1. OVERVIEW
The CF7321xx/WF7321xx is a 122.88MHz oscillator frequency, CMOS output, VCXO module IC. It incorporates a bipolar oscillator circuit and varicap diode built-in for low phase noise characteristic and wide frequency pulling range.

2. FEATURES
- Varicap diode built-in
- Oscillator: Fundamental frequency oscillation
- Output frequency \( f_{\text{OUT}} \): 30 to 122.88MHz
- Oscillator frequency: 60 to 122.88MHz (7321Bx versions)
- Frequency divider output: Available in fundamental \( f_{\text{OSC}} \) and half frequency \( f_{\text{OSC}}/2 \) output versions
- Low standby current: Oscillator stopped, power saving pull-up resistor built-in
- Output type: CMOS
- Operating voltage: 3.135 to 3.465V
- Phase noise characteristics\( \text{(typ)} \): -80dBc/Hz (B1 version, 10Hz offset, \( f=122.88MHz \) (\( \gamma=300 \), \( C_0=1.5pF \))
  -136dBc/Hz (B1 version, 1kHz offset, \( f=122.88MHz \) )
  -161dBc/Hz (B1 version, 10MHz offset, \( f=122.88MHz \))
- Frequency pulling range\( \text{(typ)} \): ±40ppm (B1 version, \( V_C=1.65 \pm 1.65V \), \( f=122.88MHz \) (\( \gamma=300 \), \( C_0=1.5pF \))

3. BLOCK DIAGRAM
CF7321xx/WF7321xx
Low-Phase Noise VCXO IC

4. PAD LAYOUT
(1) Chip size: X=0.94mm, Y=0.90mm
(2) Rear surface potential: VSS
(3) Pad size: 80μm × 80μm (VSS PAD 80μm × 160μm)
(4) Chip dimensions

*1: Chip size is the distance between the scribe line centers.

5. PAD DESCRIPTION

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>I/O</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>XT</td>
<td>I</td>
<td>Crystal element connection terminals.</td>
</tr>
<tr>
<td>2</td>
<td>XTN</td>
<td>O</td>
<td>Connect crystal between XT and XTN</td>
</tr>
<tr>
<td>3</td>
<td>VC</td>
<td>I</td>
<td>Control voltage input.</td>
</tr>
<tr>
<td>4</td>
<td>INHN</td>
<td>I</td>
<td>Output enable input. Oscillation stopped and the device goes into standby mode when Low. Power saving pull-up resistor built-in.</td>
</tr>
<tr>
<td>5</td>
<td>VSS</td>
<td>-</td>
<td>Ground</td>
</tr>
<tr>
<td>6</td>
<td>Q</td>
<td>O</td>
<td>Clock output High-impedance when standby mode</td>
</tr>
<tr>
<td>7</td>
<td>VDD</td>
<td>-</td>
<td>Supply voltage</td>
</tr>
</tbody>
</table>

*I: Input, O: Output
6. SERIES LINEUP

<table>
<thead>
<tr>
<th>Device</th>
<th>Recommended oscillation frequency range ($f_{OSC}$) (^*1)</th>
<th>Output frequency ($f_{OUT}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7321B1</td>
<td>60 to 122.88MHz</td>
<td>$f_{OSC}$</td>
</tr>
<tr>
<td>7321B2</td>
<td>30 to 61.44MHz</td>
<td>$f_{OSC}/2$</td>
</tr>
</tbody>
</table>

\(^*1\): Recommended values based on IC characteristics.

The oscillator characteristics are determined by the combination of crystal element and the IC, hence the actual oscillator is not limited to these values. Always conduct thorough circuit evaluation beforehand.

The recommended characteristics for the crystal element are:

Bx versions: $R_1 < 20\Omega$, $C_0 < 1.5pF$

7. ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
<td>$V_{DD}$</td>
<td>VDD</td>
<td>-0.3 to +5.0</td>
<td>V</td>
</tr>
<tr>
<td>Input voltage range</td>
<td>$V_{IN}$</td>
<td>XT, INHN, VC</td>
<td>-0.3 to $V_{DD}$+0.3</td>
<td>V</td>
</tr>
<tr>
<td>Output voltage range</td>
<td>$V_{OUT}$</td>
<td>XTN, Q</td>
<td>-0.3 to $V_{DD}$+0.3</td>
<td>V</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>$T_j$</td>
<td></td>
<td>+125</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>$T_{STG}$</td>
<td>Wafers, chips</td>
<td>-55 to +125</td>
<td>°C</td>
</tr>
<tr>
<td>Output current</td>
<td>$I_{OUT}$</td>
<td>Q</td>
<td>$T_a = -40 ~ +85^\circ C$</td>
<td>±20 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$T_a = -40 ~ +105^\circ C$</td>
<td>±10 mA</td>
</tr>
</tbody>
</table>

\(^*1\): Parameters must not exceed ratings, not even momentarily. If a rating is exceeded, there is a risk of IC failure, deterioration in characteristics, and decrease in reliability.

\(^2\): Parameters should not exceed ratings. If a rating is exceeded, there is a risk of deterioration in characteristics and decrease in reliability.

\(^*3\): Recommended operating voltage $V_{DD}$ value.

\(^*4\): Store separately in Nitrogen or vacuum atmosphere.

8. RECOMMENDED OPERATING CONDITIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating supply voltage</td>
<td>$V_{DD}$</td>
<td>Between VDD and VSS (^*2)</td>
<td>3.135</td>
<td>3.3</td>
<td>3.465</td>
<td>V</td>
</tr>
<tr>
<td>Input voltage</td>
<td>$V_{IN}$</td>
<td>INHN, VC</td>
<td>0</td>
<td></td>
<td>$V_{DD}$</td>
<td>V</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>$T_a$</td>
<td></td>
<td>-40</td>
<td></td>
<td>+105</td>
<td>°C</td>
</tr>
<tr>
<td>Output load</td>
<td>$C_L$</td>
<td></td>
<td>0</td>
<td></td>
<td>15</td>
<td>pF</td>
</tr>
<tr>
<td>Oscillator frequency</td>
<td>$f_{OSC}$</td>
<td>7321Bx</td>
<td>60</td>
<td></td>
<td>122.88</td>
<td>MHz</td>
</tr>
<tr>
<td>Output frequency</td>
<td>$f_{OUT}$</td>
<td>7321B1</td>
<td>60</td>
<td></td>
<td>122.88</td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7321B2</td>
<td>30</td>
<td></td>
<td>61.44</td>
<td>MHz</td>
</tr>
</tbody>
</table>

\(^*1\): The characteristics will vary greatly depending on the crystal element characteristics and mounting conditions. Use only after thorough evaluation of the oscillator characteristics.

\(^2\): For stable device operation, connect 0.01µF or larger ceramic chip capacitors between VDD and VSS, mounted as close as possible to the IC (within approximately 3mm). Also, use as thick a wiring pattern as possible between the IC and the capacitors.

*Operation outside the recommended operating conditions may adversely affect reliability. Use only within specified ratings.
9. ELECTRICAL CHARACTERISTICS

9.1. B1, B2 Versions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current consumption B1 version</td>
<td>$I_{DD}$</td>
<td>Measurement circuit 1, no load $f_{OSC}=122.88\text{MHz}$, $f_{OUT}=122.88\text{MHz}$ $V_{DD}=3.3\text{V}$</td>
<td>8.0</td>
<td>14.0</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Current consumption B2 version</td>
<td>$I_{DD}$</td>
<td>Measurement circuit 1, no load $f_{OSC}=122.88\text{MHz}$, $f_{OUT}=61.44\text{MHz}$ $V_{DD}=3.3\text{V}$</td>
<td>7.0</td>
<td>12.0</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Standby current</td>
<td>$I_{STB}$</td>
<td>Measurement circuit 1, $T_a=-40\text{ to } +105\text{C}$, $V_{DD}=3.3\text{V}$</td>
<td>10</td>
<td></td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>HIGH-level output voltage</td>
<td>$V_{OH}$</td>
<td>Measurement circuit 2, Q output $I_{OH}=4\text{mA}$ $f_{OSC}=122.88\text{MHz}$, $f_{OUT}=122.88\text{MHz}$ $V_{DD}=3.3\text{V}$</td>
<td>-0.4</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>LOW-level output voltage</td>
<td>$V_{OL}$</td>
<td>Measurement circuit 2, Q output $I_{OL}=4\text{mA}$ $f_{OSC}=61.44\text{MHz}$ $V_{DD}=3.3\text{V}$</td>
<td>0.4</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output leakage current</td>
<td>$I_Z$</td>
<td>Measurement circuit 3, Q output $V_{DD}=3.3\text{V}$, $T_a=-40\text{ to } +105\text{C}$</td>
<td>-1</td>
<td>1</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>HIGH-level input voltage</td>
<td>$V_{IH}$</td>
<td>Measurement circuit 4, INHN input $V_{DD}=3.3\text{V}$</td>
<td>0.7$V_{DD}$</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>LOW-level input voltage</td>
<td>$V_{IL}$</td>
<td>Measurement circuit 4, INHN input $V_{DD}=3.3\text{V}$</td>
<td>0.3$V_{DD}$</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Pull-up resistance 1</td>
<td>$R_{PU1}$</td>
<td>Measurement circuit 5, INHN input $V_{DD}=0\text{V}$ $V_{DD}=3.3\text{V}$, $V_{IH}=0.7\text{V}$, $f_{OSC}=122.88\text{MHz}$</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>MΩ</td>
</tr>
<tr>
<td>Pull-up resistance 2</td>
<td>$R_{PU2}$</td>
<td>Measurement circuit 5, INHN input $V_{DD}=0.7\text{V}$ $V_{DD}=3.3\text{V}$, $V_{IH}=0.7\text{V}$, $f_{OSC}=122.88\text{MHz}$</td>
<td>50</td>
<td>100</td>
<td>200</td>
<td>kΩ</td>
</tr>
<tr>
<td>Oscillator internal resistance</td>
<td>$R_{VC1}$</td>
<td>Between VC-XT, measurement circuit 6 $V_{DD}=3.3\text{V}$, $f_{OSC}=122.88\text{MHz}$</td>
<td>70</td>
<td>140</td>
<td>210</td>
<td>kΩ</td>
</tr>
<tr>
<td></td>
<td>$R_{VC2}$</td>
<td>Between VC-XTN, measurement circuit 6 $V_{DD}=3.3\text{V}$, $f_{OSC}=122.88\text{MHz}$</td>
<td>70</td>
<td>140</td>
<td>210</td>
<td>kΩ</td>
</tr>
<tr>
<td>Input leakage resistance</td>
<td>$R_{VIN}$</td>
<td>VC, $T_a=25\text{C}$, measurement circuit 7 $V_{DD}=3.3\text{V}$, $f_{OSC}=122.88\text{MHz}$</td>
<td>10</td>
<td></td>
<td>MΩ</td>
<td></td>
</tr>
<tr>
<td>Oscillator capacitance</td>
<td>$C_{VC1}$</td>
<td>Confirmed using wafer monitor pattern, design value, excluding parasitic capacitance $V_{C}=0.3\text{V}$</td>
<td>4.38</td>
<td>4.86</td>
<td>5.35</td>
<td>pF</td>
</tr>
<tr>
<td></td>
<td>$C_{VC2}$</td>
<td>Confirmed using wafer monitor pattern, design value, excluding parasitic capacitance $V_{C}=1.65\text{V}$</td>
<td>2.62</td>
<td>3.08</td>
<td>3.55</td>
<td>pF</td>
</tr>
<tr>
<td></td>
<td>$C_{XT}$</td>
<td>Confirmed using wafer monitor pattern, design value, excluding parasitic capacitance $V_{C}=0.3\text{V}$</td>
<td>6.24</td>
<td>6.94</td>
<td>7.63</td>
<td>pF</td>
</tr>
<tr>
<td></td>
<td>$C_{XTN}$</td>
<td>Confirmed using wafer monitor pattern, design value, excluding parasitic capacitance $V_{C}=1.65\text{V}$</td>
<td>3.70</td>
<td>4.36</td>
<td>5.01</td>
<td>pF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{C}=3.0\text{V}$ $V_{DD}=3.3\text{V}$, $V_{C}=1.65 \pm 1.65\text{V}$, measurement circuit 8, $f_{OSC}=122.88\text{MHz}$</td>
<td>1.89</td>
<td>2.36</td>
<td>2.83</td>
<td>pF</td>
</tr>
<tr>
<td>Maximum modulation frequency</td>
<td>$F_M$</td>
<td>$-3\text{dB}$ frequency, $T_a=25\text{C}$, design value, $V_{DD}=3.3\text{V}$, $V_{C}=1.65 \pm 1.65\text{V}$, measurement circuit 8, $f_{OSC}=122.88\text{MHz}$</td>
<td>20</td>
<td>50</td>
<td></td>
<td>kHz</td>
</tr>
</tbody>
</table>
10. SWITCHING CHARACTERISTICS

10.1. B1, B2 Versions

\[ \text{V}_{\text{DD}} = 3.135 \text{ to } 3.465 \text{V}, \text{ V}_{\text{C}} = 0.5 \text{V}_{\text{DD}}, \text{ V}_{\text{SS}} = 0 \text{V}, \text{ T}_{\text{a}} = -40 \text{ to } +105 \degree \text{C} \text{ unless otherwise noted} \]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH-level output voltage</td>
<td>( V_{\text{TOP}} )</td>
<td>( C_L = 15 \text{pF}, \text{ measurement circuit 9} )</td>
<td>0.9V_{\text{DD}}</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>LOW-level output voltage</td>
<td>( V_{\text{BASE}} )</td>
<td>( C_L = 15 \text{pF}, \text{ measurement circuit 9} )</td>
<td></td>
<td>0.1V_{\text{DD}}</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Duty cycle</td>
<td>Duty</td>
<td>( T_a = 25 \degree \text{C}, \text{ V}_{\text{DD}} = 3.3 \text{V}, \text{ measurement circuit 9} )</td>
<td>45</td>
<td>50</td>
<td>55</td>
<td>%</td>
</tr>
<tr>
<td>Output rise time</td>
<td>( t_r )</td>
<td>( C_L = 15 \text{pF}, \text{ output amplitude, measurement circuit 9, } 0.1V_{\text{DD}} \to 0.9V_{\text{DD}} )</td>
<td>1.5</td>
<td>3.0</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Output fall time</td>
<td>( t_f )</td>
<td>( C_L = 15 \text{pF}, \text{ output amplitude, measurement circuit 9, } 0.9V_{\text{DD}} \to 0.1V_{\text{DD}} )</td>
<td>1.5</td>
<td>3.0</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Output enable propagation delay*1</td>
<td>( t_{\text{OE}} )</td>
<td>( T_a = 25 \degree \text{C}, \text{ measurement circuit 10 INHN=“Low”→“High”} )</td>
<td>2</td>
<td></td>
<td></td>
<td>ms</td>
</tr>
<tr>
<td>Output disable propagation delay</td>
<td>( t_{\text{OD}} )</td>
<td>( T_a = 25 \degree \text{C}, \text{ measurement circuit 10 INHN=“High”→“Low”} )</td>
<td>200</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>

*1: Rating may vary depending on the power supply used, values of bypass capacitors, and other factors.

**Notes**

The ratings above are values obtained by measurements using NPC evaluation standard crystal element on a standards testing jig.

Ratings may have wide tolerances due to crystal element characteristics; thorough evaluation is recommended.

The recommended crystal element characteristics are R1 < 20Ω and C0 < 1.5pF.
CF7321xx/WF7321xx

Low-Phase Noise VCXO IC

Timing Diagrams

DUTY measurement voltage 0.5V\text{DD}
DUTY = \frac{t_{w}}{T} \times 100 \% 

Output switching waveform

Output state control switching waveform
11. FUNCTIONAL DESCRIPTION

11.1. INHN Function
When INHN pin goes Low, the Q pin becomes high impedance and the oscillation stops.

<table>
<thead>
<tr>
<th>INHN</th>
<th>Q</th>
<th>Oscillator</th>
</tr>
</thead>
<tbody>
<tr>
<td>High(Open)</td>
<td>f_{OUT}</td>
<td>Operating</td>
</tr>
<tr>
<td>Low</td>
<td>Disabled (Hi-Z)</td>
<td>Disabled</td>
</tr>
</tbody>
</table>

11.2. Power Saving Pull-up Resistor
The INHN pin pull-up resistance changes in response to the input level (High or Low). When INHN pin is tied Low (standby state), the pull-up resistance becomes large (R_{PU1}), reducing the current consumed by the resistance. When INHN pin is open circuit, the pull-up resistance becomes small (R_{PU2}), decreasing the susceptibility to the effects of external noise.

11.3. Oscillation Detection Function
The 7321 series incorporate an oscillation detector circuit.
The oscillation detector circuit disables the Q output until crystal oscillation becomes stable when oscillation circuit starts up. This reduces the risk of abnormal oscillation behavior when in the initial power up and in a reactivation by INHN.

11.4. Boot Function
At the time of oscillation starting, XTN pin potential is made into the V_{DD} level. It makes negative resistance enlarged and it becomes easy to start oscillation. Beware that a current flows into VC pin until it starts oscillation, when XTN pin is V_{DD} level and the voltage below V_{DD} level is being applied to VC pin.
A boot function is canceled after an oscillation start.
12. REFERENCE CHARACTERISTICS EXAMPLE (7321Bx Typical Characteristics)

The characters given below were measured using an NPC standards jig and standard crystal element, and do not represent a guarantee of device characteristics. Note that the characteristics will vary due to measurement environment and the oscillator element used.

Crystal used for evaluation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B1</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f_{OSC}$ (MHz)</td>
<td>122.88</td>
</tr>
<tr>
<td>C0 (pF)</td>
<td>1.8</td>
</tr>
<tr>
<td>$\gamma$ (=C0/C1)</td>
<td>354</td>
</tr>
<tr>
<td>R1 (Ω)</td>
<td>8.1</td>
</tr>
</tbody>
</table>

12.1. Pulling Range

[Measurement condition]

$V_{DD}$=3.3V, $V_{SS}$=0V, Ta=25℃

【7321Bx】$f_{OSC}=122.88$MHz

[Measurement circuit diagram]
12.2. Phase Noise

[Measurement condition]

\[V_{DD}=3.3\text{V}, V_{SS}=0\text{V}, T_a=25^\circ\text{C}\]

\[7321\text{B1}] f_{OSC} = 122.88\text{MHz}, f_{OUT} = 122.88\text{MHz}\]

\[7321\text{B2}] f_{OSC} = 122.88\text{MHz}, f_{OUT} = 61.44\text{MHz}\]
12.3. Modulation Bandwidth

[Measurement condition]
$V_{DD}=3.3\,V$, $V_{SS}=0\,V$, $Ta=25^\circ C$

【7321B1】$f_{OSC}=122.88\,MHz$, $f_{OUT}=122.88\,MHz$

【7321B2】$f_{OSC}=122.88\,MHz$, $f_{OUT}=61.44\,MHz$

12.4. Negative Resistance

[Measurement condition]

\[ V_{DD}=3.3\,\text{V},\; V_{SS}=0\,\text{V},\; T_a=25\,\text{C},\; C_0=0\,\text{pF} \]

【7321Bx】 When in “Boot” function

At the time of oscillation starting, negative resistance becomes deep by boot function. The boot function is released when oscillation is steady, and oscillation output starts.

[Measurement circuit diagram]

Measurement results using 4396B Agilent analyzer on NPC test jig. Measurements will vary with test jig and measurement environment.
12.5. Drive Level

[Measurement condition]

$V_{DD} = 3.3V$, $Ta = 25^\circ C$

$[7321Bx]_{f_{OSC}} = 122.88\text{MHz}$

![Graph showing DL vs. VC]

[Measurement circuit diagram]

$DL = (I_{tal})^2 \times Re$

$I_{tal}$: Current though Crystal (RMS)

$Re$: Crystal’s effective resistance
12.6. Oscillator CL Characteristics

[Measurement condition]

\[ V_{DD} = 3.3 \text{V}, \quad V_{SS} = 0 \text{V}, \quad T_a = 25^\circC \]

\[ \text{[7321Bx]} f_{OSC} = 122.88 \text{MHz} \]

\[
C_{L_{osc}} \begin{bmatrix}
0 & 0.3 & 0.6 & 0.9 & 1.2 & 1.5 & 1.8 & 2.1 & 2.4 & 2.7 & 3.0 & 3.3 \\
0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11
\end{bmatrix}
\]

\[ v_c \begin{bmatrix}
0.0 & 0.3 & 0.6 & 0.9 & 1.2 & 1.5 & 1.8 & 2.1 & 2.4 & 2.7 & 3.0 & 3.3 \\
\end{bmatrix}
\]

CL_{osc}: Oscillator circuit equivalent capacitance determined by oscillator frequency

\[
C_{Loe} = C_1 \left( \frac{f_{osc}}{f_s} \right)^2 - C_0 - 1
\]

C1: Crystal element equivalent series capacitance
C0: Crystal element equivalent parallel capacitance
fs: Crystal element series resonance frequency

[Measurement circuit diagram]
12.7. VC Terminal Input Impedance

[Measurement condition]
Ta=25°C, Vc=0V

[7321Bx]

![Graph showing VC Terminal Input Impedance vs. Input Frequency]

[Measurement circuit diagram]

- VDD
- XT
- 7321xx
- XTN
- Q
- VC
- INHN
- VSS

Impedance Analyzer (HP 4194A)
12.8. Current Consumption

[Measurement condition]
Ta=25°C, no load

\[7321B1\] $I_{\text{OSC}} = 122.88\text{MHz}, f_{\text{OUT}} = 122.88\text{MHz}$

12.9. Output Waveform
[Measurement condition]
V_{DD}=3.3V, V_c=1.65V, T_a=25°C

【7321B1】f_{OSC} = 122.88MHz, f_{OUT} = 122.88MHz

【7321B2】f_{OSC} = 122.88MHz, f_{OUT} = 61.44MHz

Measurement equipment: Oscilloscope DSO80604B(Agilent), Differential probe 1134A (Probe head E2678A)
13. MEASUREMENT CIRCUITS

These measurement circuits are used for the evaluation of the electrical and switching characteristics.

Notes
Connect the bypass capacitors, specified in the measurement circuits, VDD/-VSS.
Connect the bypass capacitors and load resistors with wiring pattern as short as possible (less than 3mm length). If the wiring pattern is too long, the desired characteristics cannot be obtained.
Note that if bypass capacitors and load resistors other than the specified values are connected, or if the components are not connected at all, the desired characteristics cannot be obtained.

* Capacitor and resistor values used by NPC
  • Capacitors: 0.01μF GRM188B11H103K (Murata Manufacturing Co., Ltd.)

13.1. Measurement Circuit 1
Measurement parameter: $I_{DD}$, $I_{STB}$

![Measurement circuit 1](image)

Figure 13-1. Measurement circuit 1
13.2. Measurement Circuit 2
Parameters: $V_{OH}$, $V_{OL}$

![Measurement Circuit 2 Diagram]

$V_S$ adjusted so that $\Delta V = 50 \times I_{OH}$

13.3. Measurement Circuit 3
Parameters: $I_Z$

![Measurement Circuit 3 Diagram]

$V_S$ adjusted so that $\Delta V = 50 \times I_{OH}$
13.4. Measurement Circuit 4
Parameter: $V_{IH}$, $V_{IL}$

![Measurement circuit 4 diagram]

$V_{IH}$: $V_{SS} \rightarrow V_{DD}$, voltage that changes enable output state
$V_{IL}$: $V_{DD} \rightarrow V_{SS}$, voltage that changes disable output state

13.5. Measurement Circuit 5
Parameters: $R_{PU1}$, $R_{PU2}$

![Measurement circuit 5 diagram]

$R_{PU1} = (V_{DD} - V_{INHN})/I_{INHN}$, $V_{INHN} = 0V$
$R_{PU2} = (V_{DD} - V_{INHN})/I_{INHN}$, $V_{INHN} = 0.7V_{DD}$

Figure 13-4. Measurement circuit 4

Figure 13-5. Measurement circuit 5
13.6. Measurement Circuit 6
Parameters: $R_{VC1}$, $R_{VC2}$

$$R_{VC1} = \frac{V_{DD}}{I_{XT}}$$
$$R_{VC2} = \frac{V_{DD}}{I_{XTN}}$$

Figure 13-6. Measurement circuit 6

13.7. Measurement Circuit 7
Parameters: $R_{VIN}$

$$R_{VIN} = \frac{V_{DD}}{I_{VIN}}$$

Figure 13-7. Measurement circuit 7
13.8. Measurement Circuit 8
Parameters: $F_M$

![Circuit Diagram]

**Figure 13-8. Measurement circuit 8**

13.9. Measurement Circuit 9
Parameter: Duty, $t_r$, $t_f$, $V_{TOP}$, $V_{BASE}$

![Circuit Diagram]

**Figure 13-9. Measurement circuit 9**
13.10. Measurement Circuit 10
Parameter: \( t_{OE}, t_{OD} \)

![Diagram of measurement circuit 10](image)

Figure 13-10. Measurement circuit 10
14. WAFER SURFACE ORIENTATION DIAGRAM

Scribe line width: 70µm

Orientation flat: Facing up

Chip size X axis

Chip size Y axis

Scribe line width
15. USAGE AND PRECAUTIONS

This product is designed and manufactured to the generally accepted standards of reliability as expected for use in general electronic and electrical equipment, such as personal equipment, machine tools, and measurement equipment. This product is not designed and manufactured to be used in any other special equipment requiring extremely high level of reliability and safety, such as aerospace equipment, nuclear power control equipment, medical equipment, transportation equipment, disaster prevention equipment, security equipment.

If you wish to use this product in equipment requiring extremely high level of reliability, please contact our sales department or representative in advance.

In the event that this product is used in such equipment, please take scrupulous care and apply fail-safe techniques including redundancy and malfunction prevention in order to prevent damage to life, health, property, or infrastructure etc. in case there is some malfunction in the product.

Please pay your attention to the following points at time of using the products shown in this document.

1. The products shown in this document (hereinafter “Products”) are designed and manufactured to the generally accepted standards of reliability as expected for use in general electronic and electrical equipment, such as personal equipment, machine tools and measurement equipment. The Products are not designed and manufactured to be used in any other special equipment requiring extremely high level of reliability and safety, such as aerospace equipment, nuclear power control equipment, medical equipment, transportation equipment, disaster prevention equipment, security equipment. The Products are not designed and manufactured to be used for the apparatus that exerts harmful influence on the human lives due to the defects, failure or malfunction of the Products.

   If you wish to use the Products in that apparatus, please contact our sales section in advance.

   In the event that the Products are used in such apparatus without our prior approval, we assume no responsibility whatsoever for any damages resulting from the use of that apparatus.

2. NPC reserves the right to change the specifications of the Products in order to improve the characteristics or reliability thereof.

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4. The constant of each circuit shown in this document is described as an example, and it is not guaranteed about its value of the mass production products.

5. In the case of that the Products in this document falls under the foreign exchange and foreign trade control law or other applicable laws and regulations, approval of the export to be based on those laws and regulations are necessary. Customers are requested appropriately take steps to obtain required permissions or approvals from appropriate government agencies.