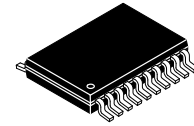


# 3.3 V Xtal or LVTTTL/LVCMOS Input 2:1 MUX to 1:4 LVPECL Fanout Buffer

## NB3N853531E



TSSOP-20  
DT SUFFIX  
CASE 948E

### Description

The NB3N853531E is a low skew 3.3 V supply 1:4 clock distribution fanout buffer. An input MUX selects either a Fundamental Parallel Mode Crystal or a LVCMOS/LVTTL Clock by using the CLK\_SEL pin (HIGH for Crystal, LOW for Clock) with LVCMOS / LVTTL levels.

The single ended CLK input is translated to four LVPECL Outputs. Using the crystal input, the NB3N853531E can be a Clock Generator. A CLK\_EN pin can enable or disable the outputs synchronously to eliminate runt pulses using LVCMOS/LVTTL levels (HIGH to enable outputs, LOW to disable outputs).

### Features

- Four Differential 3.3 V LVPECL Outputs
- Selectable Crystal or LVCMOS/LVTTL CLOCK Inputs
- Up to 266 MHz Clock Operation
- Output to Output Skew: 30 ps (Max)
- Device to Device Skew 200 ps (Max)
- Propagation Delay 1.8 ns (Max)
- Operating Range:  $V_{CC} = 3.3 \pm 5\% V$  (3.135 to 3.465 V)
- Additive Phase Jitter, RMS: 0.053 ps (Typ)
- Synchronous Clock Enable Control
- Industrial Temp. Range ( $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ )
- Pb-Free TSSOP-20 Package
- Ambient Operating Temperature Range  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- These Devices are Pb-Free and are RoHs Compliant

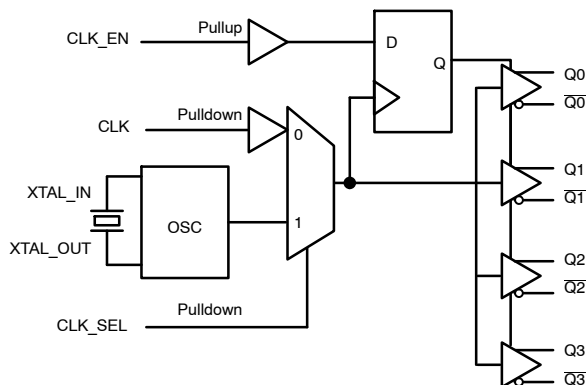
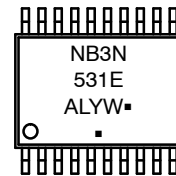


Figure 1. Simplified Logic Diagram

### MARKING DIAGRAM



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

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device           | Package            | Shipping†          |
|------------------|--------------------|--------------------|
| NB3N853531EDTR2G | TSSOP-20 (Pb-Free) | 2500 / 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](http://www.onsemi.com/BRD8011/D).

# NB3N853531E

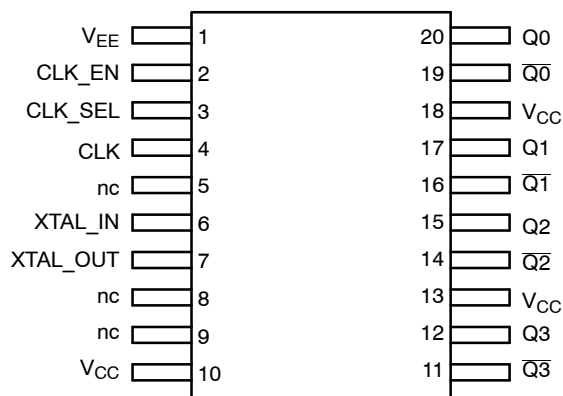


Figure 2. Pinout Diagram (Top View)

Table 1. PIN DESCRIPTION

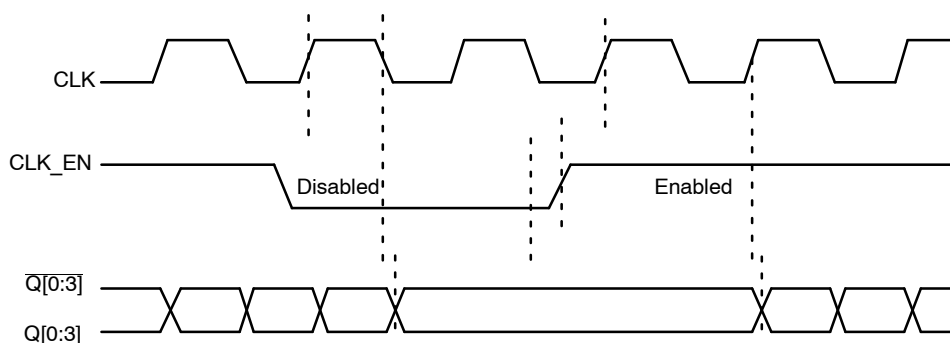
| Pin            | Name            | I/O              | Open Default | Description                                                                                                    |
|----------------|-----------------|------------------|--------------|----------------------------------------------------------------------------------------------------------------|
| 1              | V <sub>EE</sub> |                  |              | Negative (Ground) Power Supply pin must be externally connected to power supply to guarantee proper operation. |
| 2              | CLK_EN          | LVC MOS / LV TTL | Pullup       | Synchronized Clock Enable when HIGH. When LOW, outputs are disabled (Qx HIGH, Q <sub>x</sub> LOW)              |
| 3              | CLK_SEL         | LVC MOS / LV TTL | Pulldown     | Clock Input Select (HIGH selects crystal, LOW selects CLK input)                                               |
| 4              | CLK             | LVC MOS / LV TTL | Pulldown     | Clock Input. Float open when unused.                                                                           |
| 5, 8, 9        | nc              |                  |              | No Connect                                                                                                     |
| 6              | XTAL_IN         | Crystal          |              | Crystal Oscillator Input (used with pin 7). Float open when unused.                                            |
| 7              | XTAL_OUT        | Crystal          |              | Crystal Oscillator Output (used with pin 6). Float open when unused.                                           |
| 10, 13, 18     | V <sub>CC</sub> |                  |              | Positive Power Supply pins must be externally connected to power supply to guarantee proper operation.         |
| 11, 14, 16, 19 | Q[3:0]          | LVPECL           |              | Complement Differential Outputs (See <a href="#">AND8002/D</a> for termination)                                |
| 12, 15, 17, 20 | Q[3:0]          | LVPECL           |              | True Differential Outputs (See <a href="#">AND8002/D</a> for termination)                                      |

Table 2. FUNCTIONS

| Inputs |         |                         | Outputs         |      |                |
|--------|---------|-------------------------|-----------------|------|----------------|
| CLK_EN | CLK_SEL | Input Function          | Output Function | Qx   | Q <sub>x</sub> |
| 0      | 0       | CLK input selected      | Disabled        | LOW  | HIGH           |
| 0      | 1       | Crystal Inputs Selected | Disabled        | LOW  | HIGH           |
| 1      | 0       | CLK input selected      | Enabled         | CLK0 | Invert of CLK1 |
| 1      | 1       | Crystal Inputs Selected | Enabled         | CLK1 | Invert of CLK1 |

1. After CLK\_EN switches, the clock outputs are disabled or enabled following a rising and falling input clock edge as show in Figure 3.

# NB3N853531E



**Figure 3. CLK\_EN Timing Diagram**

**Table 3. ATTRIBUTES** (Note 2)

| Characteristics                                               | Value                            |
|---------------------------------------------------------------|----------------------------------|
| Internal Input Pullup Resistor                                | 50 k $\Omega$                    |
| Internal Input Pulldown Resistor                              | 50 k $\Omega$                    |
| C <sub>in</sub> Input Capacitance                             | 4 pF                             |
| ESD Protection<br>Human Body Model<br>Machine Model           | > 2 kV<br>> 200 V                |
| Moisture Sensitivity, Indefinite Time Out of Drypack (Note 2) | Level 1                          |
| Flammability Rating<br>Oxygen Index                           | UL 94 V-0 @ 0.125 in<br>28 to 34 |
| Transistor Count                                              | 333 Devices                      |
| Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test        |                                  |

2. For additional information, see Application Note [AND8003/D](#).

**Table 4. MAXIMUM RATINGS** (Note 3)

| Symbol           | Parameter                                | Condition 1         | Condition 2                                         | Rating                                        | Unit |
|------------------|------------------------------------------|---------------------|-----------------------------------------------------|-----------------------------------------------|------|
| V <sub>CC</sub>  | Supply Voltage                           |                     |                                                     | 4.6                                           | V    |
| V <sub>in</sub>  | Input Voltage                            |                     |                                                     | -0.5 ≤ V <sub>I</sub> ≤ V <sub>CC</sub> + 0.5 | V    |
| I <sub>out</sub> | Output Current                           | Continuous<br>Surge |                                                     | 50<br>100                                     | mA   |
| T <sub>A</sub>   | Operating Temperature Range, Industrial  |                     |                                                     | -40 to ≤ +85                                  | °C   |
| T <sub>stg</sub> | Storage Temperature Range                |                     |                                                     | -65 to +150                                   | °C   |
| $\theta_{JA}$    | Thermal Resistance (Junction-to-Ambient) | 0 lfpm              | Single-Layer<br>PCB (700 mm <sup>2</sup> ,<br>2 oz) | 128                                           | °C/W |
|                  |                                          | 200 lfpm            | Multi-Layer<br>PCB (700 mm <sup>2</sup> ,<br>2 oz)  | 94                                            |      |
| $\theta_{JC}$    | Thermal Resistance (Junction-to-Case)    | (Note 4)            | TSSOP-20                                            | 23 to 41                                      | °C/W |
| T <sub>sol</sub> | Wave Solder                              |                     |                                                     | 265                                           | °C   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

3. 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.

4. JEDEC standard multilayer board – 2S2P (2 signal, 2 power).

**Table 5. CRYSTAL CHARACTERISTICS AND CONNECTIONS**

| Parameter                          | Min                  | Typ | Max | Unit     |
|------------------------------------|----------------------|-----|-----|----------|
| Mode of Oscillation                | Fundamental Parallel |     |     |          |
| Frequency                          | 12                   |     | 40  | MHz      |
| Equivalent Series Resistance (ESR) |                      |     | 50  | $\Omega$ |
| Shunt Capacitance                  |                      |     | 7   | pF       |
| Drive Level                        |                      |     | 1   | mW       |

**Table 6. DC CHARACTERISTICS**  $V_{CC} = 3.3 \pm 5\% V$  (3.135 to 3.465 V),  $V_{EE} = 0 V$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$  (Note 5)

| Symbol           | Characteristic                                                                          | Min            | Typ | Max            | Unit    |
|------------------|-----------------------------------------------------------------------------------------|----------------|-----|----------------|---------|
| $I_{EE}$         | Power Supply Current                                                                    |                |     | 60             | mA      |
| $V_{IH}$         | Input HIGH Voltage                                                                      | 2              |     | $V_{CC} + 0.3$ | V       |
| $V_{IL}$         | Input LOW Voltage                                                                       | -0.3           |     | 0.8            | V       |
| $I_{IH}$         | Input High Current ( $V_{CC} = 3.456 V$ )<br>CLK, CLK_SEL = 3.456 V<br>CLK_EN = 3.456 V |                |     | 150<br>5       | $\mu A$ |
| $I_{IL}$         | Input LOW Current ( $V_{CC} = 3.456 V$ )<br>CLK, CLK_SEL = 3.456 V<br>CLK_EN = 3.456 V  | -5<br>-150     |     |                | $\mu A$ |
| $V_{OH}$         | Output HIGH Voltage                                                                     | $V_{CC} - 1.4$ |     | $V_{CC} - 0.9$ | V       |
| $V_{OL}$         | Output LOW Voltage                                                                      | $V_{CC} - 2.0$ |     | $V_{CC} - 1.7$ | V       |
| $V_{OUT\_SWING}$ | Output Voltage Swing (peak-to-peak)                                                     | 0.6            |     | 1.0            | V       |

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.

5. Outputs terminated 50  $\Omega$  to  $V_{CC} - 2.0 V$ , see Figure 4.

**Table 7. AC CHARACTERISTICS**  $V_{CC} = 3.3 \pm 5\% V$  (3.135 to 3.465 V),  $V_{EE} = 0 V$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$  (Note 6)

| Symbol          | Characteristic                                                                                           | Min | Typ   | Max | Unit |
|-----------------|----------------------------------------------------------------------------------------------------------|-----|-------|-----|------|
| $F_{MAX}$       | Maximum Operating Frequency                                                                              | 0   |       | 266 | MHz  |
| $t_{PD}$        | Propagation Delay (Notes 7 and 9)                                                                        | 1.1 |       | 1.8 | ns   |
| $t_{SKEW\_DC}$  | Duty Cycle Skew same path similar conditions at 50 MHz (Notes 7, 8 and 9)                                | 46  |       | 54  | %    |
| $t_{SKEW\_O-O}$ | Output to Output Skew Within A Device (Notes 7, 8 and 9)                                                 |     |       | 30  | ps   |
| $t_{SKEW\_D-D}$ | Device to Device Skew similar path and conditions (Notes 7, 8 and 9)                                     |     |       | 200 | ps   |
| $t_{JIT}$       | Additive Phase Noise Jitter (RMS) @ 155.52 MHz (Integrated from 12 kHz to 20 MHz) See Figure 6. (Note 9) |     | 0.053 |     | ps   |
| $t_r/t_f$       | Output rise and fall times (20% and 80% points) (Note 9)                                                 | 225 |       | 600 | ps   |

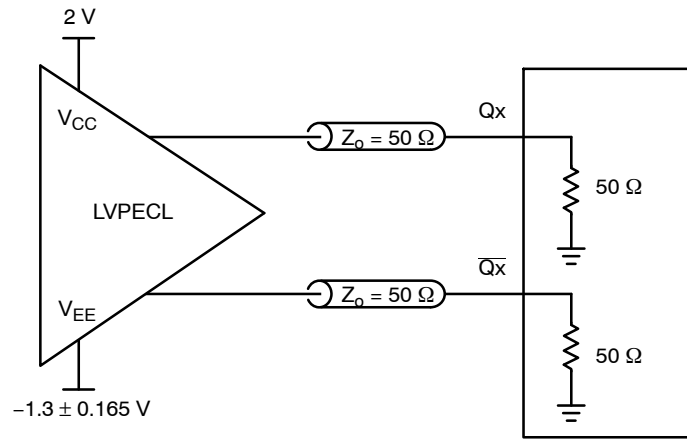
NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm.

6. Outputs terminated 50  $\Omega$  to  $V_{CC} - 2.0 V$ , see Figure 4.

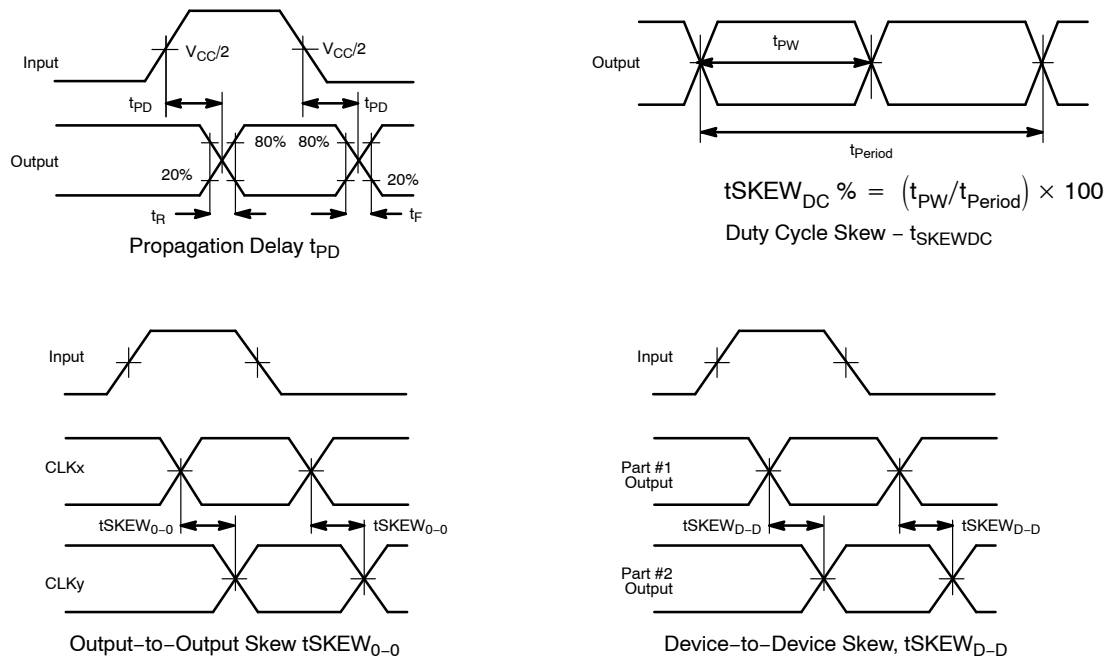
7. Measured under the same supply voltage, output loading, and input conditions.

8. Similar conditions.

9. Limits do not apply to overdriving XTAL\_IN.

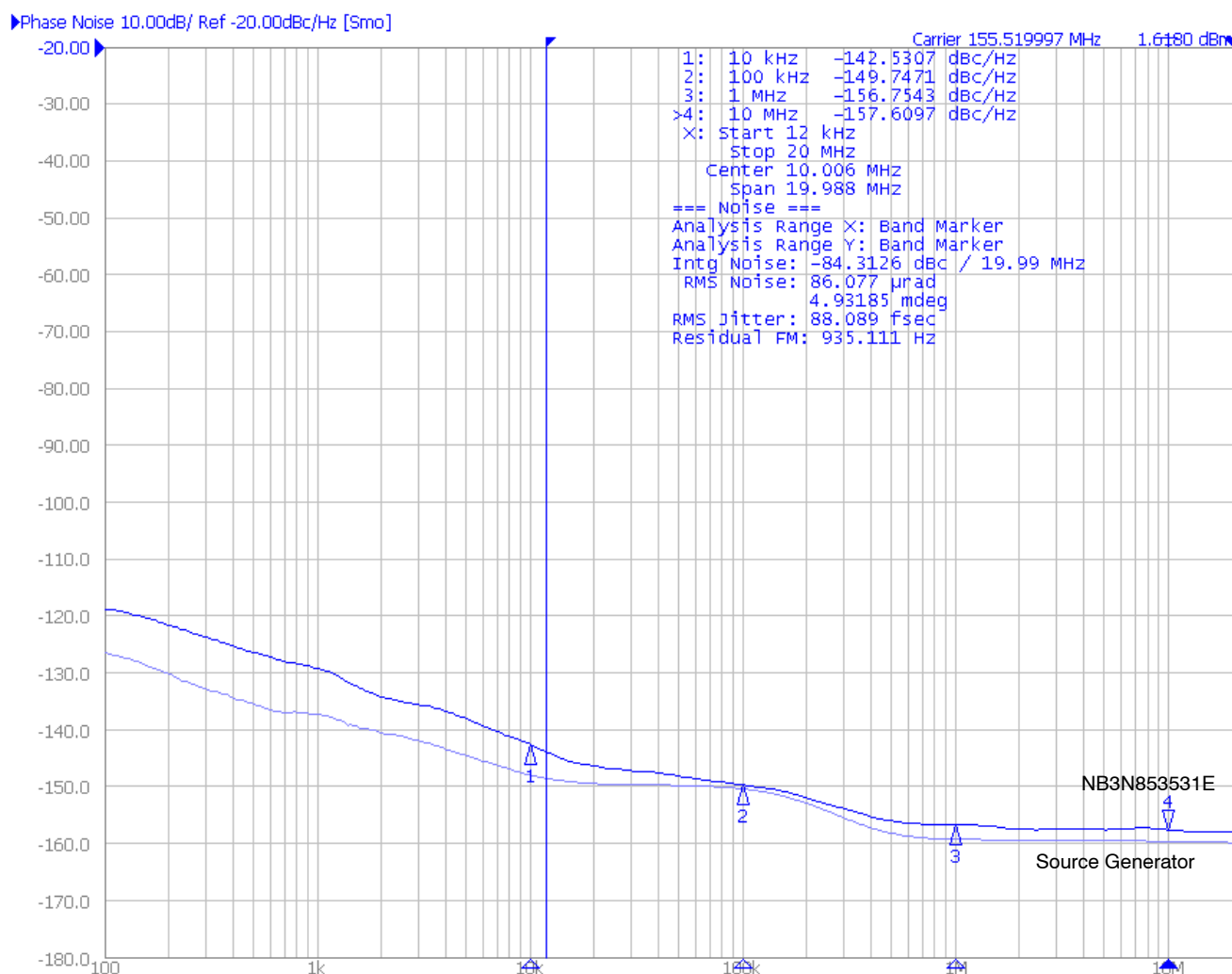


**Figure 4. Typical Test Setup and Termination for Evaluation.** A split supply of  $V_{CC} = 2.0\text{ V}$  and  $V_{EE} = -1.3 \pm 0.165\text{ V}$  allows a convenient direct connection termination into typical oscilloscope  $50\ \Omega$  to GND impedance modules. For Application termination schemes see AND8020.



**Figure 5. AC Measurement Reference**

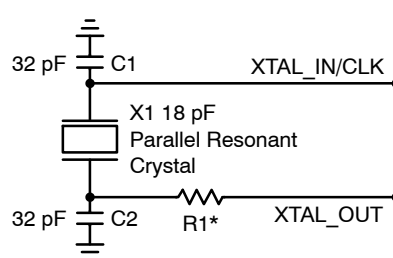
## NB3N853531E



**Figure 6.** For 155.52 MHz Carrier, the NB3N853531E Additive Phase Noise (dBc/Hz) versus SSB Offset Frequency (Hz) Integrated Jitter from 12 kHz to 20 MHz (Upper Heavy Line) is 88.1 fs RMS. The E8663B Source Generator Additive Phase Noise (Lower Light Line) is 70.1 fs RMS. Where  $t_{JIT} = \sqrt{(t_{JIToutput})^2 - (t_{JITinput})^2} = 53$  fs

### Application – Crystal Input Interface

Figure 7 shows the NB3N853531E device crystal oscillator interface using a typical parallel resonant crystal. A parallel crystal with loading capacitance  $C_L = 18$  pF could use Series Load Caps  $C1 = 32$  pF and  $C2 = 32$  pF as nominal values, after subtracting a typical 4 pF of stray cap per line. The frequency accuracy and duty cycle skew can be fine tuned by adjusting the  $C1$  and  $C2$  values. For example, increasing the  $C1$  and  $C2$  values will reduce the operational frequency. Note  $R1$  is optional and may be 0  $\Omega$ .



**Figure 7. NB3N853531E Crystal Oscillator Interface**  
\* $R1$  is optional. Assuming 4 pF stray cap per pin.

## NB3N853531E

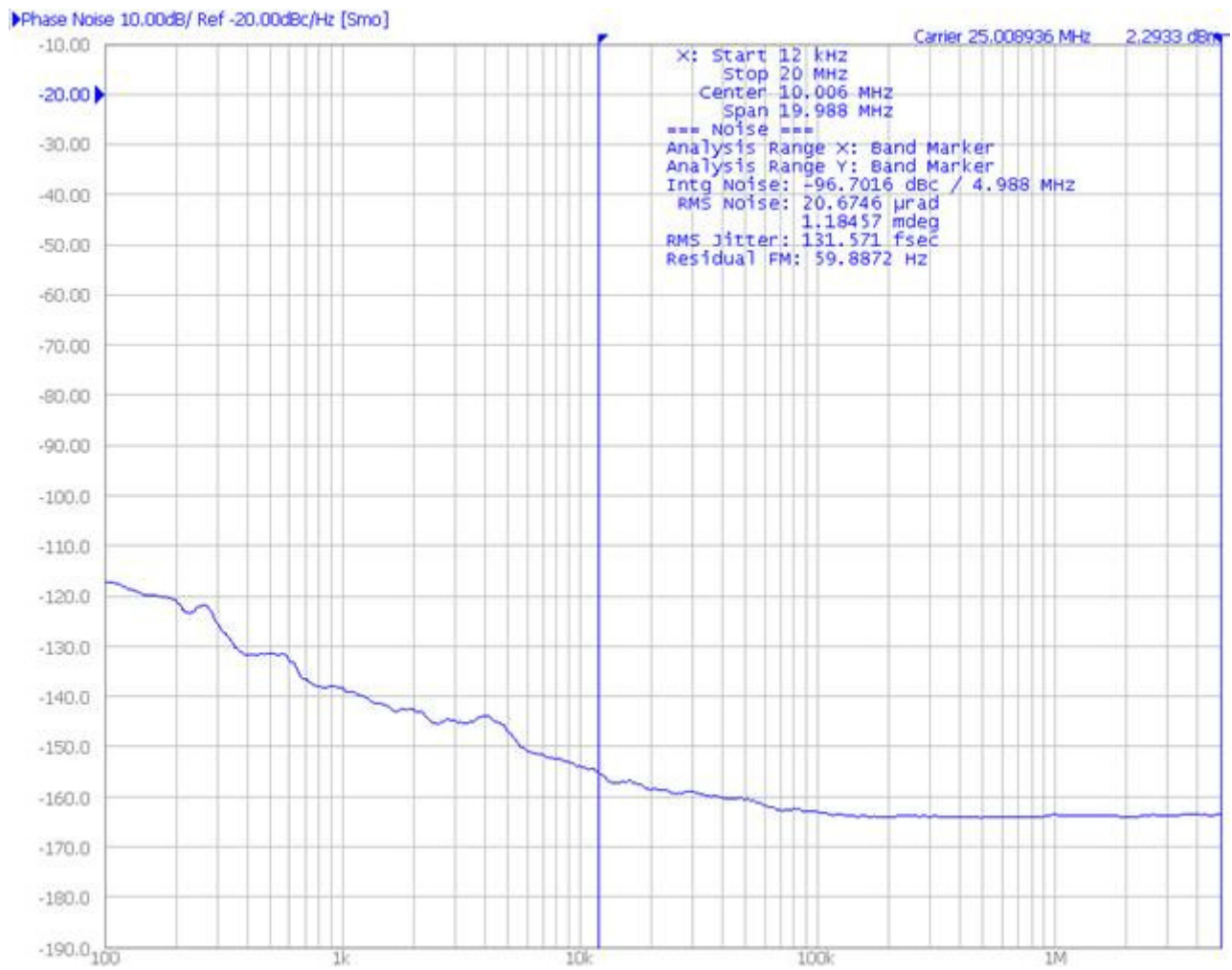


Figure 8. NB3N853531E Phase Noise with 25 MHz Crystal

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