

# NB3N5573

## 3.3 V, Crystal to 25 MHz, 100 MHz, 125 MHz and 200 MHz Dual HCSL Clock Generator



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### Description

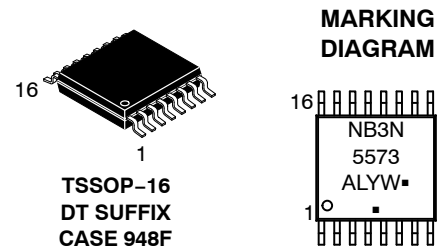
The NB3N5573 is a precision, low phase noise clock generator that supports PCI Express and Ethernet requirements. The device accepts a 25 MHz fundamental mode parallel resonant crystal and generates a differential HCSL output at 25 MHz, 100 MHz, 125 MHz or 200 MHz clock frequencies. Outputs can interface with LVDS with proper termination (See Figure 4).

This device is housed in 5.0 mm x 4.4 mm narrow body TSSOP 16 pin package.

### Features

- Uses 25 MHz Fundamental Mode Parallel Resonant Crystal
- External Loop Filter is Not Required
- HCSL Differential Output or LVDS with Proper Termination
- Four Selectable Multipliers of the Input Frequency
- Output Enable with Tri-State Outputs
- PCIe Gen1, Gen2, Gen3 Jitter Compliant
- Phase Noise: @ 100 MHz
 

Offset	Noise Power
100 Hz	-109.4 dBc
1 kHz	-127.8 dBc
10 kHz	-136.2 dBc
100 kHz	-138.8 dBc
1 MHz	-138.2 dBc
10 MHz	-161.4 dBc
20 MHz	-163.00 dBc
- Typical Period Jitter RMS of 1.5 ps
- Operating Range 3.3 V  $\pm$ 10%
- Industrial Temperature Range -40°C to +85°C
- These are Pb-Free Devices



- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- = Pb-Free Package

(\*Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

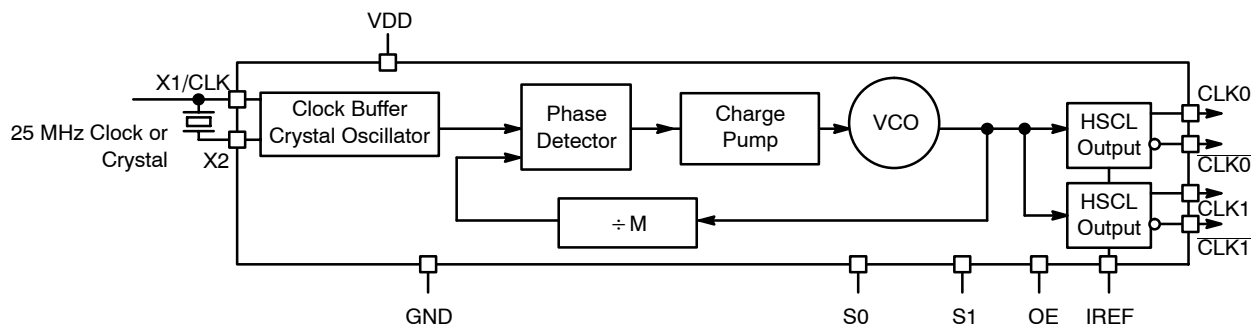


Figure 1. NB3N5573 Simplified Logic Diagram

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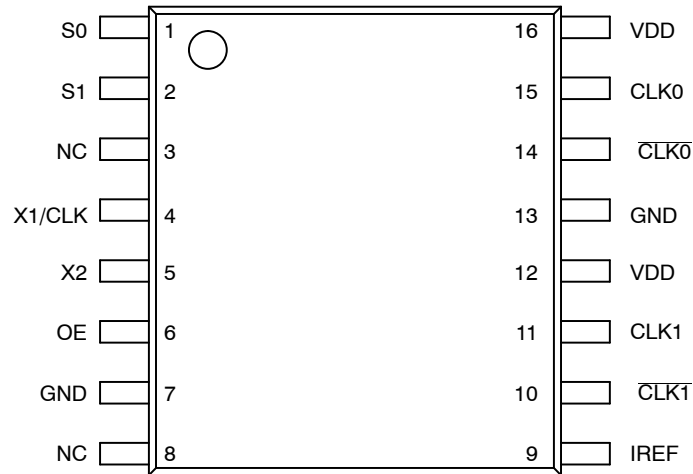


Figure 2. Pin Configuration (Top View)

Table 1. PIN DESCRIPTION

Pin	Symbol	I/O	Description
1	S0	Input	LVTTTL/LVCMOS frequency select input 0. Internal pullup resistor to V <sub>DD</sub> . See output select table 2 for details.
2	S1	Input	LVTTTL/LVCMOS frequency select input 1. Internal pullup resistor to V <sub>DD</sub> . See output select Table 2 for details.
12, 16	V <sub>DD</sub>	Power Supply	Positive supply voltage pins are connected to +3.3 V supply voltage.
4	X1/CLK	Input	Crystal or Clock input. Connect to 25 MHz crystal source or single-ended clock.
5	X2	Input	Crystal input. Connect to a 25 MHz crystal or leave unconnected for clock input.
6	OE	Input	Output enable tri-states output when connected to GND. Internal pullup resistor to V <sub>DD</sub> .
7, 13	GND	Power Supply	Ground 0 V. These pins provide GND return path for the devices.
9	I <sub>REF</sub>	Output	Output current reference pin. Precision resistor (typ. 475 Ω) is connected to set the output current.
11	CLK1	HCSL or LVDS Output	Noninverted clock output. (For LVDS levels see Figure 4)
10	CLK1	HCSL or LVDS Output	Inverted clock output. (For LVDS levels see Figure 4)
15	CLK0	HCSL or LVDS Output	Noninverted clock output. (For LVDS levels see Figure 4)
14	CLK0	HCSL or LVDS Output	Inverted clock output. (For LVDS levels see Figure 4)
3, 8	NC		Do not connect

Table 2. OUTPUT FREQUENCY SELECT TABLE WITH 25MHz CRYSTAL

S1*	S0*	CLK Multiplier	f <sub>CLKout</sub> (MHz)
L	L	1x	25
L	H	4x	100
H	L	5x	125
H	H	8x	200

\*Pins S1 and S0 default high when left open.

### Recommended Crystal Parameters

Crystal	Fundamental AT-Cut
Frequency	25 MHz
Load Capacitance	16–20 pF
Shunt Capacitance, C0	7 pF Max
Equivalent Series Resistance	50 Ω Max
Initial Accuracy at 25 °C	±20 ppm
Temperature Stability	±30 ppm
Aging	±20 ppm
C0/C1 Ratio	250 Max

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**Table 3. ATTRIBUTES**

Characteristic	Value
ESD Protection Human Body Model	> 2 kV
RPU – OE, S0 and S1 Pull-up Resistor	100 kΩ
Moisture Sensitivity, Indefinite Time Out of Dry Pack (Note 1)	Level 1
Flammability Rating Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in
Transistor Count	7623
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test	

1. For additional information, see Application Note AND8003/D.

**Table 4. MAXIMUM RATINGS** (Note 2)

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V <sub>DD</sub>	Positive Power Supply	GND = 0 V		4.6	V
V <sub>I</sub>	Input Voltage (V <sub>IN</sub> )	GND = 0 V	GND ≤ V <sub>I</sub> ≤ V <sub>DD</sub>	-0.5 V to V <sub>DD</sub> +0.5 V	V
T <sub>A</sub>	Operating Temperature Range			-40 to +85	°C
T <sub>stg</sub>	Storage Temperature Range			-65 to +150	°C
θ <sub>JA</sub>	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	TSSOP-16 TSSOP-16	138 108	°C/W °C/W
θ <sub>JC</sub>	Thermal Resistance (Junction-to-Case)	(Note 3)	TSSOP-16	33 to 36	°C/W
T <sub>sol</sub>	Wave Solder			265	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

- Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and not valid simultaneously. If stress limits are exceeded device functional operation is not implied, damage may occur and reliability may be affected.
- JEDEC standard multilayer board – 2S2P (2 signal, 2 power).

**Table 5. DC CHARACTERISTICS** (V<sub>DD</sub> = 3.3 V ±10%, GND = 0 V, T<sub>A</sub> = -40°C to +85°C, Note 4)

Symbol	Characteristic	Min	Typ	Max	Unit
V <sub>DD</sub>	Power Supply Voltage	2.97	3.3	3.63	V
I <sub>DD</sub>	Power Supply Current		120	135	mA
I <sub>DDOE</sub>	Power Supply Current when OE is Set Low			65	mA
V <sub>IH</sub>	Input HIGH Voltage (X/CLK, S0, S1, and OE)	2000		V <sub>DD</sub> + 300	mV
V <sub>IL</sub>	Input LOW Voltage (X/CLK, S0, S1, and OE)	GND - 300		800	mV
V <sub>OH</sub>	Output HIGH Voltage for HCSL Output (See Figure 5)	660	700	850	mV
V <sub>OL</sub>	Output LOW Voltage for HCSL Output (See Figure 5)	-150	0	150	mV
V <sub>cross</sub>	Crossing Voltage Magnitude (Absolute) for HCSL Output	250		550	mV
ΔV <sub>cross</sub>	Change in Magnitude of V <sub>cross</sub> for HCSL Output			150	mV

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

- Measurement taken with outputs terminated with R<sub>S</sub> = 33.2 Ω, R<sub>L</sub> = 49.9 Ω, with test load capacitance of 2 pF and current biasing resistor set at 475 Ω. See Figure 3.

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**Table 6. AC CHARACTERISTICS** ( $V_{DD} = 3.3\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ; Note 5)

Symbol	Characteristic	Min	Typ	Max	Unit
$f_{CLKIN}$	Clock/Crystal Input Frequency		25		MHz
$f_{CLKOUT}$	Output Clock Frequency	25		200	MHz
$\theta_{NOISE}$	Phase-Noise Performance $f_{CLKx} = 200\text{ MHz}/100\text{ MHz}$				dBc/Hz
	@ 100 Hz offset from carrier		-103/-109		
	@ 1 kHz offset from carrier		-118/-127.8		
	@ 10 kHz offset from carrier		-122/-136.2		
	@ 100 kHz offset from carrier		-130/-138.8		
	@ 1 MHz offset from carrier		-132/-138.2		
$t_{JITTER}$	Period Jitter Peak-to-Peak (Note 6) $f_{CLKx} = 200\text{ MHz}$		10	20	ps
	Period Jitter RMS (Note 6) $f_{CLKx} = 200\text{ MHz}$		1.5	3	
	Cycle-Cycle RMS Jitter (Note 7) $f_{CLKx} = 200\text{ MHz}$		2	5	
	Cycle-to-Cycle Peak to Peak Jitter (Note 7) $f_{CLKx} = 200\text{ MHz}$		20	35	ps
$t_{JIT(\Phi)}$	Additive Phase RMS Jitter, Integration Range 12 kHz to 20 MHz		0.4		ps
OE	Output Enable/Disable Time		10		$\mu\text{s}$
$t_{DUTY\_CYCLE}$	Output Clock Duty Cycle (Measured at cross point)	45	50	55	%
$t_R$	Output Risetime (Measured from 175 mV to 525 mV, Figure 5)	175	340	700	ps
$t_F$	Output Falltime (Measured from 525 mV to 175 mV, Figure 5)	175	340	700	ps
$\Delta t_R$	Output Risetime Variation (Single-Ended)			125	ps
$\Delta t_F$	Output Falltime Variation (Single-Ended)			125	ps
Stabilization Time	Stabilization Time From Powerup $V_{DD} = 3.3\text{ V}$		3.0		ms

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

5. Measurement taken from differential output on single-ended channel terminated with  $R_S = 33.2\ \Omega$ ,  $R_L = 49.9\ \Omega$ , with test load capacitance of 2 pF and current biasing resistor set at 475  $\Omega$ . See Figure 3.
6. Sampled with 10000 cycles.
7. Sampled with 1000 cycles.

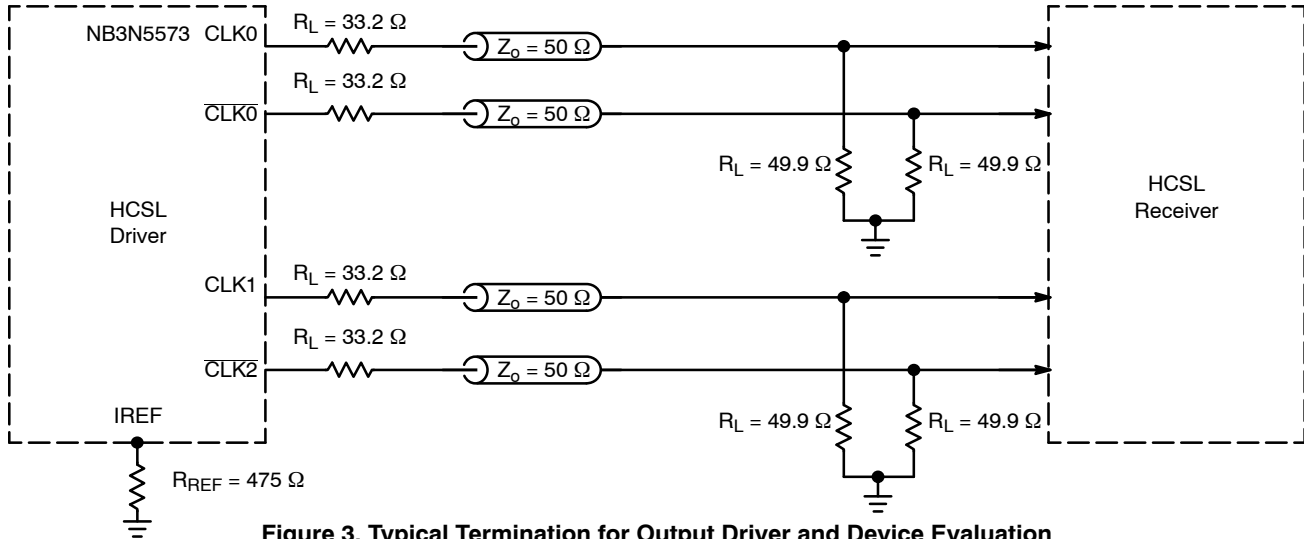
**Table 7. AC ELECTRICAL CHARACTERISTICS – PCI EXPRESS JITTER SPECIFICATIONS,**

$V_{DD} = 3.3\text{ V} \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  to  $85^\circ\text{C}$

Symbol	Characteristic	Test Conditions	Min	Typ	Max	PCIe Industry Spec	Unit
Phase Jitter P-P (Notes 9 and 12)	$T_J$ PCIe Gen1	$f = 100\text{ MHz}$ , 25 MHz Crystal Input Evaluation Band: 0 Hz – Nyquist (clock frequency/2)		6	21	86	ps
Phase Jitter RMS (Notes 9 and 12)	tREFCLK_HF_RMS (PCIe Gen 2)	$f = 100\text{ MHz}$ , 25 MHz Crystal Input High Band: 1.5 MHz – Nyquist (clock frequency/2)		0.6	3	3.1	ps
Phase Jitter RMS (Notes 9 and 12)	tREFCLK_LF_RMS (PCIe Gen 2)	$f = 100\text{ MHz}$ , 25 MHz Crystal Input Low Band: 10 kHz – 1.5 MHz		0.08	0.3	3	ps
Phase Jitter RMS (Notes 11 and 12)	tREFCLK_RMS (PCIe Gen 3)	$f = 100\text{ MHz}$ , 25 MHz Crystal Input Evaluation Band: 0 Hz – Nyquist (clock frequency/2)		0.23	0.7	0.8	ps

8. Electrical parameters are guaranteed over the specified ambient operating temperature range, which is established when the device is mounted in a test socket with maintained transverse airflow greater than 500 lfm. The device will meet specifications after thermal equilibrium has been reached under these conditions.
9. Peak-to-Peak jitter after applying system transfer function for the Common Clock Architecture. Maximum limit for PCI Express Gen 1 is 86 ps peak-to-peak for a sample size of 106 clock periods.
10. RMS jitter after applying the two evaluation bands to the two transfer functions defined in the Common Clock Architecture and reporting the worst case results for each evaluation band. Maximum limit for PCI Express Generation 2 is 3.1 ps RMS for tREFCLK\_HF\_RMS (High Band) and 3.0ps RMS for tREFCLK\_LF\_RMS (Low Band).
11. RMS jitter after applying system transfer function for the common clock architecture.
12. This parameter is guaranteed by characterization. Not tested in production

**HCSL INTERFACE**



**Figure 3. Typical Termination for Output Driver and Device Evaluation**

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## LVDS COMPATIBLE INTERFACE

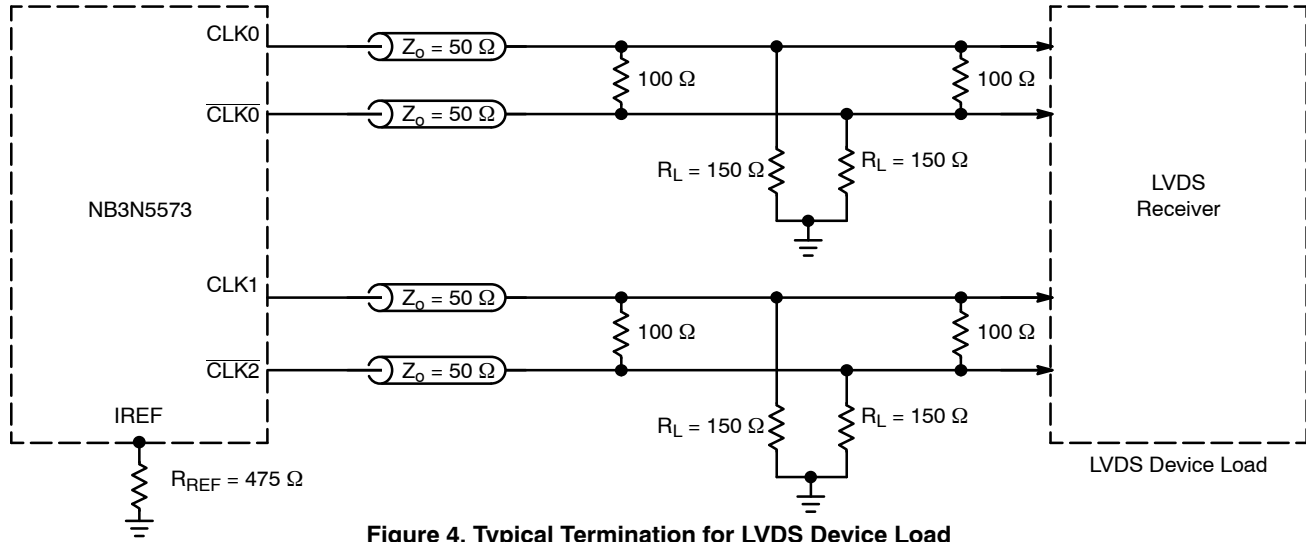


Figure 4. Typical Termination for LVDS Device Load

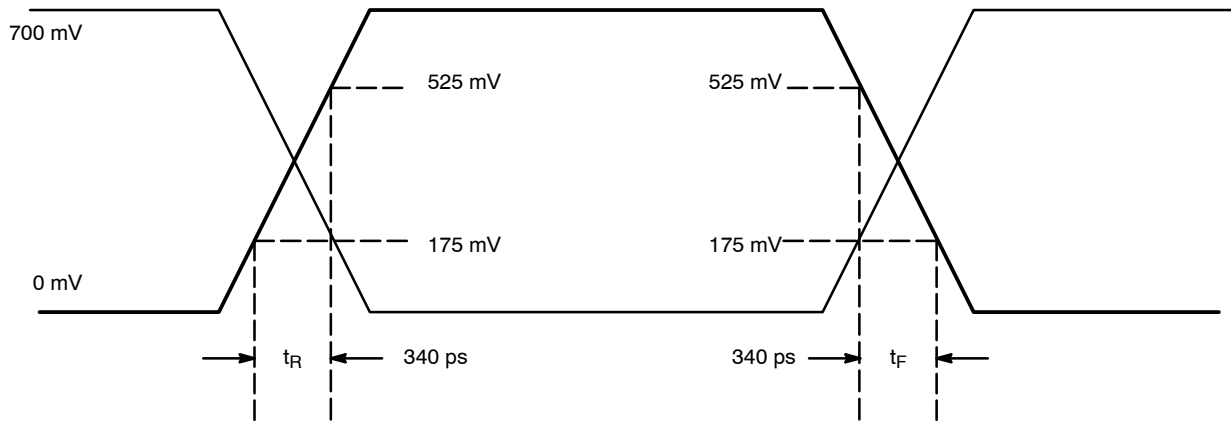


Figure 5. HCSL Output Parameter Characteristics

## ORDERING INFORMATION

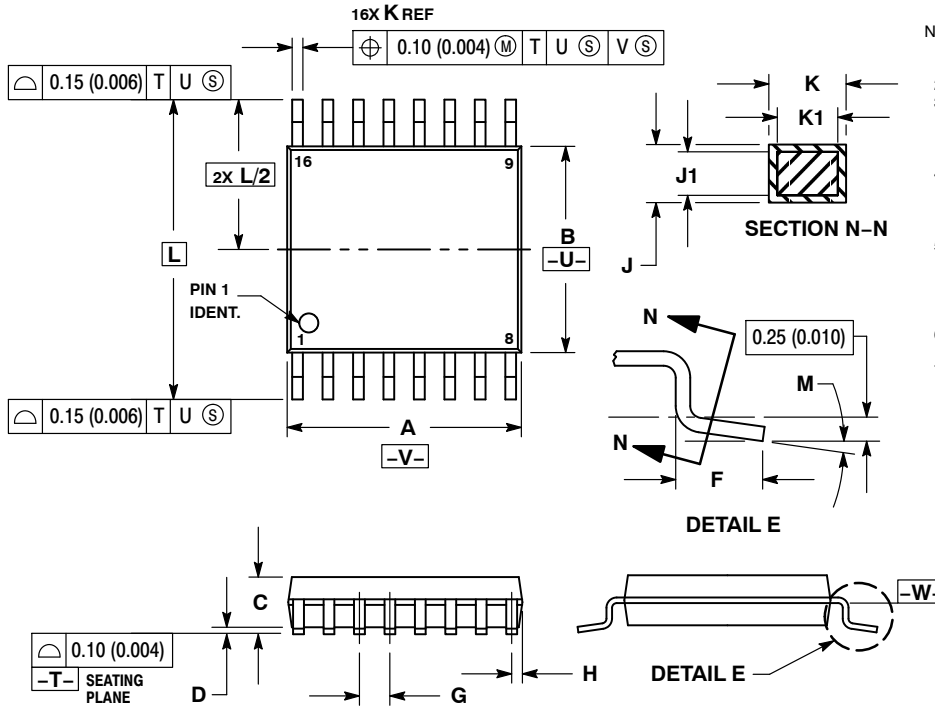
Device	Package	Shipping <sup>†</sup>
NB3N5573DTG	TSSOP-16 (Pb-Free)	96 Units / Rail
NB3N5573DTR2G	TSSOP-16 (Pb-Free)	2500 / Tape & Reel

<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.

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## PACKAGE DIMENSIONS

TSSOP-16  
CASE 948F  
ISSUE B

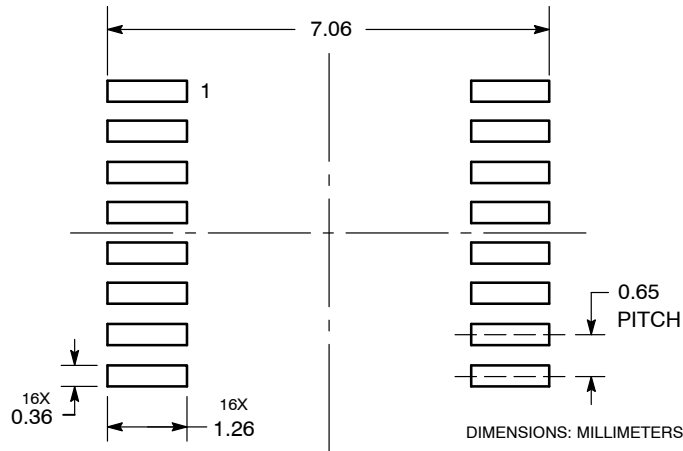


### NOTES:


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°

### SOLDERING FOOTPRINT\*



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

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