Ultra high stability temperature compensated crystal oscillator

Product name: TG5032CFN / TG5032SFN

Features
- Ultra high stability (<100ppb)
- Low phase noise
- Frequency range: 10 MHz to 40 MHz
- Output: CMOS, Clipped sine wave
- Supply voltage: 2.375 to 3.63 V
- External dimensions: 5.0 × 3.2 × 1.45 mm
- Small size package (4pads)
- Pb free.
- Complies with EU RoHS directive.

Applications
- Small Cells
- Stratum3
- Femtocell
- Network system etc.

Description
This product is ultra high stability temperature compensated crystal oscillator of CMOS and Clipped sine wave outputs using fundamental oscillation of Crystal unit. This has realized a low phase noise in frequency 10 to 40 MHz, and it is suitable for the reference clock include Small Cells. This allows the product to be compliant with various standards including GR-1244-CORE Stratum3, G8262 ECC-1&ECC-2.

► Explanation of the mark that are using it for the documents

<table>
<thead>
<tr>
<th>mark</th>
<th>explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pb Free</td>
<td>Pb free.</td>
</tr>
<tr>
<td>RoHS Compliant</td>
<td>Complies with EU RoHS directive.</td>
</tr>
<tr>
<td></td>
<td>*About the products without the Pb-free mark. Contains Pb in products exempted by EU RoHS directive. (Contains Pb in sealing glass, high melting temperature type solder or other.)</td>
</tr>
<tr>
<td></td>
<td>Designed for automotive applications such as Car Multimedia, Body Electronics, Remote Keyless Entry etc.</td>
</tr>
<tr>
<td></td>
<td>Designed for automotive applications related to driving safety (Engine Control Unit, Air Bag, ESC etc.).</td>
</tr>
</tbody>
</table>

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- Transportation vehicles and related (automobiles, aircraft, trains, vessels, etc.)
- Medical instruments to sustain life
- Submarine transmitters / Power stations and related / Fire work equipment and security equipment / traffic control equipment / and others requiring equivalent reliability.
1. Electrical characteristics

1) Absolute maximum ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>V_{CC}-GND</td>
<td>V</td>
<td>-0.5</td>
<td>-</td>
<td>+4.0</td>
<td>Store as bare product after packing</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>T_{stg}</td>
<td>°C</td>
<td>-40</td>
<td>-</td>
<td>+90</td>
<td></td>
</tr>
<tr>
<td>Frequency control voltage</td>
<td>V_{C}-GND</td>
<td>V</td>
<td>-0.5</td>
<td>-</td>
<td>V_{CC}+0.5</td>
<td>V_{C} Terminal</td>
</tr>
</tbody>
</table>

2) Operating conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>V_{CC}</td>
<td>V</td>
<td>2.375</td>
<td>3.63</td>
<td>-</td>
<td>Supply voltage range</td>
</tr>
<tr>
<td></td>
<td>GND</td>
<td>V</td>
<td>2.375</td>
<td>2.625</td>
<td>+2.5</td>
<td>V_{CC}=2.5 V Type</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.7</td>
<td>3.0</td>
<td>3.0</td>
<td>V_{CC}=2.85 V Type</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.85</td>
<td>3.15</td>
<td>3.15</td>
<td>V_{CC}=3.0 V Type</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.135</td>
<td>3.465</td>
<td>3.465</td>
<td>V_{CC}=3.3 V Type</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>T_{use}</td>
<td>°C</td>
<td>-40</td>
<td>+25</td>
<td>+85</td>
<td>Standard</td>
</tr>
<tr>
<td>Frequency control voltage</td>
<td>V_{C}</td>
<td>V</td>
<td>GND</td>
<td>N.C.</td>
<td>-</td>
<td>V_{C} Terminal / TCXO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.65</td>
<td>1.65</td>
<td>2.65</td>
<td>V_{C} Terminal / VC-TCXO</td>
</tr>
<tr>
<td>Output load condition</td>
<td>Load _C</td>
<td>pF</td>
<td>13.5</td>
<td>15</td>
<td>16.5</td>
<td>CMOS output</td>
</tr>
<tr>
<td></td>
<td>Load _C</td>
<td>pF</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>Clipped output</td>
</tr>
<tr>
<td></td>
<td>Load _R</td>
<td>kΩ</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>Clipped sine wave</td>
</tr>
<tr>
<td></td>
<td>Cc</td>
<td>µF</td>
<td>0.01</td>
<td>-</td>
<td>-</td>
<td>DC-cut sine wave</td>
</tr>
</tbody>
</table>

*1 DC-cut capacitor is not included in this TCXO. Please attach an external DC-cut capacitor (0.01 µF Min.) to the out pin.

3-1) Frequency characteristics (V_{CC}=Typ., G_{ND}=0.0 V, V_{C}=Typ. V, Load=Typ., T_{use}=+25°C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency tolerance</td>
<td>f_{tol}</td>
<td>× 10^6</td>
<td>-1.0</td>
<td>-</td>
<td>+1.0</td>
<td></td>
</tr>
<tr>
<td>(T_{use}=+25°C/+2°C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T_{use}=40°C to +85°C (Standard)</td>
</tr>
<tr>
<td>(Refloow cycles : 2 times)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency / temperature characteristics (Reference to (f_{max}+f_{min})/2)</td>
<td>f_{o-TC}</td>
<td>× 10^6</td>
<td>-0.10</td>
<td>-</td>
<td>+0.10</td>
<td>T_{use}=40°C to +85°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.14</td>
<td>-</td>
<td>+0.14</td>
<td>T_{use}=40°C to +85°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.25</td>
<td>-</td>
<td>+0.25</td>
<td>T_{use}=40°C to +85°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.28</td>
<td>-</td>
<td>+0.28</td>
<td>T_{use}=40°C to +85°C</td>
</tr>
<tr>
<td>Frequency / load coefficient</td>
<td>fo-Load</td>
<td>× 10^6</td>
<td>-0.10</td>
<td>-</td>
<td>+0.10</td>
<td>Load +/-10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.05</td>
<td>-</td>
<td>+0.05</td>
<td>Load +/-2%</td>
</tr>
<tr>
<td>Frequency / voltage coefficient</td>
<td>fo- V_{CC}</td>
<td>× 10^6</td>
<td>-0.10</td>
<td>-</td>
<td>+0.10</td>
<td>V_{CC} +/-5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.05</td>
<td>-</td>
<td>+0.05</td>
<td>V_{CC} +/-2%</td>
</tr>
<tr>
<td>Frequency slope</td>
<td></td>
<td>× 10^6</td>
<td>-0.10</td>
<td>-</td>
<td>+0.10</td>
<td>Minimum of 1 frequency reading every 2°C, over the operating temperature range (1°C/minute max.)</td>
</tr>
<tr>
<td>Hysteresis</td>
<td></td>
<td>× 10^6</td>
<td>-0.20</td>
<td>-</td>
<td>+0.20</td>
<td>Frequency measured before and after at +25°C</td>
</tr>
<tr>
<td>Frequency aging</td>
<td>f_{age}</td>
<td>× 10^6</td>
<td>-0.5</td>
<td>-</td>
<td>+0.5</td>
<td>T_{use}=25°C, First year</td>
</tr>
<tr>
<td>Holdover stability</td>
<td></td>
<td>× 10^6</td>
<td>-3.0</td>
<td>-</td>
<td>+3.0</td>
<td>T_{use}=25°C, 20 years</td>
</tr>
<tr>
<td>(Constant temperature)</td>
<td></td>
<td>× 10^6</td>
<td>-0.01</td>
<td>-</td>
<td>+0.01</td>
<td>T_{use}=25°C, 1 day *3</td>
</tr>
<tr>
<td>Holdover stability</td>
<td></td>
<td>× 10^6</td>
<td>-0.04</td>
<td>-</td>
<td>+0.04</td>
<td>T_{use}=25°C, 1 day *3</td>
</tr>
<tr>
<td>(Free-run accuracy)</td>
<td></td>
<td>× 10^6</td>
<td>-4.6</td>
<td>-</td>
<td>+4.6</td>
<td>T_{use}=25°C, 1 day *4</td>
</tr>
<tr>
<td>Acceleration sensitivity</td>
<td></td>
<td>× 10^7</td>
<td>-2.0</td>
<td>-</td>
<td>3 axes, 30-1500 Hz</td>
<td></td>
</tr>
</tbody>
</table>

*2 Measured in the elapse of 24 hours after reflow soldering.
*3 After 10 days of continuous operation.
*4 After 48 hours of continuous operation.
*5 This includes initial frequency tolerance, frequency / temperature characteristics, frequency / load coefficient, frequency/voltage coefficient and frequency aging (+25°C, 20 years)
### 3-2) Frequency control characteristics

(Vcc=Typ., GND=0.0 V, Vc=Typ. V, Load=Typ., T_use=+25°C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency control range</td>
<td>f_cont</td>
<td>x 10⁶</td>
<td>10.0</td>
<td>-</td>
<td>-5.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+5.0</td>
<td>-</td>
<td>+10.0</td>
</tr>
</tbody>
</table>

Notes:
- Vc=1.5V+/-1.0V, Vc=1.65V+/-1.0V
- Vc-GND(DC), Vc=Typ.

### Frequency change polarity

- Positive polarity

### Linearity

-%

### Input impedance

Z<sub>IN</sub> kΩ

### 4) Electrical Characteristics

(Vcc=Typ., GND=0.0 V, Vc=Typ. V, Load=Typ., T_use=+25°C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current consumption</td>
<td>ICC</td>
<td>mA</td>
<td>5.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.0</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:
- Clipped sine wave (Standard)
- CMOS (~26MHz)
- CMOS (~40MHz)
- t=0 at 90%Vcc

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start up time</td>
<td>t_str</td>
<td>ms</td>
<td>1.0</td>
<td>-</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5.0</td>
<td>-</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Notes:
- 10%Vcc to 90%Vcc level
- CMOS output

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rise time</td>
<td>tr</td>
<td>ns</td>
<td>10%</td>
<td>-</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>90%</td>
<td>-</td>
<td>10%</td>
</tr>
</tbody>
</table>

Notes:
- 50% Vcc level
- CMOS output

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall time</td>
<td>tf</td>
<td>ns</td>
<td>90%</td>
<td>-</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50%</td>
<td>-</td>
<td>90%</td>
</tr>
</tbody>
</table>

Notes:
- CMOS output
- 90%Vcc to 10%Vcc level
- CMOS output

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symmetry</td>
<td>SYM</td>
<td>%</td>
<td>45</td>
<td>50</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>40</td>
<td>50</td>
<td>60</td>
</tr>
</tbody>
</table>

Notes:
- 50% Vcc level
- CMOS output
- GND level(DC-cut)
- CMOS output
- Clipped sine wave (Option)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>High output voltage</td>
<td>V&lt;sub&gt;OH&lt;/sub&gt;</td>
<td>V</td>
<td>90%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Low output voltage</td>
<td>V&lt;sub&gt;OL&lt;/sub&gt;</td>
<td>V</td>
<td>10%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Output level</td>
<td>V&lt;sub&gt;p-p&lt;/sub&gt;</td>
<td>V</td>
<td>0.8</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:
- Clipped sine wave

### Phase noise (19.2MHz)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L(f)</td>
<td>dBC/Hz</td>
<td>-</td>
<td>-60</td>
<td>-46</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-90</td>
<td>-78</td>
<td>-100</td>
</tr>
</tbody>
</table>

Notes:
- 1 Hz offset
- 10 Hz offset

### Phase noise (30.72MHz)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L(f)</td>
<td>dBC/Hz</td>
<td>-</td>
<td>-116</td>
<td>-106</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-139</td>
<td>-131</td>
<td>-100</td>
</tr>
</tbody>
</table>

Notes:
- 1 kHz offset
- 10 kHz offset

### Phase noise (40MHz)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L(f)</td>
<td>dBC/Hz</td>
<td>-</td>
<td>-156</td>
<td>-150</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-157</td>
<td>-43</td>
<td>-100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-135</td>
<td>-75</td>
<td>-100</td>
</tr>
</tbody>
</table>

Notes:
- 1 MHz offset
- 10 Hz offset
2. Characteristics

2-1) “Frequency / temperature characteristics”
2-1-1) Standard spec : +/-0.1 × 10^-9 Max. (T_use=-40°C to +85°C)

19.2MHz [N=40pcs]

30.72MHz [N=40pcs]

40MHz [N=40pcs]
2-2) Frequency aging (40MHz) [N=5pcs]

![Graph showing frequency aging data](image)

- About 1 year:
  - Ave.: $-0.10 \times 10^{-6}$
  - Max.: $-0.05 \times 10^{-6}$
  - Min.: $-0.12 \times 10^{-6}$

- About 20 years:
  - Ave.: $-0.54 \times 10^{-6}$
  - Max.: $-0.35 \times 10^{-6}$
  - Min.: $-0.66 \times 10^{-6}$

2-3) Holdover stability (19.2MHz) [N=40pcs]

![Graph showing holdover stability data](image)

2-4) Frequency control characteristics [N=40pcs]

![Graph showing frequency control characteristics](image)
2-5) current consumption

2-6) Rise time / Fall time (at CMOS output)

2-7) Output voltage [\(V_{OH}, V_{OL}\)] (at CMOS output)

2-8) Symmetry (at CMOS output)

2-9) Output level [\(V_{p-p}\)] (at Clipped sine wave)
2-10) start up time (19.2MHz, 40MHz)

19.2MHz

40MHz
2-11) Phase noise (19.2MHz, 30.72MHz, 40MHz, refer to data of Page 3.)

2-12) Short term stability [ADEV] (19.2MHz)

2-13) TDEV (19.2MHz, Loop BW=0.1Hz)
Constant temperature : +25 deg.C
Constant temperature : +70 deg.C

2-14) MTIE (19.2MHz, Loop BW=0.1Hz)
Constant temperature : +25 deg.C
Constant temperature : +70 deg.C

Compliant with G.813 option 1 and 2
3. Outline

3-1) Outline dimensions and Pin information

TG5032CFN/SFN

3-2) Soldering pattern

Example of patterning design indicated as follows. In an actual design, please consider mounting density, the reliability of soldering, etc. and check whether performance is optimal.

Soldering pattern of TG5032CFN/SFN

Please set By-pass capacitor (0.1μF) near the Vcc pad

To maintain stable operation, provide a 0.1μF by-pass capacitor at a location as near as possible to the power source terminal of the crystal product (between Vcc - GND).
4. Timing chart

4-1) Output waveform (CMOS output)

\[ \text{SYM} = \frac{t_w}{t} \times 100 \% \]

4-2) Output waveform (Clipped sine wave output)

\[ \text{SYM} = \frac{t_w}{t} \times 100 \% \]
5. Test circuit

5-1) CMOS output for TCXO

1) Output Load : 15 pF

![Test Circuit Diagram]

2) Current consumption

![Current Consumption Diagram]

3) Conditions

1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz
   Impossible to measure both frequency and waveform at the same time. (In case of using oscilloscope's amplifier output, possible to measure both at the same time.)

2. Load_C includes probe capacitance.

3. A capacitor (By-pass: 0.1 µF) is placed between Vcc and GND, and closely to TCXO.

4. Use the current meter whose internal impedance value is small.

5. Power Supply
   Impedance of power supply should be as low as possible.

6. GND pin should be connected to low impedance GND.
5-2) CMOS output for VC-TCXO

1) Output Load : 15 pF

2) Current consumption

3) Conditions

1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz

   Impossible to measure both frequency and wave form at the same time. (In case of using
   oscilloscope's amplifier output, possible to measure both at the same time.)

2. Load_C includes probe capacitance.

3. A capacitor (By-pass: 0.1 µF) is placed between V_CC and GND, and closely to TCXO.

4. Use the current meter whose internal impedance value is small.

5. Power Supply
   Impedance of power supply should be as low as possible.

6. GND pin should be connected to low impedance GND.
5-3) Clipped sine wave output for TCXO

1) Output Load: $10 \, \text{k}\Omega \parallel 10 \, \text{pF}$

![Circuit Diagram](attachment:image.png)

2) Current consumption

![Circuit Diagram](attachment:image.png)

3) Conditions

1. Oscilloscope: Impedance Min. $1 \, \text{M}\Omega$
   Input capacitance Max. $10 \, \text{pF}$
   Band width Min. $300 \, \text{MHz}$

   Impossible to measure both frequency and wave form at the same time. (In case of using oscilloscope's amplifier output, possible to measure both at the same time.)

2. Load_C includes probe capacitance.

3. A capacitor (By-pass: $0.1 \, \mu\text{F}$) is placed between $V_{cc}$ and GND, and closely to TCXO.

4. Use the current meter whose internal impedance value is small.

5. Power Supply
   Impedance of power supply should be as low as possible.

6. GND pin should be connected to low impedance GND.
5-4) Clipped sine wave output for VC-TCXO

1) Output Load : 10 kΩ // 10 pF

![Circuit Diagram]

2) Current consumption

![Circuit Diagram]

3) Conditions

1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz

   Impossible to measure both frequency and wave form at the same time. (In case of using oscilloscope's amplifier output, possible to measure both at the same time.)

2. Load_C includes probe capacitance.

3. A capacitor (By-pass: 0.1 µF) is placed between Vcc and GND, and closely to TCXO.

4. Use the current meter whose internal impedance value is small.

5. Power Supply
   Impedance of power supply should be as low as possible.

6. GND pin should be connected to low impedance GND.
6. Handling precautions

Prior to using this product, please carefully read the section entitled “Precautions” on our Web site (http://www5.epsondevice.com/en/quartz/tech/precaution/) for instructions on how to handle and use the product properly to ensure optimal performance of the product in your equipment. Before using the product under any conditions other than those specified therein, please consult with us to verify and confirm that the performance of the product will not be negatively affected by use under such conditions.

In addition to the foregoing precautions, in order to avoid the deteriorating performance of the product, we strongly recommend that you DO NOT use the product under ANY of the following conditions:

(1) Mounting the product on a board using water-soluble solder flux and using the product without removing the residue of the flux completely from the board. The residue of such flux that is soluble in water or water-soluble cleaning agent, especially the residues which contains active halogens, will negatively affect the performance and reliability of the product.

(2) Using the product in any manner that will result in any shock or impact to the product.

(3) Using the product in places where the product is exposed to water, chemicals, organic solvent, sunlight, dust, corrosive gasses, or other materials.

(4) Using the product in places where the product is exposed to static electricity or electromagnetic waves.

(5) Applying ultrasonic cleaning without advance verification and confirmation that the product will not be affected by such a cleaning process, because it may damage the crystal, IC and/or metal line of the product.

(6) Touching the IC surface with tweezers or other hard materials directly.

(7) Using the product under any other conditions that may negatively affect the performance and/or reliability of the product.

(8) Power supply with ripple may cause of incorrect operation or degradation of phase noise characteristics, so please evaluate before use.

(9) Frequency aging is from environmental tests results to the expectation of the amount of the frequency variation. This doesn't guarantee the product-life cycle.

Should any customer use the product in any manner contrary to the precautions and/or advice herein, such use shall be done at the customer’s own risk.
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