## Evaluation Data of Oscillation Circuit for Crystal Unit

### Murata’s recommendation

<table>
<thead>
<tr>
<th>Item</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC name</td>
<td>BES2300(Register:128)</td>
</tr>
<tr>
<td>Parts Number of Crystal Unit</td>
<td>XRCGB26M000F1H8R0</td>
</tr>
<tr>
<td>Circuit Parameter</td>
<td>External</td>
</tr>
<tr>
<td></td>
<td>load capacitance</td>
</tr>
<tr>
<td></td>
<td>Feedback resistance</td>
</tr>
<tr>
<td></td>
<td>Damping resistance</td>
</tr>
<tr>
<td>Supply Voltage Range</td>
<td>3.3V</td>
</tr>
<tr>
<td>Temp. Range</td>
<td>-30 to 85deg.C</td>
</tr>
</tbody>
</table>

#### Test Circuit

![Test Circuit Diagram](DFR-18-1353)

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### Characteristics of oscillation circuit on above condition

<table>
<thead>
<tr>
<th>Circuit Characteristics</th>
<th>Value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center Frequency and Difference</td>
<td>26.000045 MHz</td>
<td>Oscillating frequency and its shift against nominal frequency.</td>
</tr>
<tr>
<td>Load Capacitance on your PCB</td>
<td>4.9 pF</td>
<td>This value shows load capacitance the evaluated circuit has.</td>
</tr>
<tr>
<td>Negative Resistance and Oscillation margin</td>
<td>[-R] 726 Ω</td>
<td>The details is explained in page 2.</td>
</tr>
<tr>
<td>Drive Level</td>
<td>21 μW</td>
<td>Drive power of crystal under circuit condition.</td>
</tr>
<tr>
<td>Oscillating Voltage</td>
<td>VINp-p 0.9 V</td>
<td>Swing level at input side.</td>
</tr>
<tr>
<td></td>
<td>VOUTp-p 1.0 V</td>
<td>Swing level at output side.</td>
</tr>
<tr>
<td>Oscillation Start up Time</td>
<td>0.35 ms</td>
<td>Time to reach 90% of the oscillation level under steady state.</td>
</tr>
</tbody>
</table>

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**Notes**

The characteristics of the crystal oscillation circuit is affected by the circuit constants and actual mounting conditions and so on. Therefore, it is possible to get the different results from above one due to the production variation of the crystal oscillator circuit.

In your company, please use the results after confirmation of the matching between your crystal unit and oscillator circuit.

And furthermore, since the above-mentioned evaluation results evaluate only an oscillating circuit block, please confirm the checking of operations of a set in your company.

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**Murata Manufacturing Co., Ltd.**

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DFR-18-1353
## Test Data: Characteristics of recommended conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Center frequency</strong></td>
<td>26.000045 MHz</td>
</tr>
<tr>
<td>Center frequency difference</td>
<td>2 ppm from 26MHz</td>
</tr>
</tbody>
</table>

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

**Load capacitance of the circuit** 4.9 pF

This value shows load capacitance the evaluated circuit has.

Our crystal proposed in this report is sorted with 5pF as load capacitance.

**Negative resistance**

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

<table>
<thead>
<tr>
<th>Ratio</th>
<th>12.1 times</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>{-R}</td>
</tr>
<tr>
<td>$R_{1\text{spec}}$</td>
<td>60 ohm</td>
</tr>
</tbody>
</table>

$|{-R}| = R_{\text{max}} + R_{e}$

- $R_{\text{max}}$: Maximum series resistance for Crystal Unit to keep oscillation
- $R_{e}$: Effective resistance of Crystal Unit at actual oscillation frequency

**Drive level**

Drive power of crystal under circuit condition shown in page 1

<table>
<thead>
<tr>
<th>Drive level</th>
<th>21 uW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive level = $I^2 \times R_1$</td>
<td></td>
</tr>
</tbody>
</table>

- $I$: 0.76 mA (RMS)

Current through Crystal Unit measured by current probe

- $R_1$: 36.2 ohm
Evaluation Data of Oscillation Circuit for Crystal Unit

### Test Data: Characteristics of recommended conditions

#### Oscillation waveform
MODEL: XRCG826M000F1H89R0 with BES2300 (Register: 128)

<table>
<thead>
<tr>
<th>VIN [V]</th>
<th>VOUT [V]</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>0.9</td>
<td>-0.1</td>
</tr>
<tr>
<td>0.9</td>
<td>-0.1</td>
</tr>
</tbody>
</table>

Typical sample at Set=3.3V, +25deg.C

- Broken line: GND

#### Oscillation start up waveform
MODEL: XRCG826M000F1H89R0 with BES2300 (Register: 128)

Start up time
The time takes to become 90% of steady amplitude of Vout(Xout) after oscillation circuit starts working.

Typical sample at Set=3.3V, +25deg.C

- Broken line: GND