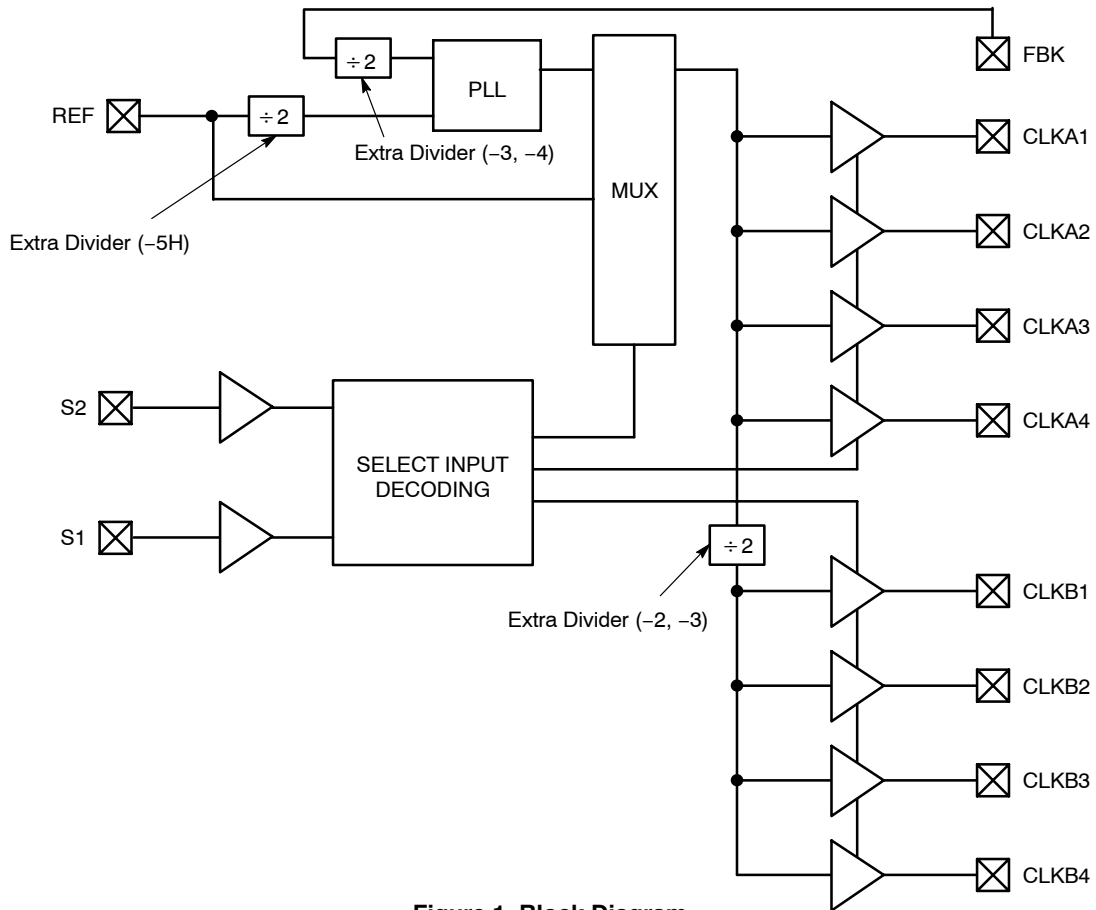


# NB2308A



**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

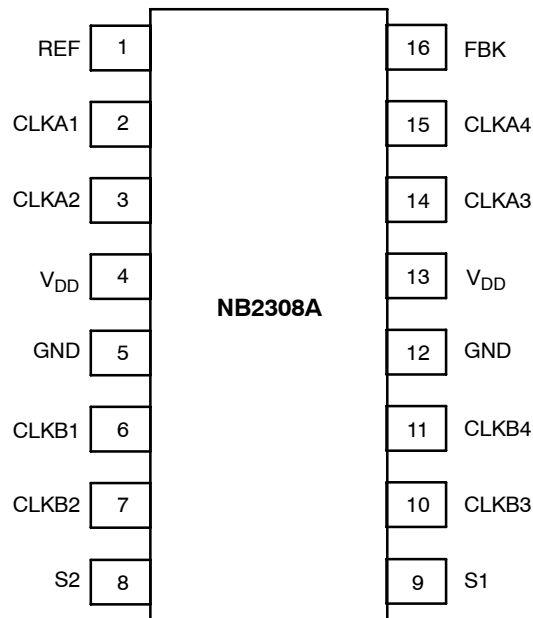
1. Output phase is indeterminant (0° or 180° from input clock). If phase integrity is required, use the NB2308Ax2.

**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)	Commercial Industrial	0 -40	70 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	$V_{IN} = 0\text{ V}$		50.0	μA	
$I_{IH}$	Input HIGH Current	$V_{IN} = V_{DD}$		100.0	μA	
$V_{OL}$	Output LOW Voltage	$I_{OL} = 8\text{ mA} (-1, -2, -3, -4)$ $I_{OL} = 12\text{ mA} (-1H, -5H)$		0.4	V	
$V_{OH}$	Output HIGH Voltage	$I_{OH} = -8\text{ mA} (-1, -2, -3, -4)$ $I_{OH} = -12\text{ mA} (-1H, -5H)$	2.4		V	
$I_{DD}$	Supply Current (Note 7)	Unloaded outputs 100 MHz REF	-2, -3, -4		49	mA
		Select inputs at $V_{DD}$ or GND	-1H, -5H		60	mA
		Unloaded outputs, 66 MHz REF (-1, -2, -3, -4)			34	mA
		Unloaded outputs, 33 MHz REF (-1, -2, -3, -4)			18	mA

7. Supply currents are measured for PLL-Bypass Mode ( $S2 = 1, S1 = 0$ ).

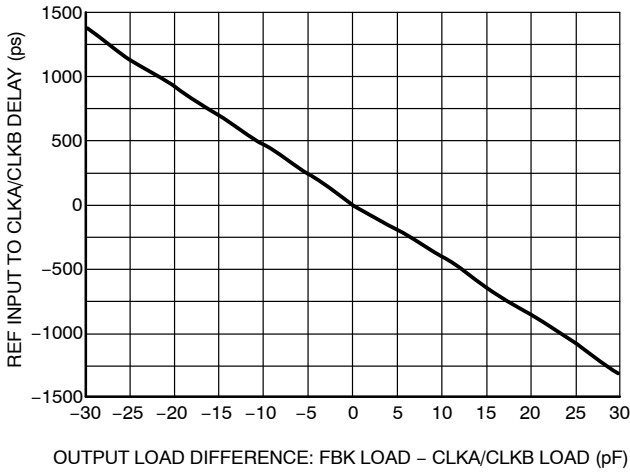
# NB2308A

**Table 7. SWITCHING CHARACTERISTICS FOR COMMERCIAL AND INDUSTRIAL TEMPERATURE DEVICES**

Parameter	Description	Test Conditions	Min	Typ	Max	Unit
t <sub>1</sub>	Output Frequency	30 pF load (all devices)	15		100	MHz
		15 pF load (-1H, -5H)	15		133.3	
		15 pF load (-1, -2, -3, -4)	15		133.3	
t <sub>1</sub>	Duty Cycle = (t <sub>2</sub> / t <sub>1</sub> ) * 100 (all devices)	Measured at 1.4 V, F <sub>OUT</sub> = < 66.66 MHz 30 pF load	40.0	50.0	60.0	%
		Measured at 1.4 V, F <sub>OUT</sub> = < 50 MHz 15 pF load	45.0	50.0	55.0	
t <sub>3</sub>	Output Rise Time (-1, -2, -3, -4)	Measured between 0.8 V and 2.0 V 30 pF load			2.20	ns
		Measured between 0.8 V and 2.0 V 15 pF load			1.50	
	Output Rise Time (-1H, -5H)	Measured between 0.8 V and 2.0 V 30 pF load			1.50	
t <sub>4</sub>	Output Fall Time (-1, -2, -3, -4)	Measured between 2.0 V and 0.8 V 30 pF load			2.20	ns
		Measured between 0.8 V and 2.0 V 15 pF load			1.50	
	Output Fall Time (-1H, -5H)	Measured between 2.0 V and 0.8 V 30 pF load			1.25	
t <sub>5</sub>	Output-to-Output Skew on same Bank (-1, -2, -3, -4)	All outputs equally loaded			200	ps
	Output-to-Output Skew (-1H, -5H)	All outputs equally loaded			200	
	Output Bank A-to-Output Bank B Skew (-1, -4, -5H)	All outputs equally loaded			200	
	Output Bank A-to-Output Bank B Skew (-2, -3)	All outputs equally loaded			400	
t <sub>6</sub>	Delay, REF Rising Edge to FBK Rising Edge	Measured at V <sub>DD</sub> /2		0	±250	ps
t <sub>7</sub>	Device-to-Device Skew	Measured at V <sub>DD</sub> /2 on the FBK pins of the device		0	700	ps
t <sub>J</sub>	Cycle-to-Cycle Jitter (-1, -1H, -4, -5H)	Measured at 66.67 MHz, loaded outputs, 15 pF load			200	ps
		Measured at 66.67 MHz, loaded outputs, 30 pF load			200	
		Measured at 133.3 MHz, loaded outputs 15 pF load			100	
	Cycle-to-Cycle Jitter (-2, -3)	Measured at 66.67 MHz, loaded outputs, 30 pF load			400	
		Measured at 66.67 MHz, loaded outputs, 15 pF load			400	
t <sub>LOCK</sub>	PLL Lock Time	Stable power supply, valid clock presented 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.

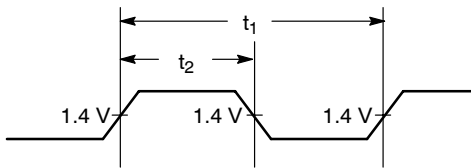


**Figure 3. REF Input to CLKA/CLKB Delay vs. Difference in Loading between FBK Pin and CLKA/CLKB Pins**

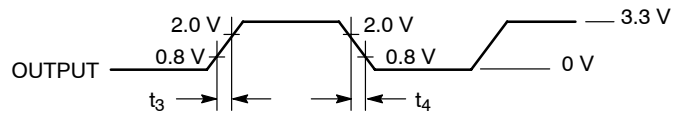
To close the feedback loop of the NB2308A, the FBK pin can be driven from any of the eight available output pins. The output driving the FBK pin will be driving a total load of 7 pF plus any additional load that it drives. The relative loading of this output (with respect to the remaining outputs) can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

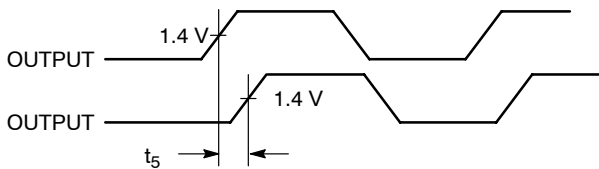
**SWITCHING WAVEFORMS**



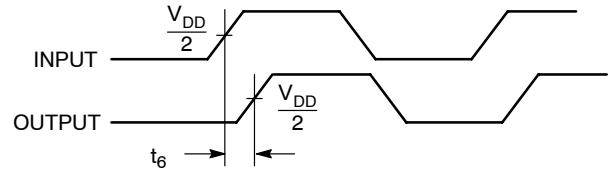
**Figure 4. Duty Cycle Timing**



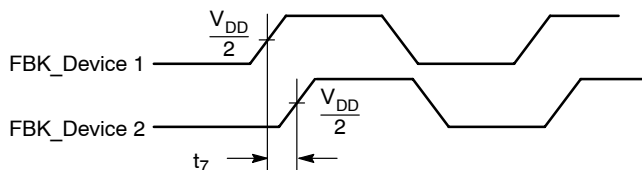
**Figure 5. All Outputs Rise/Fall Time**



**Figure 6. Output - Output Skew**



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



**Figure 8. Device - Device Skew**

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## TEST CIRCUITS

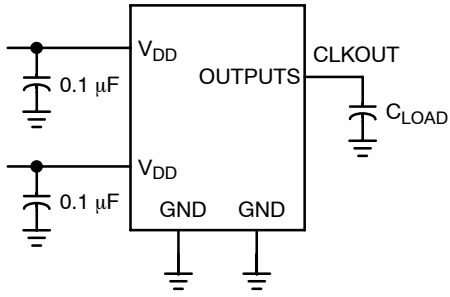


Figure 9. Test Circuit #1

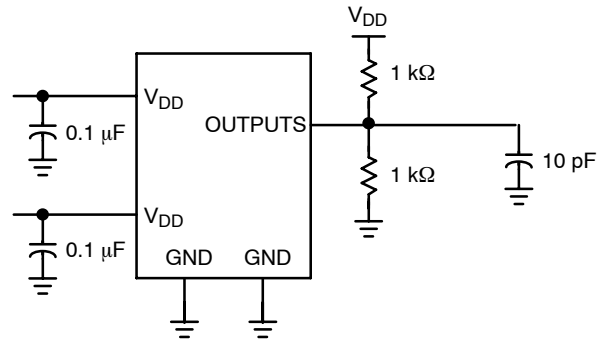


Figure 10. Test Circuit #2  
For parameter  $t_b$  (output slew rate) on -1H devices

## BLOCK DIAGRAMS

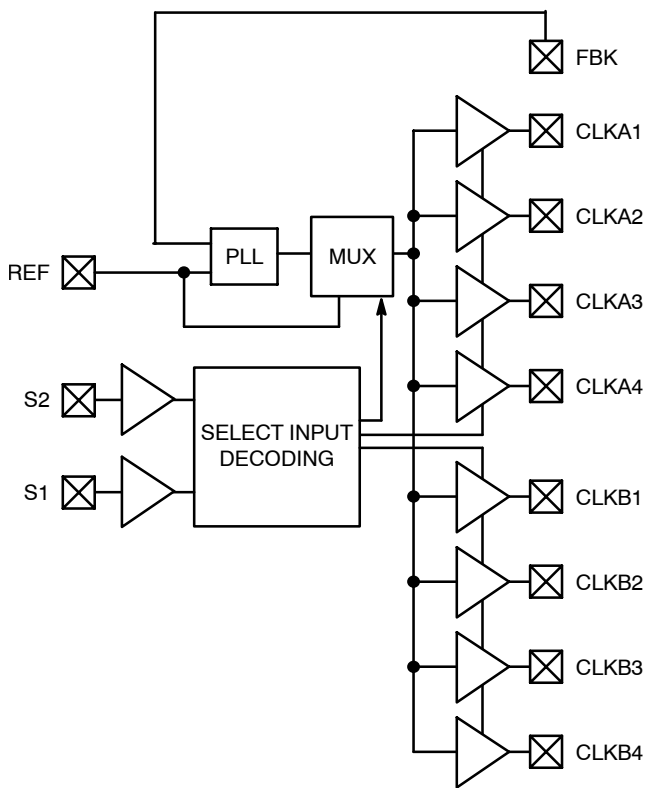


Figure 11. NB2308Ax1 and NB2308Ax1H

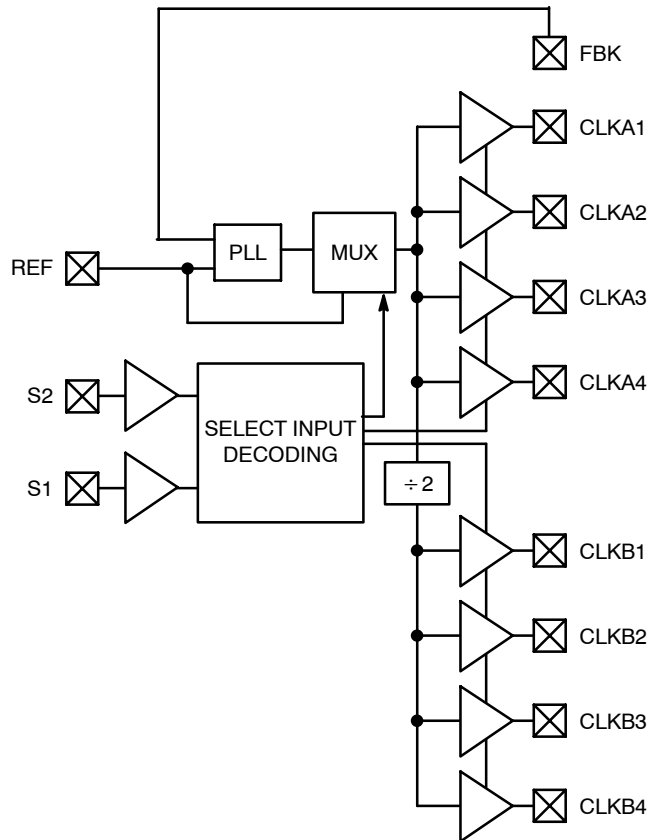


Figure 12. NB2308Ax2

# NB2308A

## BLOCK DIAGRAMS

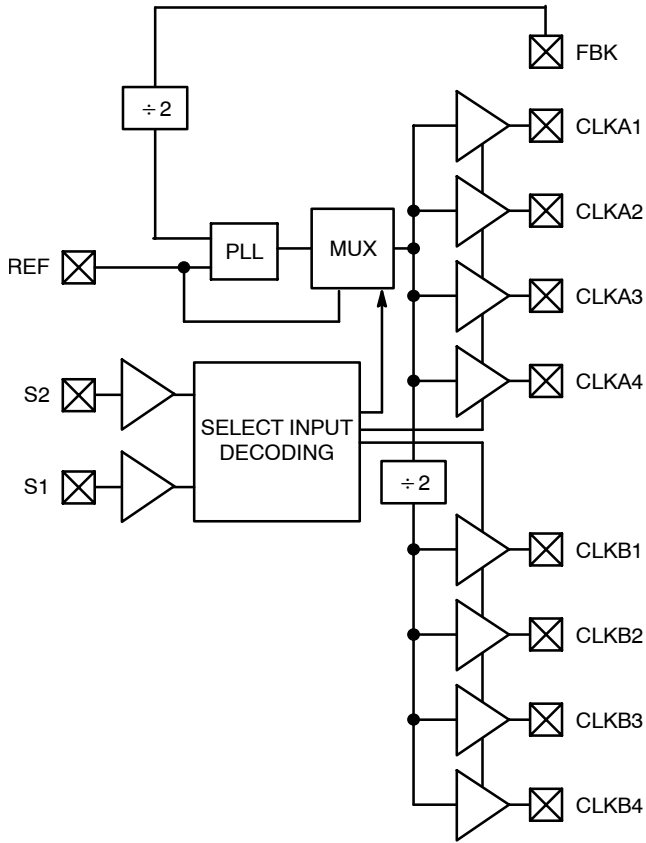


Figure 13. NB2308Ax3

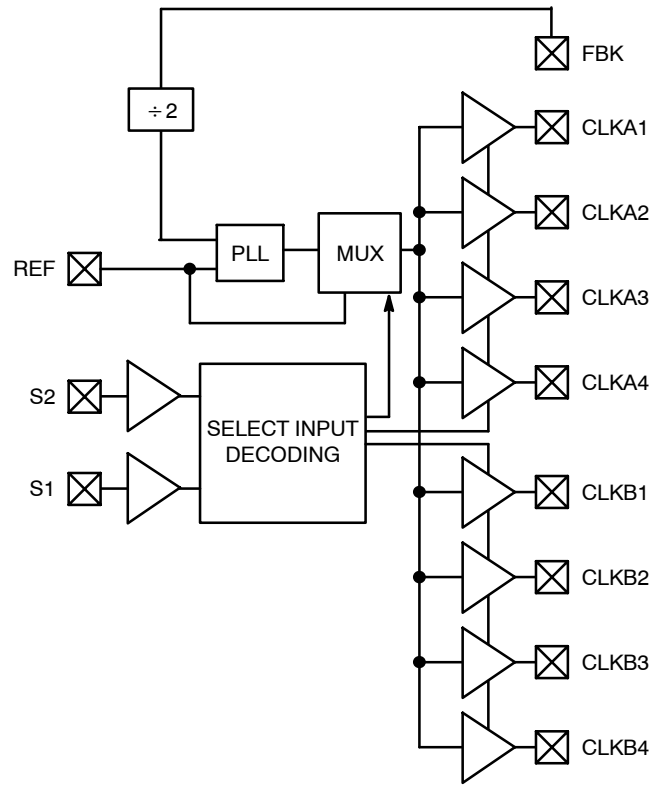


Figure 14. NB2308Ax4

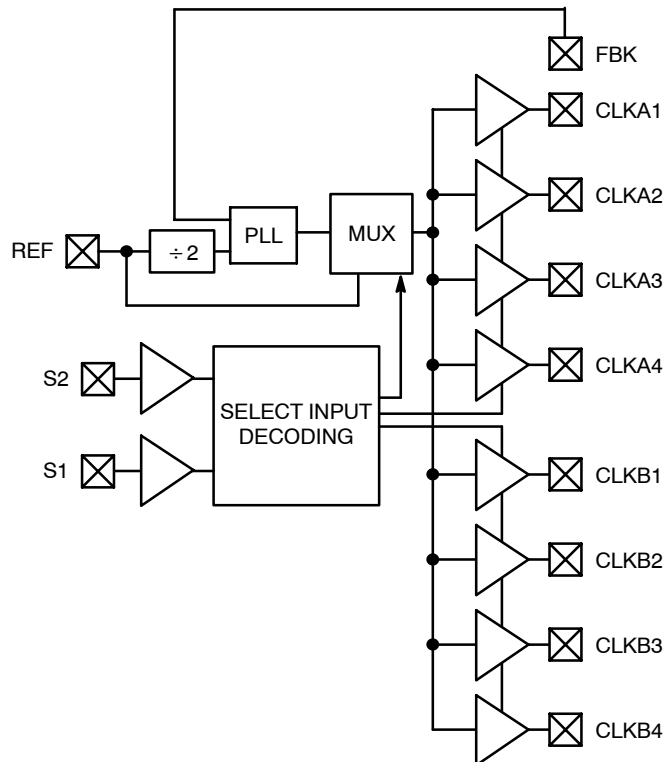


Figure 15. NB2308Ax5H

## NB2308A

### ORDERING INFORMATION

Device	Marking	Operating Range	Package	Shipping†	Availability
NB2308AC1DG	2308AC1G	Commercial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AC1DR2G	2308AC1G	Commercial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI1DG	2308AI1G	Industrial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AI1DR2G	2308AI1G	Industrial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AC1HDG	2308AC1HG	Commercial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AC1HDR2G	2308AC1HG	Commercial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI1HDG	2308AI1HG	Industrial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AI1HDR2G	2308AI1HG	Industrial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AC1DTG	2308AC1	Commercial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AC1DTR2G	2308AC1	Commercial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI1DTG	2308AI1	Industrial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AI1DTR2G	2308AI1	Industrial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AC1HDTG	2308AI1H	Commercial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AC1HDTR2G	2308AI1H	Commercial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI1HDTG	2308AI1H	Industrial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AI1HDTR2G	2308AI1H	Industrial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AC2DG	2308AC2G	Commercial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AC2DR2G	2308AC2G	Commercial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI2DG	2308AI2G	Industrial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AI2DR2G	2308AI2G	Industrial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AC2DTG	2308AC2	Commercial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AC2DTR2G	2308AC2	Commercial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI2DTG	2308AI2	Industrial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AI2DTR2G	2308AI2	Industrial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>

†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

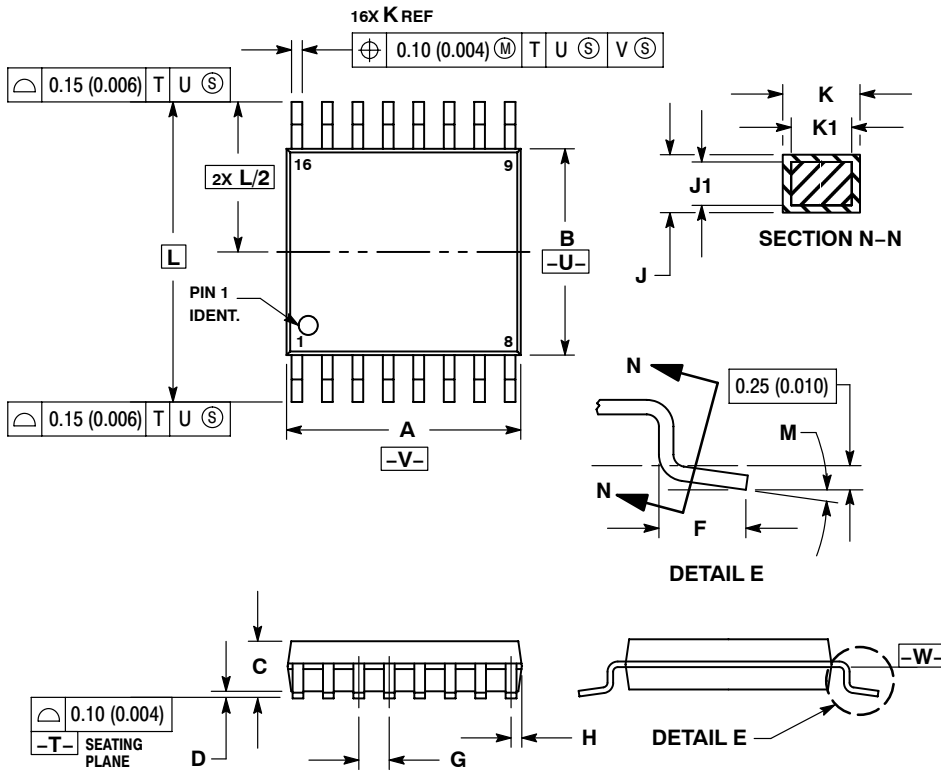
Device	Marking	Operating Range	Package	Shipping <sup>†</sup>	Availability
NB2308AC3DG	2308AC3G	Commercial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AC3DR2G	2308AC3G	Commercial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI3DG	2308AI3G	Industrial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AI3DR2G	2308AI3G	Industrial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AC3DTG	2308AC3	Commercial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AC3DTR2G	2308AC3	Commercial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI3DTG	2308AI3	Industrial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AI3DTR2G	2308AI3	Industrial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AC4DG	2308AC4G	Commercial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AC4DR2G	2308AC4G	Commercial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI4DG	2308AI4G	Industrial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AI4DR2G	2308AI4G	Industrial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AC4DTG	2308AC4	Commercial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AC4DTR2G	2308AC4	Commercial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI4DTG	2308AI4	Industrial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AI4DTR2G	2308AI4	Industrial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AC5HDG	2308AC5HG	Commercial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AC5HDR2G	2308AC5HG	Commercial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI5HDG	2308AI5HG	Industrial	SOIC-16 (Pb-Free)	48 Units / Rail	<i>Now</i>
NB2308AI5HDR2G	2308AI5HG	Industrial	SOIC-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AC5HDTG	2308AC5H	Commercial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AC5HDTR2G	2308AC5H	Commercial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>
NB2308AI5HDTG	2308AI5H	Industrial	TSSOP-16 (Pb-Free)	96 Units / Rail	<i>Now</i>
NB2308AI5HDTR2G	2308AI5H	Industrial	TSSOP-16 (Pb-Free)	2500 Tape & Reel	<i>Now</i>

<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



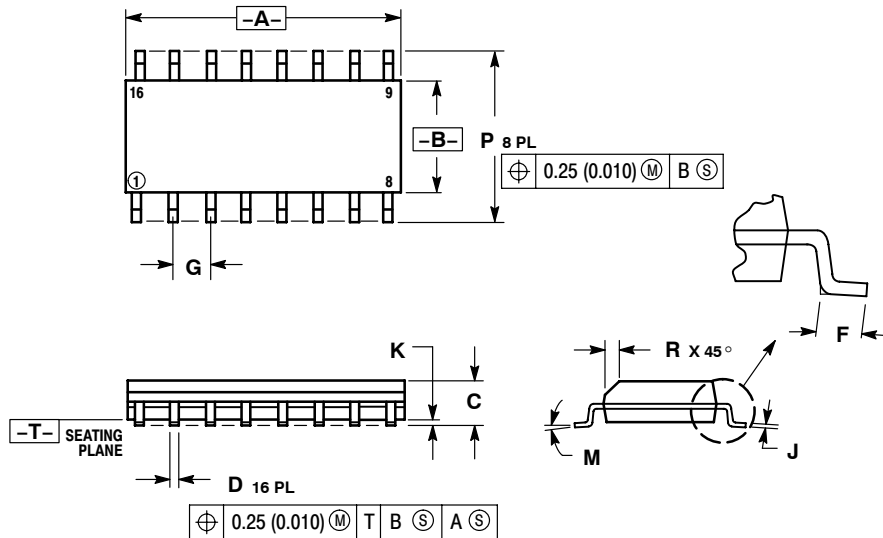
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
  4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. 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

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