

# NBXSPA022

## 2.5 V / 3.3 V, 187.5 MHz LVDS Clock Oscillator

The NBXSPA022 single frequency crystal oscillator (XO) is designed to meet today's requirements for 2.5 V and 3.3 V LVDS clock generation applications. The device uses a high Q fundamental crystal and Phase Lock Loop (PLL) multiplier to provide 187.5 MHz, ultra low jitter and phase noise LVDS differential output.

This device is a member of ON Semiconductor's PureEdge™ clock family that provides accurate and precision clock solutions.

Available in 5 mm x 7 mm SMD (CLCC) package on 16 mm tape and reel in quantities of 1000.

### Features

- LVDS Differential Output
- Uses High Q Fundamental Mode Crystal and PLL Multiplier
- Ultra Low Jitter and Phase Noise – 0.5 ps (12 kHz – 20 MHz)
- Output Frequency – 187.5 MHz
- Hermetically Sealed Ceramic SMD Package
- RoHS Compliant
- Operating Range: 2.5 V  $\pm 5\%$   
3.3 V  $\pm 10\%$
- Total Frequency Stability –  $\pm 50$  ppm
- This is a Pb-Free Device

### Applications

- 12 Gb/s Ethernet Clock

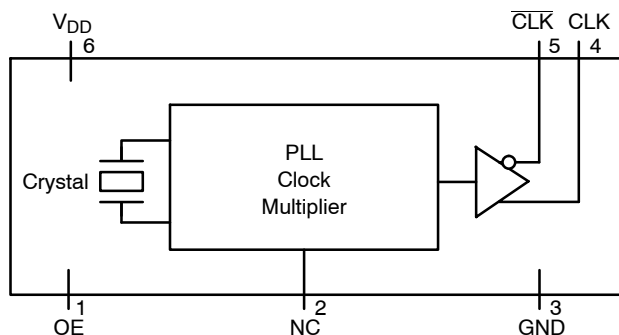
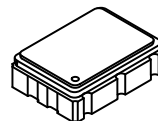


Figure 1. Simplified Logic Diagram



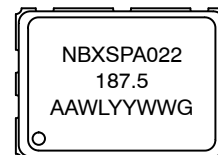
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6 PIN CLCC  
LN SUFFIX  
CASE 848AB

### MARKING DIAGRAM



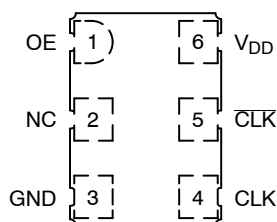
NBXSPA022 = NBXSPA022 ( $\pm 50$  PPM)  
187.5 = Output Frequency (MHz)  
AA = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G or ■ = Pb-Free Package

### ORDERING INFORMATION

Device	Package	Shipping†
NBXSPA022LN1TAG	CLCC-6 (Pb-Free)	1000/ Tape & Reel
NBXSPA022LNHTAG	CLCC-6 (Pb-Free)	100/ Tape & Reel

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

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**Figure 2. Pin Connections** (Top View)

**Table 1. PIN DESCRIPTION**

Pin No.	Symbol	I/O	Description
1	OE	LVTTTL/LVCMOS Control Input	Output Enable Pin. When left floating pin defaults to logic HIGH and output is active. See OE pin description Table 2.
2	NC	N/A	No Connect
3	GND	Power Supply	Ground 0 V
4	CLK	LVDS Output	Non-Inverted Clock Output. Typically loaded with 100 $\Omega$ receiver termination resistor across differential pair.
5	$\overline{\text{CLK}}$	LVDS Output	Inverted Clock Output. Typically loaded with 100 $\Omega$ receiver termination resistor across differential pair.
6	V <sub>DD</sub>	Power Supply	Positive power supply voltage. Voltage should not exceed 2.5 V $\pm$ 5% or 3.3 V $\pm$ 10%.

**Table 2. OUTPUT ENABLE TRI-STATE FUNCTION**

OE Pin	Output Pins
Open	Active
HIGH Level	Active
LOW Level	High Z

**Table 3. ATTRIBUTES**

Characteristic	Value
Input Default State Resistor	170 k $\Omega$
ESD Protection	Human Body Model Machine Model
	2 kV 200 V
Meets or Exceeds JEDEC Standard EIA/JESD78 IC Latchup Test	

1. For additional Moisture Sensitivity information, refer to Application Note AND8003/D.

**Table 4. MAXIMUM RATINGS**

Symbol	Parameter	Condition 1	Condition 2	Rating	Units
V <sub>DD</sub>	Positive Power Supply	GND = 0 V		4.6	V
I <sub>out</sub>	LVDS Output Current	Continuous Surge		25 50	mA
T <sub>A</sub>	Operating Temperature Range			-40 to +85	$^{\circ}$ C
T <sub>stg</sub>	Storage Temperature Range			-55 to +120	$^{\circ}$ C
T <sub>sol</sub>	Wave Solder	See Figure 5		260	$^{\circ}$ 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.

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**Table 5. DC CHARACTERISTICS** ( $V_{DD} = 2.5\text{ V} \pm 5\%$  or  $V_{DD} = 3.3\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ) (Note 2)

Symbol	Characteristic	Conditions	Min.	Typ.	Max.	Units
$I_{DD}$	Power Supply Current			85	105	mA
$V_{IH}$	OE Input HIGH Voltage		2000		$V_{DD}$	mV
$V_{IL}$	OE Input LOW Voltage		GND - 300		800	mV
$I_{IH}$	Input HIGH Current		-100		+100	$\mu\text{A}$
$I_{IL}$	Input LOW Current		-100		+100	$\mu\text{A}$
$\Delta V_{OD}$	Change in Magnitude of $V_{OD}$ for Complementary Output States (Note 3)		0	1	25	mV
$V_{OS}$	Offset Voltage		1125		1375	mV
$\Delta V_{OS}$	Change in Magnitude of $V_{OS}$ for Complementary Output States (Note 3)		0	1	25	mV
$V_{OH}$	Output HIGH Voltage	$V_{DD} = 2.5\text{ V}$ $V_{DD} = 3.3\text{ V}$		1425	1600	mV
$V_{OL}$	Output LOW Voltage	$V_{DD} = 2.5\text{ V}$ $V_{DD} = 3.3\text{ V}$	900	1075		mV
$V_{OD}$	Differential Output Voltage		250		450	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 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.

2. Measurement taken with outputs terminated with 100 ohm across differential pair. See Figure 4.
3. Parameter guaranteed by design verification not tested in production.

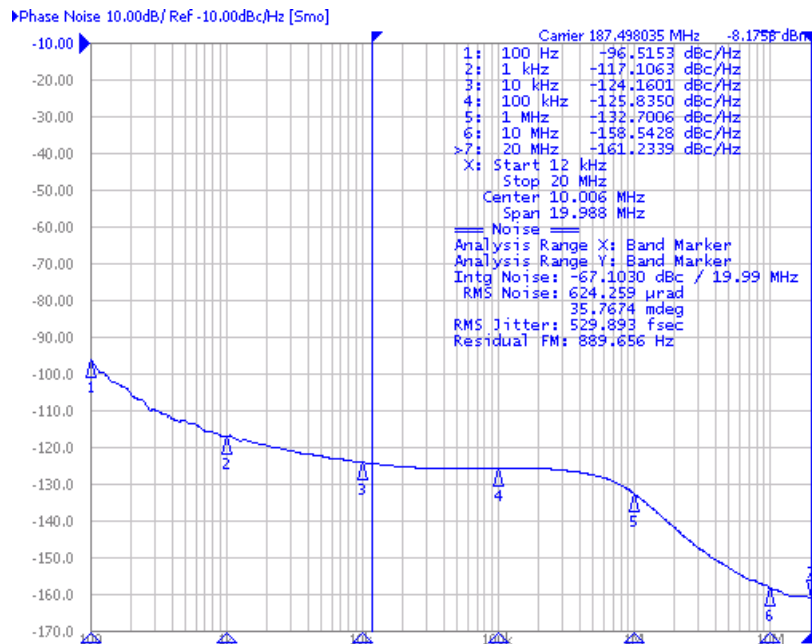
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**Table 6. AC CHARACTERISTICS** ( $V_{DD} = 2.5\text{ V} \pm 5\%$  or  $V_{DD} = 3.3\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ ,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ) (Note 4)

Symbol	Characteristic	Conditions	Min.	Typ.	Max.	Units
$f_{CLKOUT}$	Output Clock Frequency			187.5		MHz
$\Delta f$	Frequency Stability – NBXSPA022	(Note 5)			$\pm 50$	ppm
$\Phi_{NOISE}$	Phase-Noise Performance $f_{CLKout} = 187.5\text{ MHz}$ (See Figure 3)	100 Hz of Carrier		-96		dBc/Hz
		1 kHz of Carrier		-117		dBc/Hz
		10 kHz of Carrier		-124		dBc/Hz
		100 kHz of Carrier		-126		dBc/Hz
		1 MHz of Carrier		-133		dBc/Hz
		10 MHz of Carrier		-158		dBc/Hz
$t_{jit}(\Phi)$	RMS Phase Jitter	12 kHz to 20 MHz		0.5	0.75	ps
$t_{jitter}$	Cycle to Cycle, RMS	1000 Cycles		1	8	ps
	Cycle to Cycle, Peak-to-Peak	1000 Cycles		7	35	ps
	Period, RMS	10,000 Cycles		0.6	4	ps
	Period, Peak-to-Peak	10,000 Cycles		5	20	ps
$t_{OE/OD}$	Output Enable/Disable Time				200	ns
$t_{DUTY\_CYCLE}$	Output Clock Duty Cycle (Measured at Cross Point)		48	50	52	%
$t_R$	Output Rise Time (20% and 80%)			250	400	ps
$t_F$	Output Fall Time (80% and 20%)			250	400	ps
$t_{start}$	Start-up Time			1	5	ms
		Aging	1 <sup>st</sup> Year			3
		Every Year After 1 <sup>st</sup>			1	ppm

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.

- Measurement taken with outputs terminated with 100 ohm across differential pair. See Figure 4.
- Parameter guarantees 10 years of aging. Includes initial stability at 25°C, shock, vibration and first year aging.

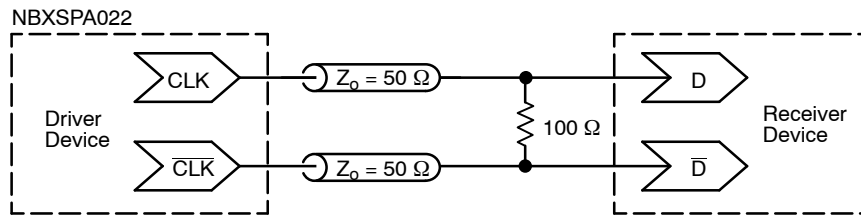


**Figure 3. Typical Phase Noise Plot at 187.5 MHz**

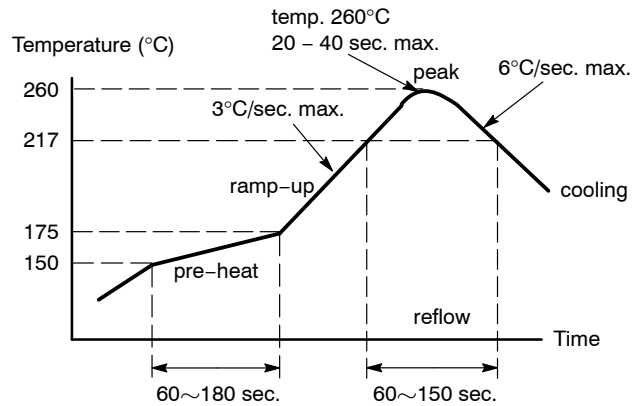
# NBXSPA022

**Table 7. RELIABILITY COMPLIANCE**

Parameter	Standard	Method
Shock	Mechanical	MIL-STD-833, Method 2002, Condition B
Solderability	Mechanical	MIL-STD-833, Method 2003
Vibration	Mechanical	MIL-STD-833, Method 2007, Condition A
Solvent Resistance	Mechanical	MIL-STD-202, Method 215
Resistance to Soldering Heat	Mechanical	MIL-STD-203, Method 210, Condition I or J
Thermal Shock	Environment	MIL-STD-833, Method 1001, Condition A
Moisture Resistance	Environment	MIL-STD-833, Method 1004



**Figure 4. Typical Termination for Output Driver and Device Evaluation**

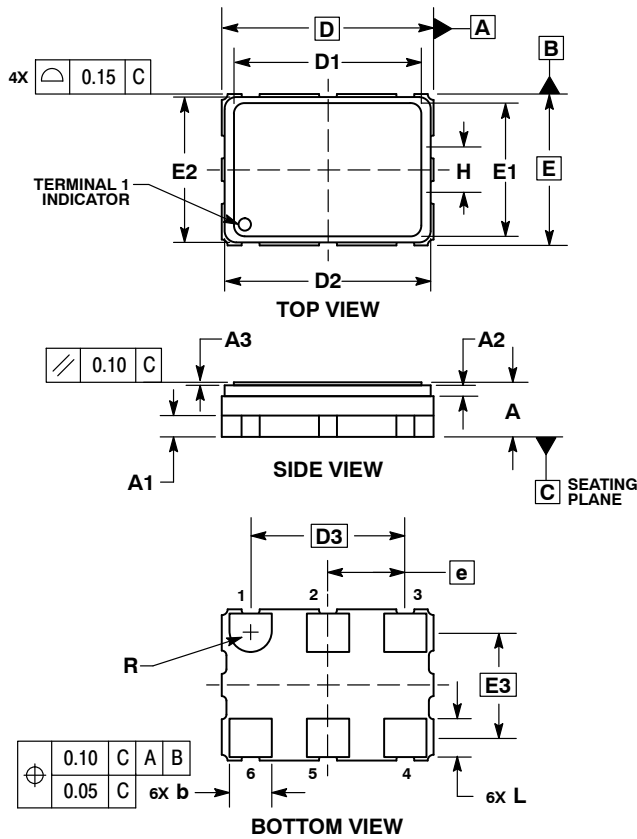


**Figure 5. Recommended Reflow Soldering Profile**

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## PACKAGE DIMENSIONS

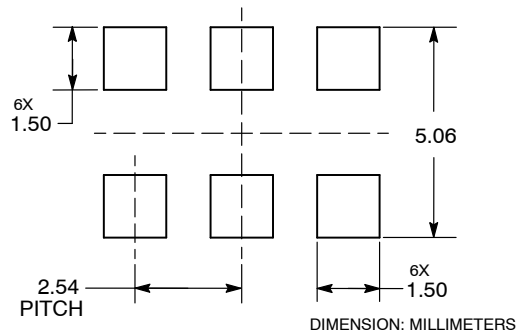
6 PIN CLCC, 7x5, 2.54P  
CASE 848AB-01  
ISSUE C



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	1.70	1.80	1.90
A1	0.70 REF		
A2	0.36 REF		
A3	0.08	0.10	0.12
b	1.30	1.40	1.50
D	7.00 BSC		
D1	6.17	6.20	6.23
D2	6.66	6.81	6.96
D3	5.08 BSC		
E	5.00 BSC		
E1	4.37	4.40	4.43
E2	4.65	4.80	4.95
E3	3.49 BSC		
e	2.54 BSC		
H	1.80 REF		
L	1.17	1.27	1.37
R	0.70 REF		

### 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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