## Evaluation Data of Oscillation Circuit for Crystal Unit

### Murata's recommendation 推奨回路定数

<table>
<thead>
<tr>
<th>Item</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC name</td>
<td>QN9080</td>
</tr>
<tr>
<td>Parts Number of Crystal Unit</td>
<td>XRCGB32M000F2N13R0</td>
</tr>
<tr>
<td>Circuit Parameter</td>
<td></td>
</tr>
<tr>
<td>External load capacitance</td>
<td>CL1 Open</td>
</tr>
<tr>
<td>Feedback resistance</td>
<td>RT No mount</td>
</tr>
<tr>
<td>Damping resistance</td>
<td>Rd 0ohm</td>
</tr>
<tr>
<td>Supply Voltage Range</td>
<td>1.8 to 3.6V</td>
</tr>
<tr>
<td>Temp. Range</td>
<td>-40 to 85deg.C</td>
</tr>
</tbody>
</table>

### Characteristics of oscillation circuit on above condition 推奨定数での発振回路特性

- **Center Frequency and Difference**
  - Oscillating frequency and its shift against nominal frequency.

- **Load Capacitance on your PCB**
  - This value shows load capacitance the evaluated circuit has.

- **Negative Resistance and Oscillation margin**
  - The details is explained in page 2.

- **Drive Level**
  - Drive power of crystal under circuit condition.

- **Oscillating Voltage**
  - Swing level at input side.

- **Oscillation Start up Time**
  - Time to reach 90% of the oscillation level under steady state.

### Notes

1. Frequency difference means the oscillating frequency difference between your PCB and Murata's frequency sorting circuit.
2. The measurement results is affected by the rise-up characteristics of supplied voltage on your PCB.

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**Evaluation board**

**Crystal Unit**

<table>
<thead>
<tr>
<th>Test Circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>777 777 777</td>
</tr>
<tr>
<td>777 777 777</td>
</tr>
<tr>
<td>VIN CL1 CL2</td>
</tr>
<tr>
<td>VOUT CL2</td>
</tr>
<tr>
<td>Xout Xn</td>
</tr>
<tr>
<td>Rin Rd Rf</td>
</tr>
<tr>
<td>39 40 40</td>
</tr>
</tbody>
</table>

**Set : 1.8 to 3.6V**

**Crystal Unit : XRCGB32M000F2N13R0**

**Set = 1.8 to 3.6V**

**CL1 = Open**

**CL2 = Open**

**Rf : No mount**

**Rd = 0ohm**

**Ta = -40 to 85deg.C**

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**Murata Manufacturing Co., Ltd.**

TCD-17-0068
Evaluation Data of Oscillation Circuit for Crystal Unit

Center frequency 32.000125 MHz

Center frequency difference 4 ppm from 32 MHz

This frequency difference causes imbalance of initial frequency tolerance on your PCB, because of load capacitance difference.

Load capacitance of the circuit 9.5 pF

This value shows load capacitance the evaluated circuit has.

Our crystal proposed in this report is sorted with 10pF as load capacitance.

Negative resistance

Ratio of negative resistance \(|-R|\) to \(R_{1 \text{spec.}}\).

Ratio 6.5 times

\[
\text{Ratio} = \frac{|-R|}{R_{1 \text{spec.}}}.
\]

\[
|R| = \frac{391 \text{ ohm}}{\text{Maximum series resistance for Crystal Unit to keep oscillation}}
\]

\[
R_{\text{max}} = 360 \text{ ohm}
\]

\[
R_e = 30.9 \text{ ohm}
\]

\[
R_{1 \text{spec.}} = 60 \text{ ohm}
\]

Effective resistance of Crystal Unit at actual oscillation frequency


eqivalent series resistance

Drive level

Drive power of crystal under circuit condition shown in page 1

Drive level 53 uW

\[
\text{Drive level} = I^2 \times R_1
\]

\[
I = 1.41 \text{ mA (RMS)}
\]

Current through Crystal Unit measured by current probe

\[
R_1 = 26.7 \text{ ohm}
\]
Evaluation Data of Oscillation Circuit for Crystal Unit

- **Temperature Characteristics**

  **MODEL:** XRCGB32M000F2N13R0 with QN9080

  Typical sample at Set=3V

  TC range: -40 to 85 deg.C

  TC drift spec: ± ppm

- **Table:**

<table>
<thead>
<tr>
<th>VIN (V)</th>
<th>VOUT (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>0.8</td>
<td>-0.1</td>
</tr>
<tr>
<td>0.9</td>
<td>0.9</td>
</tr>
</tbody>
</table>

  Typical sample at Set=3V, +25 deg.C


  [VOUT] Vertical: 1V/div., Broken line: GND

- **Oscillation waveform**

  **MODEL:** XRCGB32M000F2N13R0 with QN9080

  Typical sample at Set=3V, +25 deg.C

- **Oscillation start up waveform**

  **MODEL:** XRCGB32M000F2N13R0 with QN9080

  Start up time
  The time takes to become 90% of steady amplitude of Vout(Xout)
  after power is applied.

  Typical sample at Set=3V, +25 deg.C


  Broken line: GND