<br>30 pF load<br>Measured at 66.67 MHz, loaded outputs,<br>15 pF load                                                        |                |              | 400<br>400            |      |
| $t_{LOCK}$ | PLL Lock Time                                          | Stable power supply, valid clock presented<br>on REF and FBK pins                                                                                                   |                |              | 1.0                   | ms   |

### Zero Delay and Skew Control

All outputs should be uniformly loaded to achieve Zero Delay between input and output.

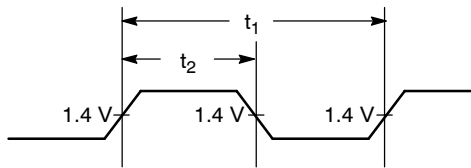


**Figure 3. REF Input to CLKA/CLKB Delay vs. Difference in Loading between FBK Pin and CLKA/CLKB Pins**

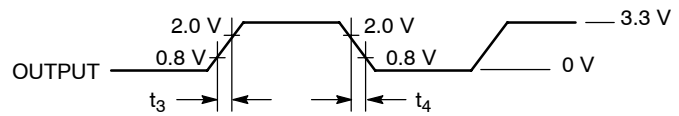
To close the feedback loop of the NB2308A, the FBK pin can be driven from any of the eight available output pins. The output driving the FBK pin will be driving a total load of 7 pF plus any additional load that it drives. The relative loading of this output (with respect to the remaining outputs) can adjust the input-output delay. This is shown in Figure 3.

For applications requiring zero input-output delay, all outputs including the one providing feedback should be equally loaded. If input-output delay adjustments are required, use the above graph to calculate loading differences between the feedback output and remaining outputs. For zero output-output skew, be sure to load outputs equally.

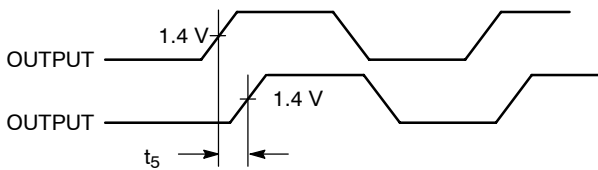
### SWITCHING WAVEFORMS



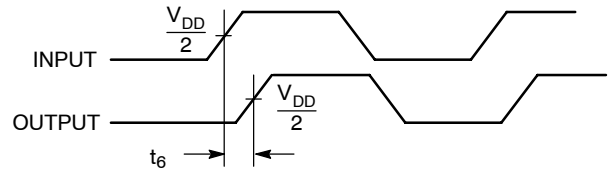
**Figure 4. Duty Cycle Timing**



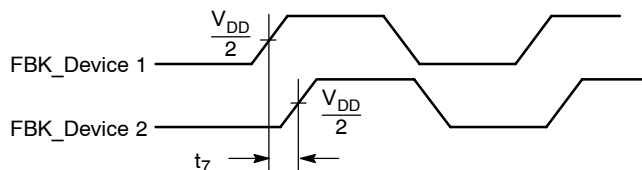
**Figure 5. All Outputs Rise/Fall Time**



**Figure 6. Output - Output Skew**



**Figure 7. Input - Output Propagation Delay**



**Figure 8. Device - Device Skew**

# NB2308A

## TEST CIRCUITS

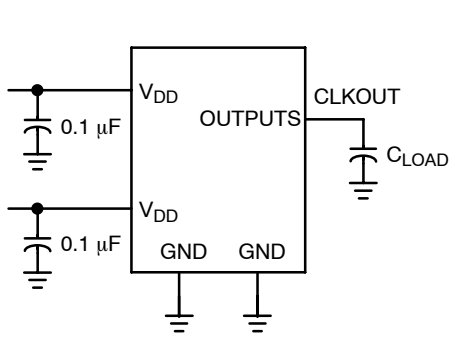


Figure 9. Test Circuit #1

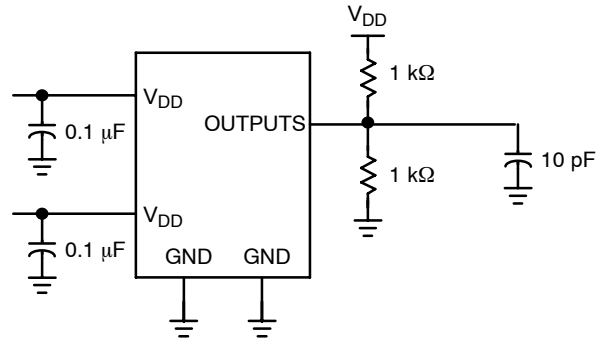


Figure 10. Test Circuit #2  
For parameter  $t_g$  (output slew rate) on -1H devices

## BLOCK DIAGRAMS

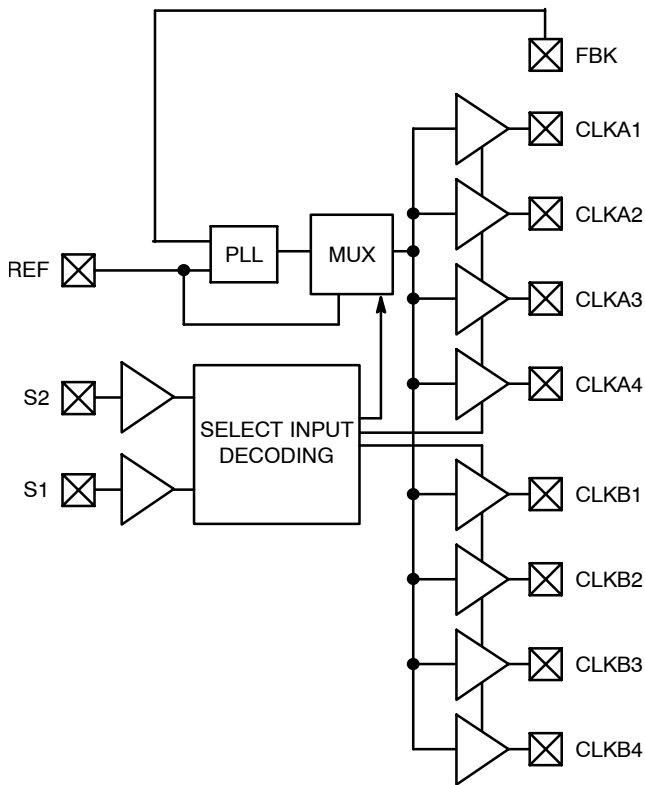


Figure 11. NB2308Ax1 and NB2308Ax1H

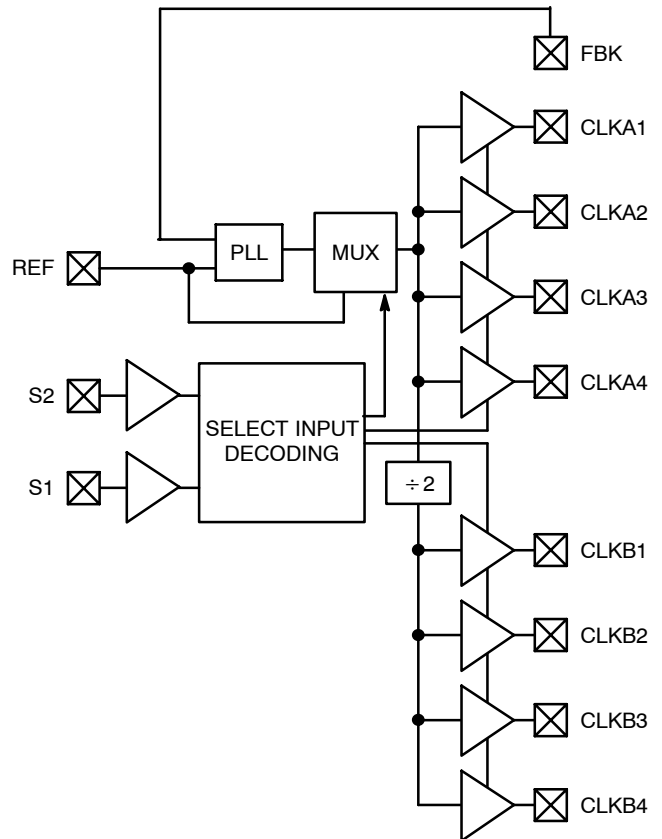


Figure 12. NB2308Ax2

# NB2308A

## BLOCK DIAGRAMS

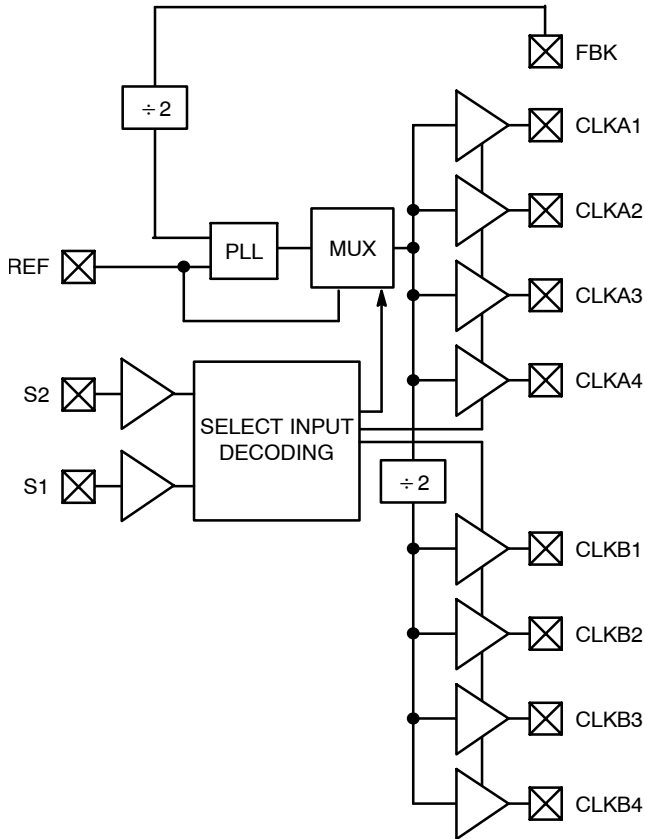


Figure 13. NB2308Ax3

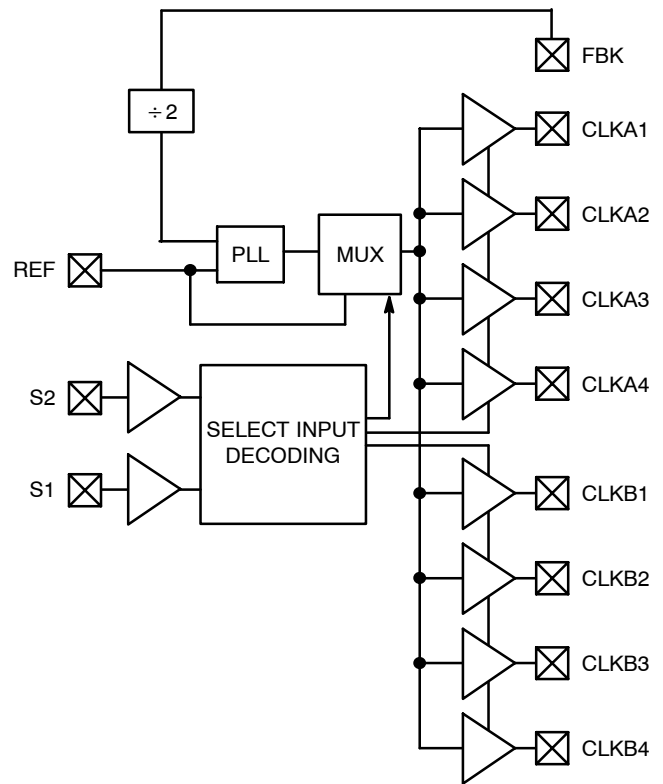


Figure 14. NB2308Ax4

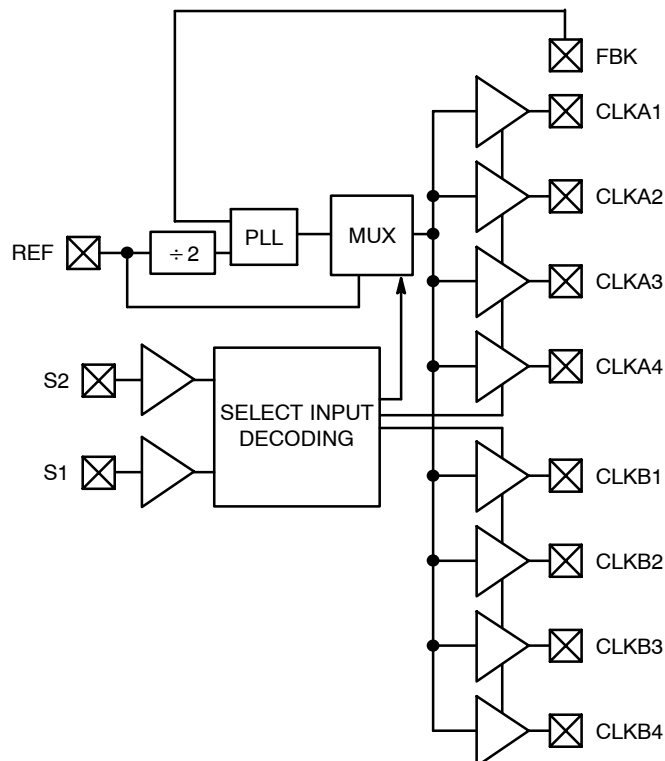


Figure 15. NB2308Ax5H

# NB2308A

## ORDERING INFORMATION

| Device          | Marking   | Operating Range | Package               | Shipping <sup>†</sup> | Availability |
|-----------------|-----------|-----------------|-----------------------|-----------------------|--------------|
| NB2308AC1D      | 2308AC1   | Commercial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AC1DG     | 2308AC1G  | Commercial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AC1DR2    | 2308AC1   | Commercial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AC1DR2G   | 2308AC1G  | Commercial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AI1D      | 2308AI1   | Industrial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AI1DG     | 2308AI1G  | Industrial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AI1DR2    | 2308AI1   | Industrial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AI1DR2G   | 2308AI1G  | Industrial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AC1HD     | 2308AC1H  | Commercial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AC1HDG    | 2308AC1HG | Commercial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AC1HDR2   | 2308AC1H  | Commercial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AC1HDR2G  | 2308AC1HG | Commercial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AI1HD     | 2308AI1H  | Industrial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AI1HDG    | 2308AI1HG | Industrial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AI1HDR2   | 2308AI1H  | Industrial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AI1HDR2G  | 2308AI1HG | Industrial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AC1DT     | 2308AC1   | Commercial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AC1DTG    | 2308AC1   | Commercial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AC1DTR2   | 2308AC1   | Commercial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AC1DTR2G  | 2308AC1   | Commercial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |
| NB2308AI1DT     | 2308AI1   | Industrial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AI1DTG    | 2308AI1   | Industrial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AI1DTR2   | 2308AI1   | Industrial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AI1DTR2G  | 2308AI1   | Industrial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |
| NB2308AC1HDT    | 2308AI1H  | Commercial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AC1HDTG   | 2308AI1H  | Commercial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AC1HDTR2  | 2308AI1H  | Commercial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AC1HDTR2G | 2308AI1H  | Commercial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |
| NB2308AI1HDT    | 2308AI1H  | Industrial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AI1HDTG   | 2308AI1H  | Industrial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AI1HDTR2  | 2308AI1H  | Industrial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AI1HDTR2G | 2308AI1H  | Industrial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# NB2308A

## ORDERING INFORMATION

| Device         | Marking  | Operating Range | Package               | Shipping <sup>†</sup> | Availability |
|----------------|----------|-----------------|-----------------------|-----------------------|--------------|
| NB2308AC2D     | 2308AC2  | Commercial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AC2DG    | 2308AC2G | Commercial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AC2DR2   | 2308AC2  | Commercial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AC2DR2G  | 2308AC2G | Commercial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AI2D     | 2308AI2  | Industrial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AI2DG    | 2308AI2G | Industrial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AI2DR2   | 2308AI2  | Industrial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AI2DR2G  | 2308AI2G | Industrial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AC2DT    | 2308AC2  | Commercial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AC2DTG   | 2308AC2  | Commercial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AC2DTR2  | 2308AC2  | Commercial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AC2DTR2G | 2308AC2  | Commercial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |
| NB2308AI2DT    | 2308AI2  | Industrial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AI2DTG   | 2308AI2  | Industrial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AI2DTR2  | 2308AI2  | Industrial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AI2DTR2G | 2308AI2  | Industrial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |
| NB2308AC3D     | 2308AC3  | Commercial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AC3DG    | 2308AC3G | Commercial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AC3DR2   | 2308AC3  | Commercial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AC3DR2G  | 2308AC3G | Commercial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AI3D     | 2308AI3  | Industrial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AI3DG    | 2308AI3G | Industrial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AI3DR2   | 2308AI3  | Industrial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AI3DR2G  | 2308AI3G | Industrial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AC3DT    | 2308AC3  | Commercial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AC3DTG   | 2308AC3  | Commercial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AC3DTR2  | 2308AC3  | Commercial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AC3DTR2G | 2308AC3  | Commercial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |
| NB2308AI3DT    | 2308AI3  | Industrial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AI3DTG   | 2308AI3  | Industrial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AI3DTR2  | 2308AI3  | Industrial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AI3DTR2G | 2308AI3  | Industrial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# NB2308A

## ORDERING INFORMATION

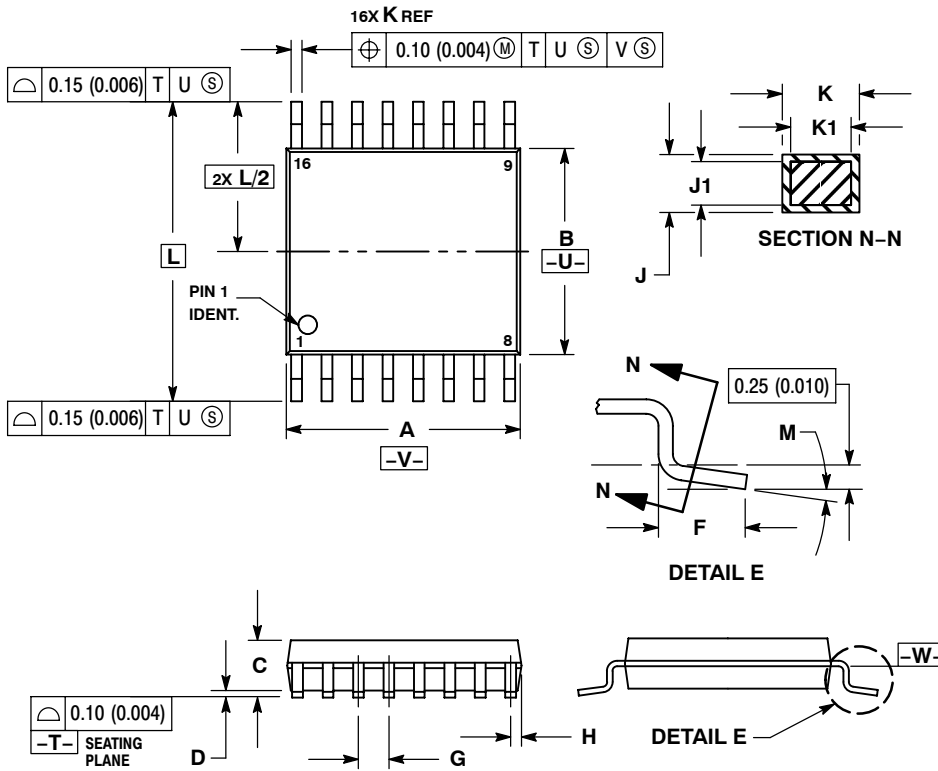
| Device          | Marking   | Operating Range | Package               | Shipping <sup>†</sup> | Availability |
|-----------------|-----------|-----------------|-----------------------|-----------------------|--------------|
| NB2308AC4D      | 2308AC4   | Commercial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AC4DG     | 2308AC4G  | Commercial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AC4DR2    | 2308AC4   | Commercial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AC4DR2G   | 2308AC4G  | Commercial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AI4D      | 2308AI4   | Industrial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AI4DG     | 2308AI4G  | Industrial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AI4DR2    | 2308AI4   | Industrial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AI4DR2G   | 2308AI4G  | Industrial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AC4DT     | 2308AC4   | Commercial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AC4DTG    | 2308AC4   | Commercial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AC4DTR2   | 2308AC4   | Commercial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AC4DTR2G  | 2308AC4   | Commercial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |
| NB2308AI4DT     | 2308AI4   | Industrial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AI4DTG    | 2308AI4   | Industrial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AI4DTR2   | 2308AI4   | Industrial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AI4DTR2G  | 2308AI4   | Industrial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |
| NB2308AC5HD     | 2308AC5H  | Commercial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AC5HDG    | 2308AC5HG | Commercial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AC5HDR2   | 2308AC5H  | Commercial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AC5HDR2G  | 2308AC5HG | Commercial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AI5HD     | 2308AI5H  | Industrial      | SOIC-16               | 48 Units / Rail       | Now          |
| NB2308AI5HDG    | 2308AI5HG | Industrial      | SOIC-16<br>(Pb-Free)  | 48 Units / Rail       | Now          |
| NB2308AI5HDR2   | 2308AI5H  | Industrial      | SOIC-16               | 2500 Tape & Reel      | Now          |
| NB2308AI5HDR2G  | 2308AI5HG | Industrial      | SOIC-16<br>(Pb-Free)  | 2500 Tape & Reel      | Now          |
| NB2308AC5HDT    | 2308AC5H  | Commercial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AC5HDTG   | 2308AC5H  | Commercial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AC5HDTR2  | 2308AC5H  | Commercial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AC5HDTR2G | 2308AC5H  | Commercial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |
| NB2308AI5HDT    | 2308AI5H  | Industrial      | TSSOP-16              | 96 Units / Rail       | Now          |
| NB2308AI5HDTG   | 2308AI5H  | Industrial      | TSSOP-16<br>(Pb-Free) | 96 Units / Rail       | Now          |
| NB2308AI5HDTR2  | 2308AI5H  | Industrial      | TSSOP-16              | 2500 Tape & Reel      | Now          |
| NB2308AI5HDTR2G | 2308AI5H  | Industrial      | TSSOP-16<br>(Pb-Free) | 2500 Tape & Reel      | Now          |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# NB2308A

## PACKAGE DIMENSIONS

TSSOP-16  
CASE 948F-01  
ISSUE A



### NOTES:

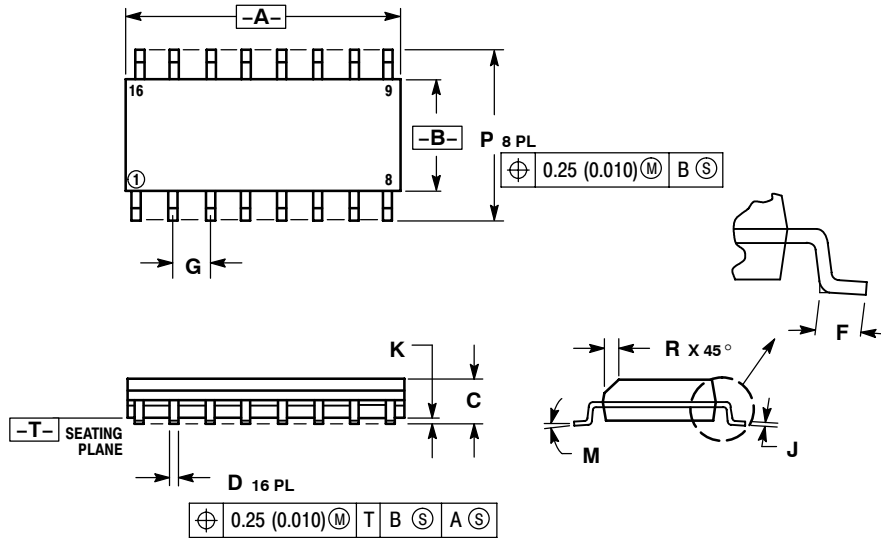
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 4.90        | 5.10 | 0.193     | 0.200 |
| B   | 4.30        | 4.50 | 0.169     | 0.177 |
| C   | ---         | 1.20 | ---       | 0.047 |
| D   | 0.05        | 0.15 | 0.002     | 0.006 |
| F   | 0.50        | 0.75 | 0.020     | 0.030 |
| G   | 0.65 BSC    |      | 0.026 BSC |       |
| H   | 0.18        | 0.28 | 0.007     | 0.011 |
| J   | 0.09        | 0.20 | 0.004     | 0.008 |
| J1  | 0.09        | 0.16 | 0.004     | 0.006 |
| K   | 0.19        | 0.30 | 0.007     | 0.012 |
| K1  | 0.19        | 0.25 | 0.007     | 0.010 |
| L   | 6.40 BSC    |      | 0.252 BSC |       |
| M   | 0°          | 8°   | 0°        | 8°    |

# NB2308A

## PACKAGE DIMENSIONS

SOIC-16  
CASE 751B-05  
ISSUE J



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 9.80        | 10.00 | 0.386     | 0.393 |
| B   | 3.80        | 4.00  | 0.150     | 0.157 |
| C   | 1.35        | 1.75  | 0.054     | 0.068 |
| D   | 0.35        | 0.49  | 0.014     | 0.019 |
| F   | 0.40        | 1.25  | 0.016     | 0.049 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| J   | 0.19        | 0.25  | 0.008     | 0.009 |
| K   | 0.10        | 0.25  | 0.004     | 0.009 |
| M   | 0°          | 7°    | 0°        | 7°    |
| P   | 5.80        | 6.20  | 0.229     | 0.244 |
| R   | 0.25        | 0.50  | 0.010     | 0.019 |

Licensed under US patent Nos 5,488,627, 6,646,463 and 5,631,920.

ON Semiconductor and are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

### PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT:**  
Literature Distribution Center for ON Semiconductor  
P.O. Box 61312, Phoenix, Arizona 85082-1312 USA  
**Phone:** 480-829-7710 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 480-829-7709 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada

**Japan:** ON Semiconductor, Japan Customer Focus Center  
2-9-1 Kamimeguro, Meguro-ku, Tokyo, Japan 153-0051  
**Phone:** 81-3-5773-3850

**ON Semiconductor Website:** <http://onsemi.com>

**Order Literature:** <http://www.onsemi.com/litorder>

For additional information, please contact your local Sales Representative.

NB2308A/D