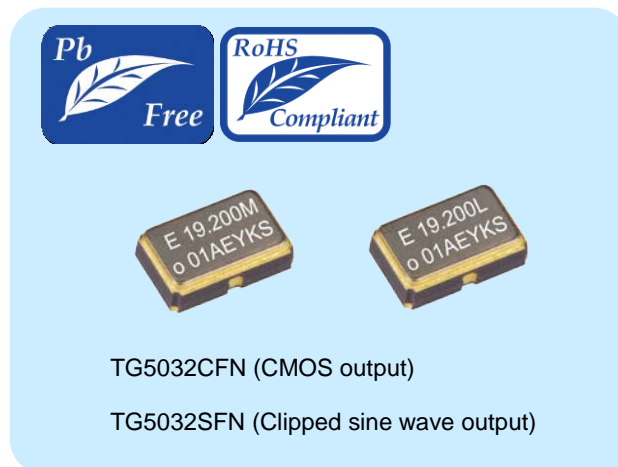


# Ultra high stability temperature compensated crystal oscillator

Product name : TG5032CFN / TG5032SFN

## Features

- Ultra high stability ( $\leq 100$ ppb)
- 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

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

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## 1. Electrical characteristics

### 1) Absolute maximum ratings

| Parameter                 | Symbol               | Unit | Min. | Typ. | Max                  | Notes                               |
|---------------------------|----------------------|------|------|------|----------------------|-------------------------------------|
| Supply voltage            | V <sub>CC</sub> -GND | V    | -0.5 | -    | +4.0                 |                                     |
| Storage temperature       | T <sub>stg</sub>     | °C   | -40  | -    | +90                  | Store as bare product after packing |
| Frequency control voltage | V <sub>C</sub> -GND  | V    | -0.5 | -    | V <sub>CC</sub> +0.5 | V <sub>C</sub> Terminal             |

### 2) Operating conditions

| Parameter                   | Symbol            | Unit | Min.  | Typ. | Max   | Notes                                    |
|-----------------------------|-------------------|------|-------|------|-------|--|
| Supply voltage              | V <sub>CC</sub>   | V    | 2.375 | -    | 3.63  | Supply voltage range                     |
|                             |                   |      | 2.375 | 2.5  | 2.625 | V <sub>CC</sub> =2.5 V Type              |
|                             |                   |      | 2.7   | 2.85 | 3.0   | V <sub>CC</sub> =2.85 V Type             |
|                             |                   |      | 2.85  | 3.0  | 3.15  | V <sub>CC</sub> =3.0 V Type              |
|                             |                   |      | 3.135 | 3.3  | 3.465 | V <sub>CC</sub> =3.3 V Type              |
|                             | GND               |      | 0.0   | -    | 0.0   |  |
| Operating temperature range | T <sub>use</sub>  | °C   | -40   | +25  | +85   | Standard                                 |
| Frequency control voltage   | V <sub>C</sub>    | V    | GND   | N.C. | -     | V <sub>C</sub> Terminal / TCXO           |
|                             |                   |      | 0.5   | 1.5  | 2.5   | V <sub>C</sub> Terminal / VC-TCXO        |
|                             |                   |      | 0.65  | 1.65 | 2.65  |  |
| Output load condition       | Load <sub>C</sub> | pF   | 13.5  | 15   | 16.5  | CMOS output                              |
|                             | Load <sub>C</sub> | pF   | 9     | 10   | 11    | Clipped sine wave                        |
|                             | Load <sub>R</sub> | kΩ   | 9     | 10   | 11    |  |
|                             | C <sub>c</sub>    | μF   | 0.01  | -    | -     | DC-cut capacitor *1<br>Clipped sine wave |

\*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<sub>CC</sub>=Typ., GND=0.0 V, V<sub>C</sub>=Typ. V, Load=Typ., T<sub>use</sub>=+25°C)

| Parameter  | Symbol              | Unit                      | Min.  | Typ. | Max   | Notes  |
|--|---------------------|---------------------------|-------|------|-------|--|
| Output frequency   | f <sub>o</sub>      | MHz                       | 10    | -    | 40    |  |
| Frequency tolerance *2<br>(T <sub>use</sub> =+25°C +/-2°C)<br>(Reflow cycles : 2 times)            | f <sub>tol</sub>    | × 10 <sup>-6</sup>        | -1.0  | -    | +1.0  |  |
| Frequency / temperature characteristics<br>(Reference to (f <sub>max</sub> +f <sub>min</sub> )/2.) | fo-Tc               | × 10 <sup>-6</sup>        | -0.10 | -    | +0.10 | T <sub>use</sub> =-40°C to +85°C (Standard)  |
|  |                     |                           | -0.14 | -    | +0.14 | T <sub>use</sub> =-40°C to +85°C   |
|  |                     |                           | -0.25 | -    | +0.25 | T <sub>use</sub> =-40°C to +85°C   |
|  |                     |                           | -0.28 | -    | +0.28 | T <sub>use</sub> =-40°C to +85°C   |
| Frequency / load coefficient   | fo-Load             | × 10 <sup>-6</sup>        | -0.10 | -    | +0.10 | Load +/-10%  |
|  |                     |                           | -0.05 | -    | +0.05 | Load +/-2%   |
| Frequency / voltage coefficient  | fo- V <sub>CC</sub> | × 10 <sup>-6</sup>        | -0.10 | -    | +0.10 | V <sub>CC</sub> +/-5%  |
|  |                     |                           | -0.05 | -    | +0.05 | V <sub>CC</sub> +/-2%  |
| Frequency slope  | -                   | × 10 <sup>-6</sup><br>/°C | -0.10 | -    | +0.10 | Minimum of 1 frequency reading every 2°C, over the operating temperature range (1°C/minute max.) |
| Hysteresis   | -                   | × 10 <sup>-6</sup>        | -0.20 | -    | +0.20 | Frequency measured before and after at +25°C.  |
| Frequency aging  | f <sub>age</sub>    | × 10 <sup>-6</sup>        | -0.5  | -    | +0.5  | T <sub>use</sub> =+25°C, First year  |
|  |                     |                           | -3.0  | -    | +3.0  | T <sub>use</sub> =+25°C, 20 years  |
| Holdover stability<br>(Constant temperature)   | -                   | × 10 <sup>-6</sup>        | -0.01 | -    | +0.01 | T <sub>use</sub> =+25°C, 1 day *3  |
|  |                     |                           | -0.04 | -    | +0.04 | T <sub>use</sub> =+25°C, 1 day *4  |
| Holdover stability<br>(Free-run accuracy)  | -                   | × 10 <sup>-6</sup>        | -4.6  | -    | +4.6  | *5   |
| Acceleration sensitivity   | -                   | × 10 <sup>-9</sup><br>/G  | -     | 2.0  | -     | 3 axes, 30-1500 Hz   |

\*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** (V<sub>CC</sub>=Typ., GND=0.0 V, V<sub>C</sub>=Typ. V, Load=Typ., T<sub>use</sub>=+25°C)

| Parameter                 | Symbol            | Unit               | Min.              | Typ.   | Max           | Notes   |
|---------------------------|-------------------|--------------------|-------------------|--------|---------------|---|
| Frequency control range   | f <sub>cont</sub> | x 10 <sup>-6</sup> | -10.0<br>+5.0     | -<br>- | -5.0<br>+10.0 | V <sub>C</sub> =1.5V±/-1.0V, V <sub>C</sub> =1.65V±/-1.0V |
| Linearity                 | -                 | %                  | -10               | -      | +10           |   |
| Input impedance           | Z <sub>IN</sub>   | kΩ                 | 100               | -      | -             | V <sub>C</sub> -GND(DC), V <sub>C</sub> =Typ.             |
| Frequency change polarity | -                 | -                  | Positive polarity |        |               |   |

**4) Electrical Characteristics** (V<sub>CC</sub>=Typ., GND=0.0 V, V<sub>C</sub>=Typ. V, Load=Typ., T<sub>use</sub>=+25°C)

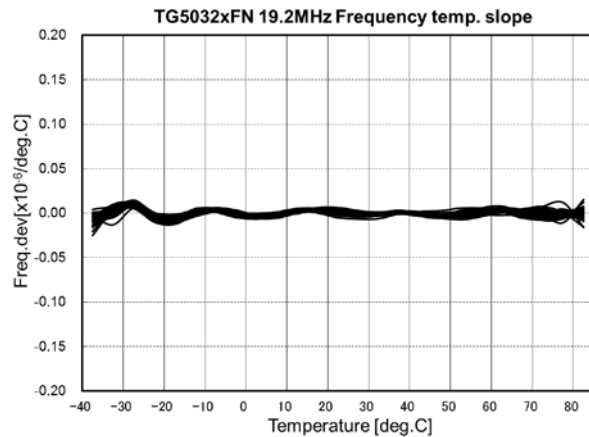
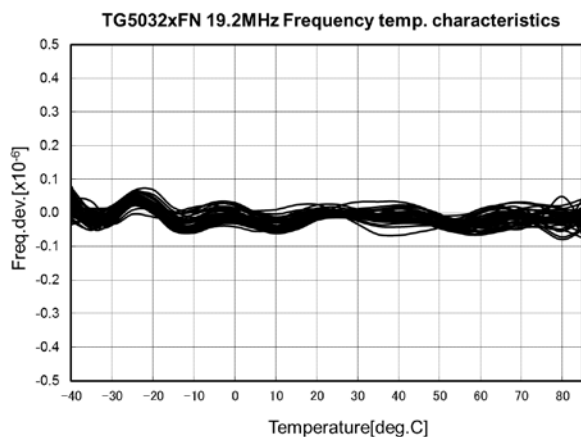
| Parameter                 | Symbol           | Unit             | Min.                | Typ. | Max                 | Notes   |
|---------------------------|------------------|------------------|---------------------|------|---------------------|---|
| Current consumption       | I <sub>CC</sub>  | mA               | -                   | -    | 5.0                 | Clipped sine wave (Standard)                                  |
|                           |                  |                  | -                   | -    | 3.0                 | Clipped sine wave ( <b>Option</b> )                           |
|                           |                  |                  | -                   | -    | 5.0                 | CMOS (~26MHz)   |
|                           |                  |                  | -                   | -    | 6.0                 | CMOS (~40MHz)   |
| Start up time             | t <sub>str</sub> | ms               | -                   | 1.0  | 5.0                 | t=0 at 90%V <sub>CC</sub>                                     |
| Rise time                 | t <sub>r</sub>   | ns               | -                   | -    | 8.0                 | 10%V <sub>CC</sub> to 90%V <sub>CC</sub> level<br>CMOS output |
| Fall time                 | t <sub>f</sub>   | ns               | -                   | -    | 8.0                 | 90%V <sub>CC</sub> to 10%V <sub>CC</sub> level<br>CMOS output |
| Symmetry                  | SYM              | %                | 45                  | 50   | 55                  | 50% V <sub>CC</sub> level<br>CMOS output                      |
|                           |                  |                  | 40                  | 50   | 60                  | GND level(DC-cut)<br>Clipped sine wave ( <b>Option</b> )      |
| High output voltage       | V <sub>OH</sub>  | V                | 90% V <sub>CC</sub> | -    | -                   | CMOS output   |
| Low output voltage        | V <sub>OL</sub>  | V                | -                   | -    | 10% V <sub>CC</sub> | CMOS output   |
| Output level              | V <sub>p-p</sub> | V <sub>p-p</sub> | 0.8                 | -    | -                   | Clipped sine wave   |
| Phase noise<br>(19.2MHz)  | L(f)             | dBc/<br>Hz       | -                   | -60  | -46                 | 1 Hz offset   |
|                           |                  |                  | -                   | -90  | -78                 | 10 Hz offset  |
|                           |                  |                  | -                   | -116 | -106                | 100 Hz offset   |
|                           |                  |                  | -                   | -139 | -131                | 1 kHz offset  |
|                           |                  |                  | -                   | -153 | -147                | 10 kHz offset   |
|                           |                  |                  | -                   | -154 | -148                | 100 kHz offset  |
|                           |                  |                  | -                   | -155 | -149                | 1 MHz offset  |
| Phase noise<br>(30.72MHz) | L(f)             | dBc/<br>Hz       | -                   | -59  | -44                 | 1 Hz offset   |
|                           |                  |                  | -                   | -89  | -77                 | 10 Hz offset  |
|                           |                  |                  | -                   | -116 | -106                | 100 Hz offset   |
|                           |                  |                  | -                   | -137 | -129                | 1 kHz offset  |
|                           |                  |                  | -                   | -152 | -146                | 10 kHz offset   |
|                           |                  |                  | -                   | -154 | -148                | 100 kHz offset  |
|                           |                  |                  | -                   | -156 | -150                | 1 MHz offset  |
| Phase noise<br>(40MHz)    | L(f)             | dBc/<br>Hz       | -                   | -57  | -43                 | 1 Hz offset   |
|                           |                  |                  | -                   | -87  | -75                 | 10 Hz offset  |
|                           |                  |                  | -                   | -113 | -103                | 100 Hz offset   |
|                           |                  |                  | -                   | -135 | -127                | 1 kHz offset  |
|                           |                  |                  | -                   | -151 | -145                | 10 kHz offset   |
|                           |                  |                  | -                   | -153 | -147                | 100 kHz offset  |
|                           |                  |                  | -                   | -155 | -149                | 1 MHz offset  |

## 2. Characteristics

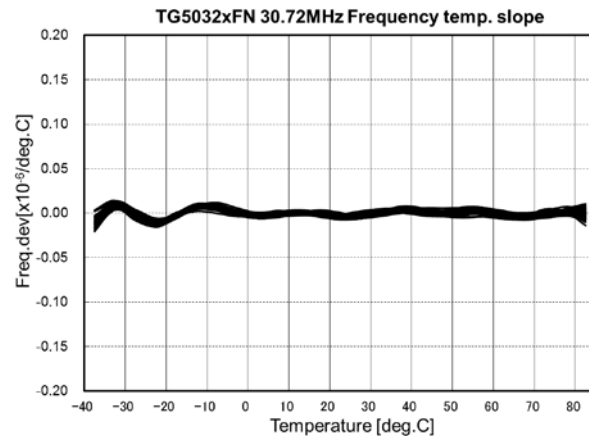
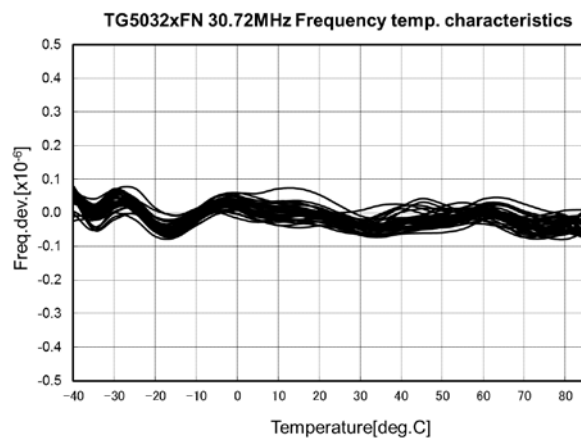
### 2-1) "Frequency / temperature characteristics"

2-1-1) Standard spec :  $\pm 0.1 \times 10^{-6}$  Max. ( $T_{use} = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ )

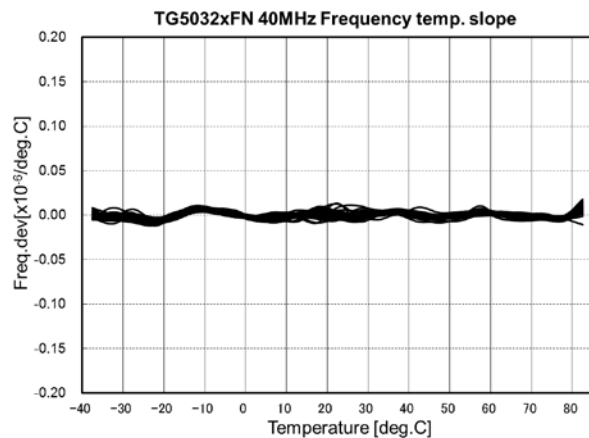
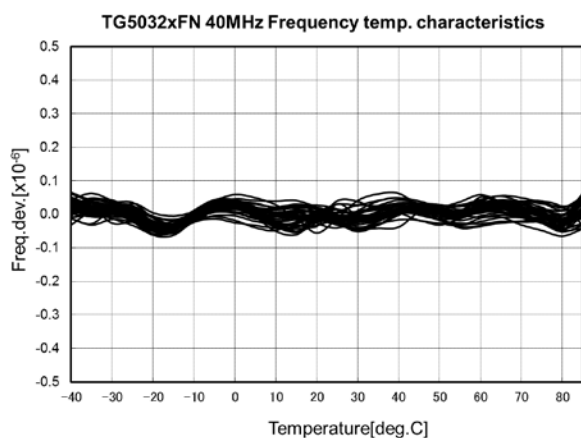
19.2MHz [N=40pcs]



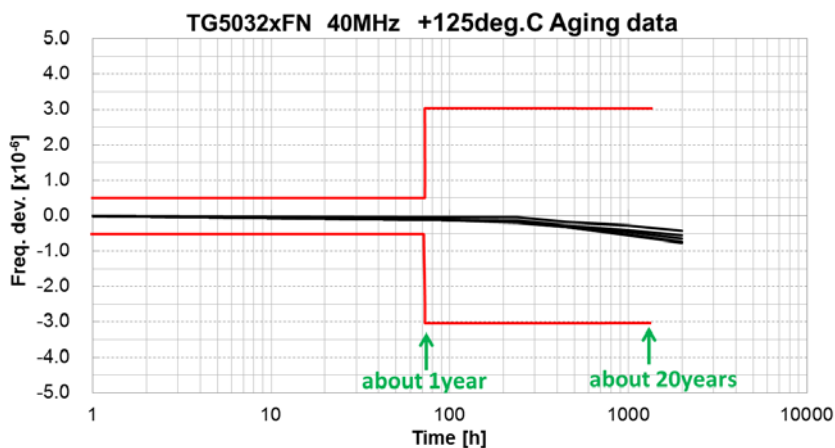
30.72MHz [N=40pcs]



40MHz [N=40pcs]



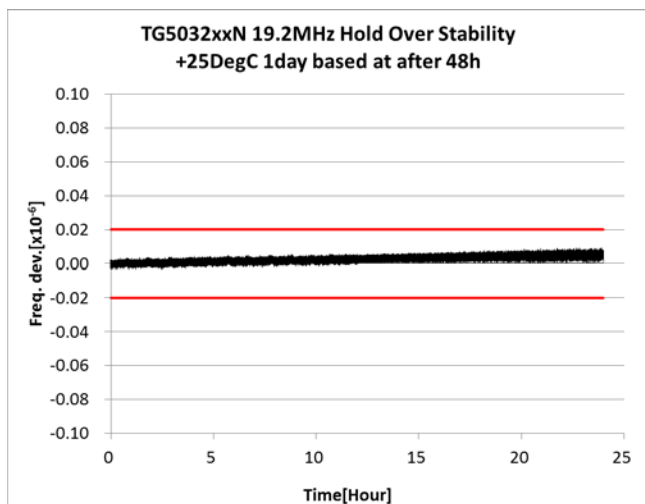
## 2-2) Frequency aging (40MHz) [N=5pcs]



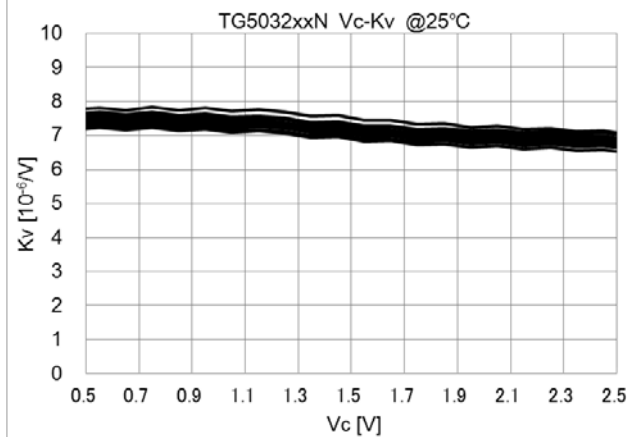
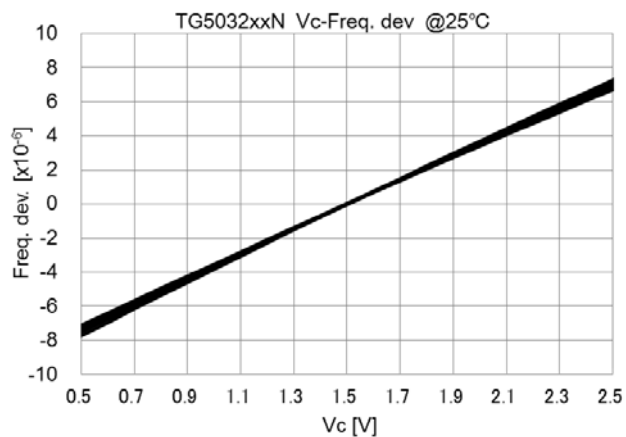
about 1year  
 Ave. :  $-0.10 \times 10^{-6}$   
 Max. :  $-0.05 \times 10^{-6}$   
 Min. :  $-0.12 \times 10^{-6}$

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

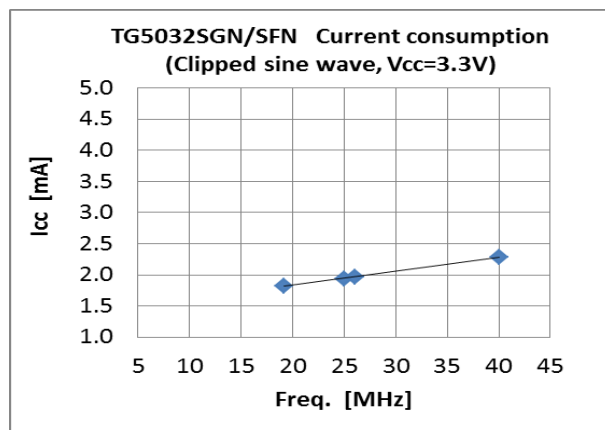
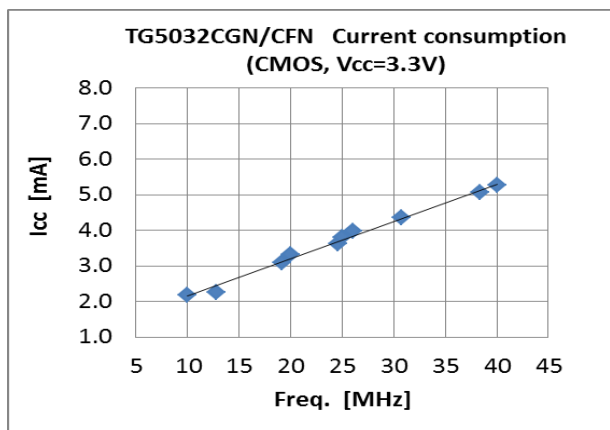
## 2-3) Holdover stability (19.2MHz) [N=40pcs]



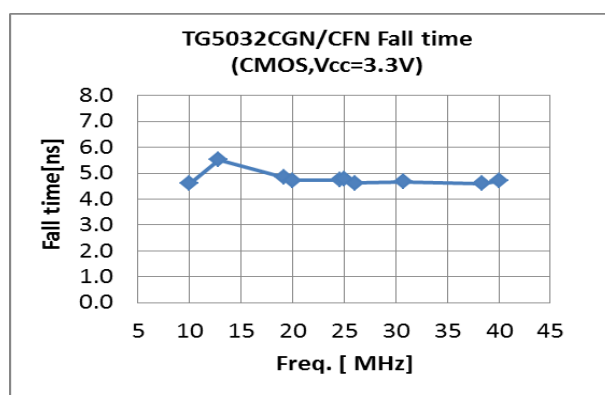
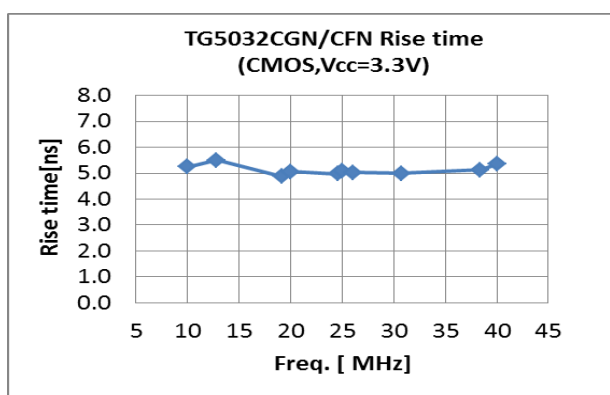
## 2-4) Frequency control characteristics [N=40pcs]



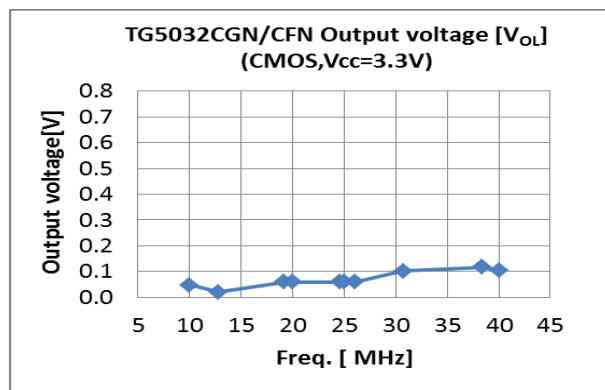
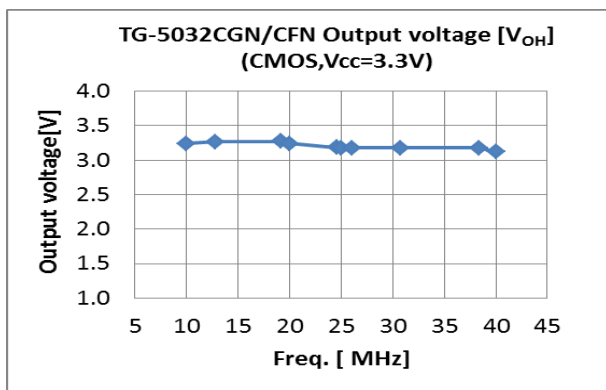
## 2-5) current consumption



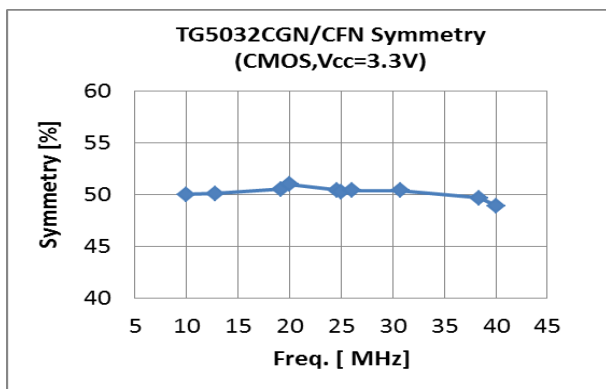
## 2-6) Rise time / Fall time (at CMOS output)



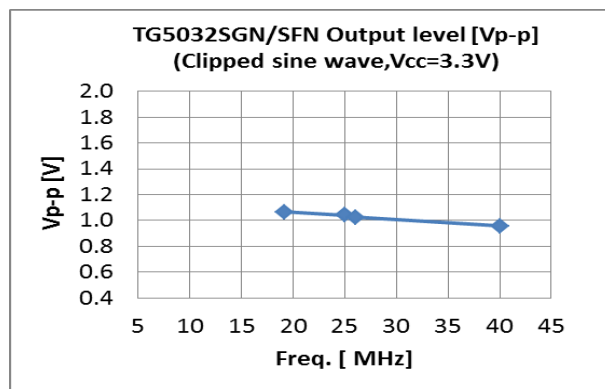
## 2-7) Output voltage [V<sub>OH</sub>, V<sub>OL</sub>] (at CMOS output)



## 2-8) Symmetry (at CMOS output)

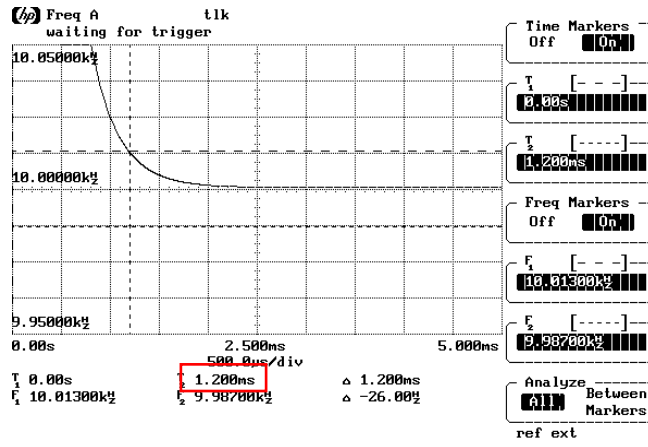


## 2-9) Output level [V<sub>P-P</sub>] (at Clipped sine wave)

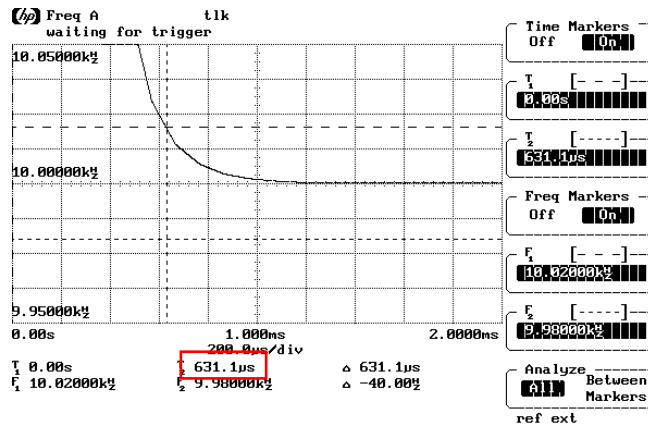


2-10) start up time(19.2MHz, 40MHz)

19.2MHz

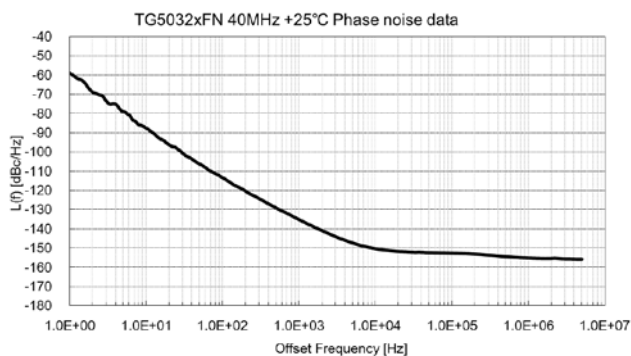
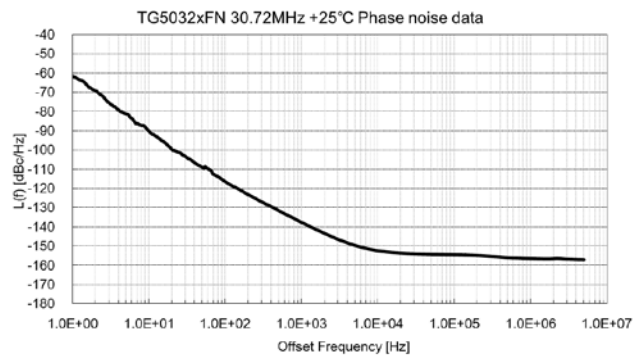
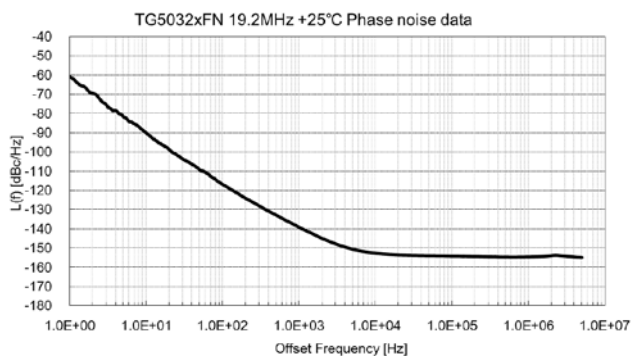


40MHz

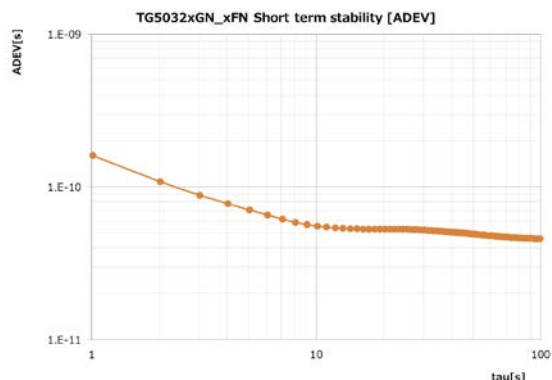




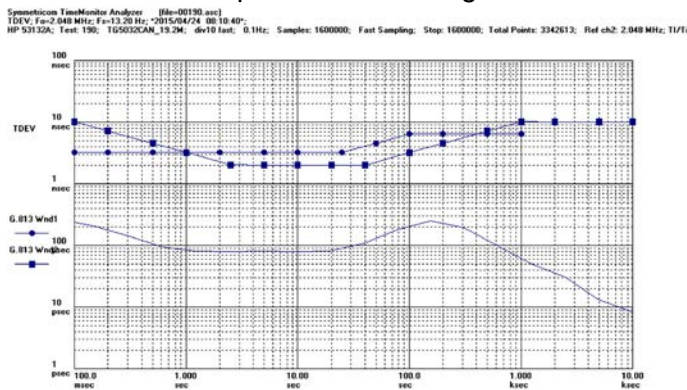
## 2-11) Phase noise (19.2MHz, 30.72MHz, 40MHz, refer to data of Page3.)



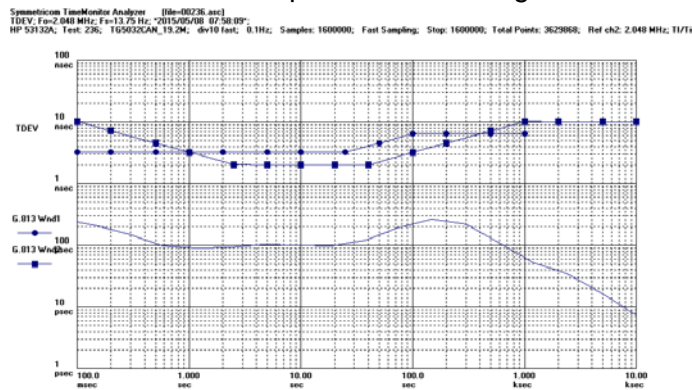
## 2-12) Short term stability [ADEV] (19.2MHz)



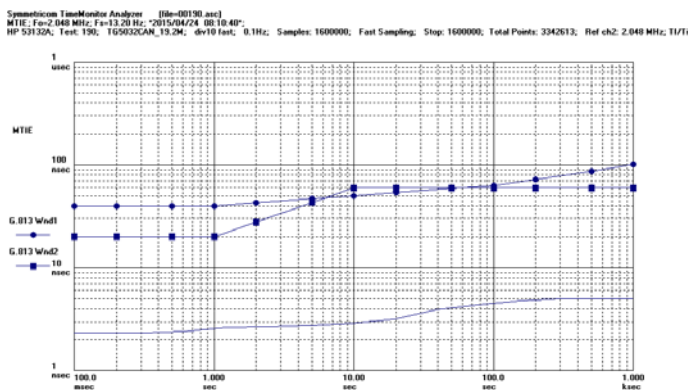
## 2-13) TDEV (19.2MHz, Loop BW=0.1Hz) Constant temperature : +25 deg.C



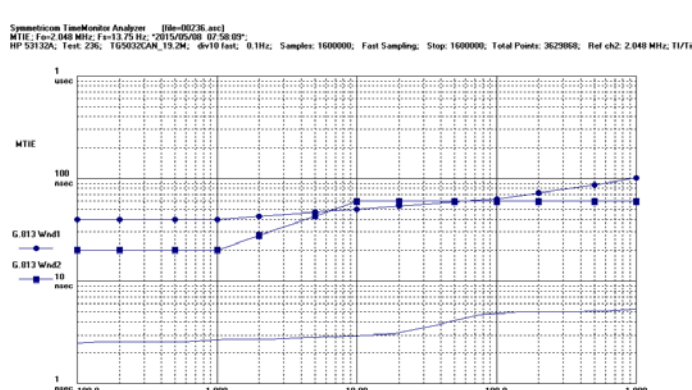
## Constant temperature : +70 deg.C



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



## Constant temperature : +70 deg.C



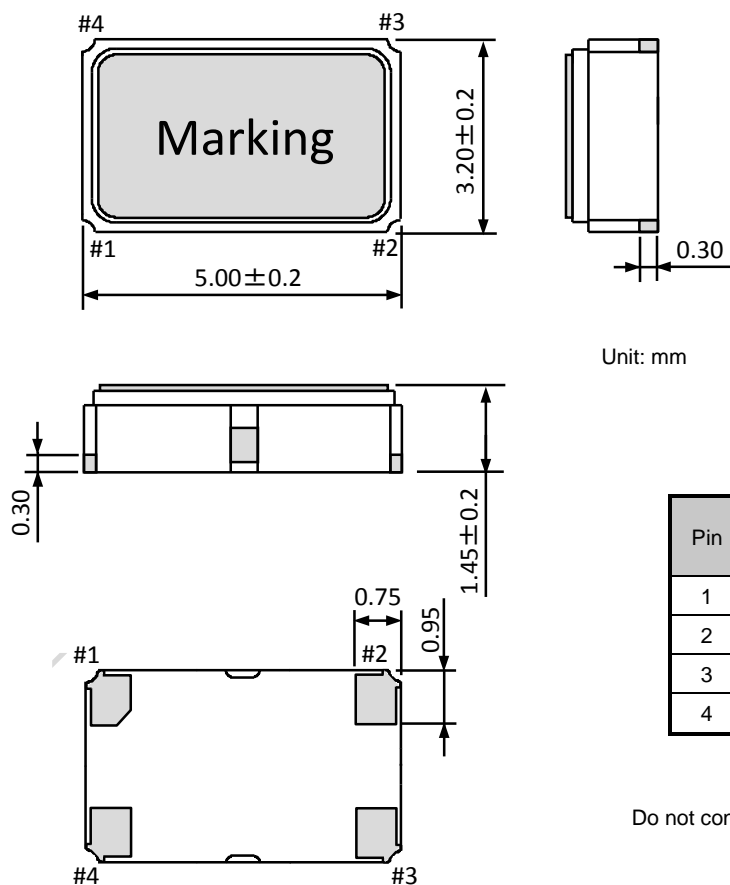
Compliant with G.813 option1 and 2



### 3. Outline

#### 3-1) Outline dimensions and Pin information

##### TG5032CFN/SFN



Unit: mm

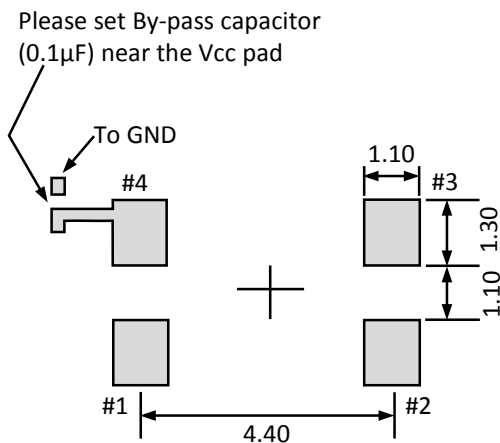
Do not connect "N.C." pin with any other pins (also mutually)

#### 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

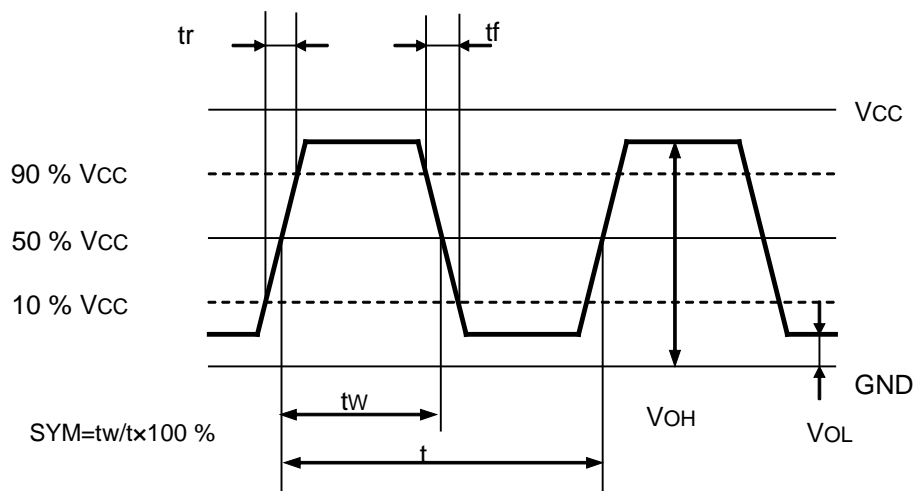
unit : mm



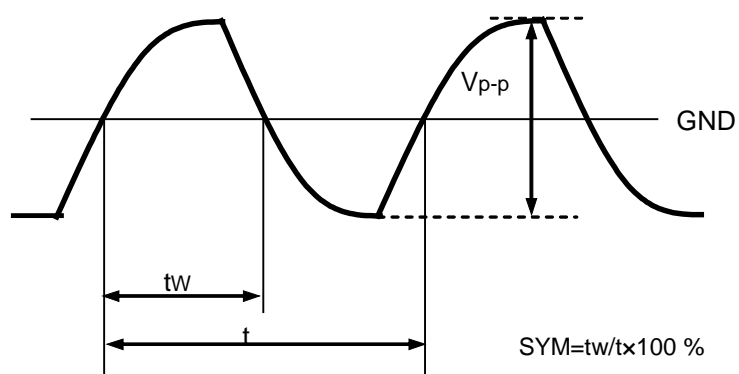
To maintain stable operation, provide a 0.1µF by-pass capacitor at a location as near as possible to the power source terminal of the crystal product (between Vcc - GND).

## 4. Timing chart

4-1) Output waveform (CMOS output)



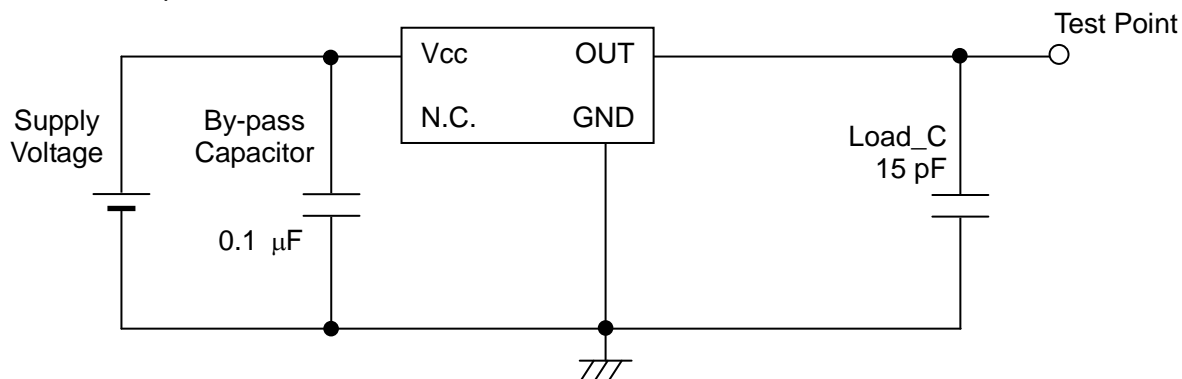
4-2) Output waveform (Clipped sine wave output)



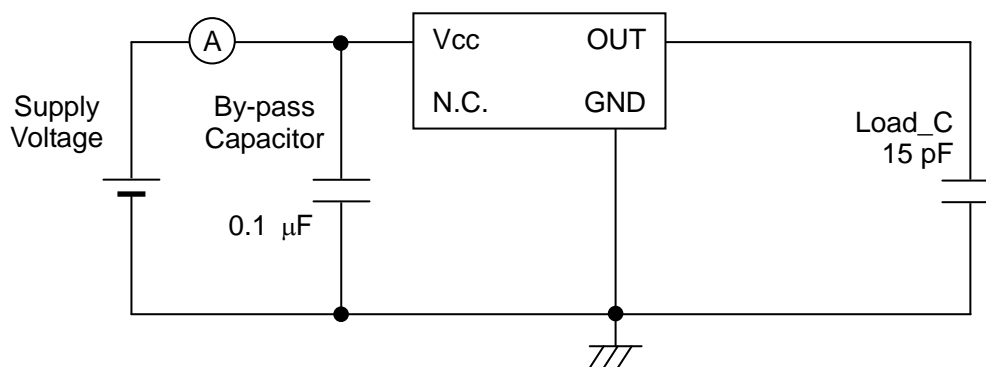
## 5. Test circuit

### 5-1) CMOS output for TCXO

1) Output Load : 15 pF



2) Current consumption



3) Conditions

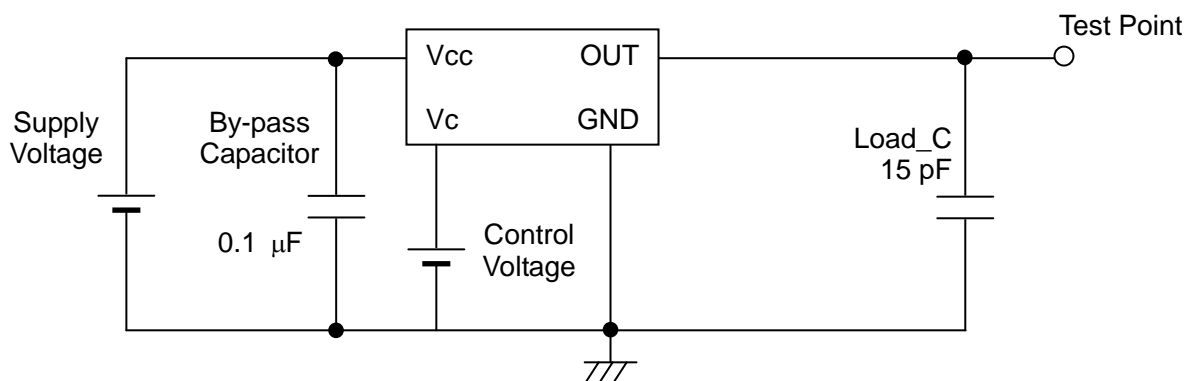
- |                            |              |
|----------------------------|--------------|
| 1. Oscilloscope: Impedance | Min. 1 MΩ    |
| Input capacitance          | Max. 10 pF   |
| Band width                 | Min. 300 MHz |

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.)

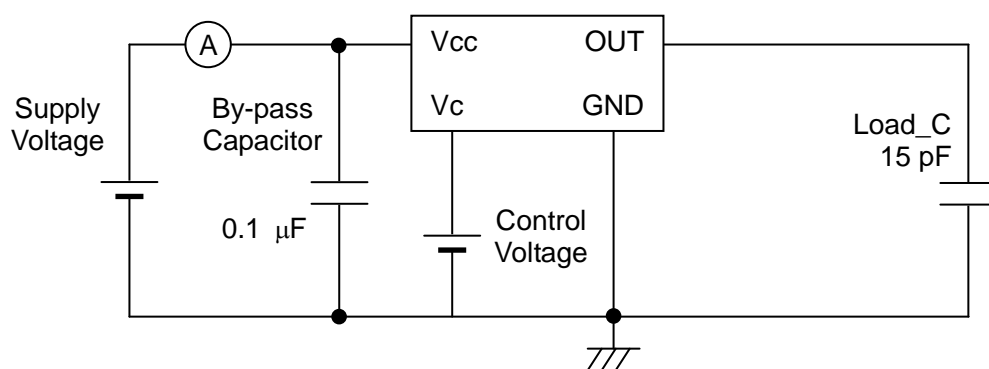
2. Load\_C includes probe capacitance.
3. A capacitor (By-pass: 0.1 μF) is placed between V<sub>CC</sub> and GND, and closely to TCXO.
4. Use the current meter whose internal impedance value is small.
5. Power Supply  
Impedance of power supply should be as low as possible.
6. GND pin should be connected to low impedance GND.

## 5-2) CMOS output for VC-TCXO

1) Output Load : 15 pF



2) Current consumption



3) Conditions

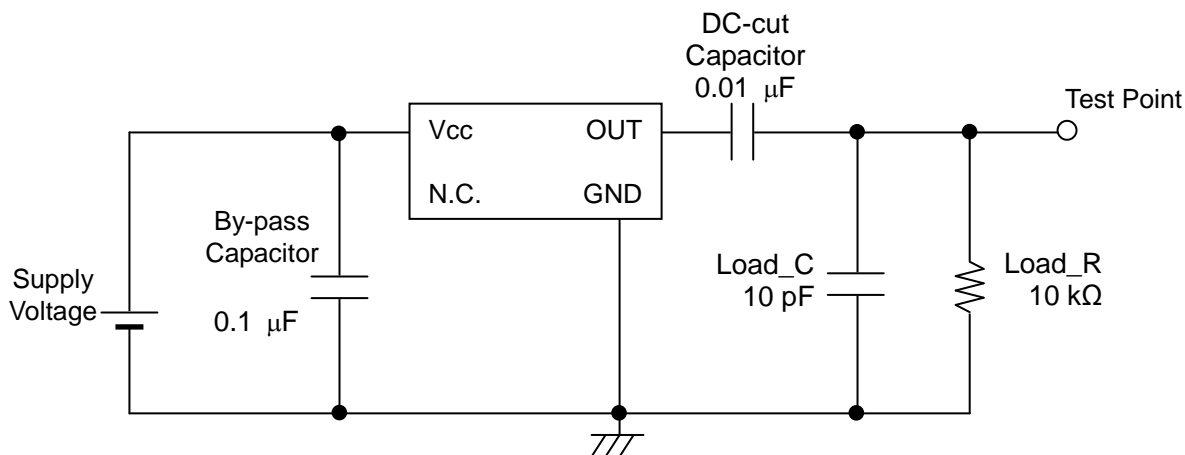
- |                            |              |
|----------------------------|--------------|
| 1. Oscilloscope: Impedance | Min. 1 MΩ    |
| Input capacitance          | Max. 10 pF   |
| Band width                 | Min. 300 MHz |

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.)

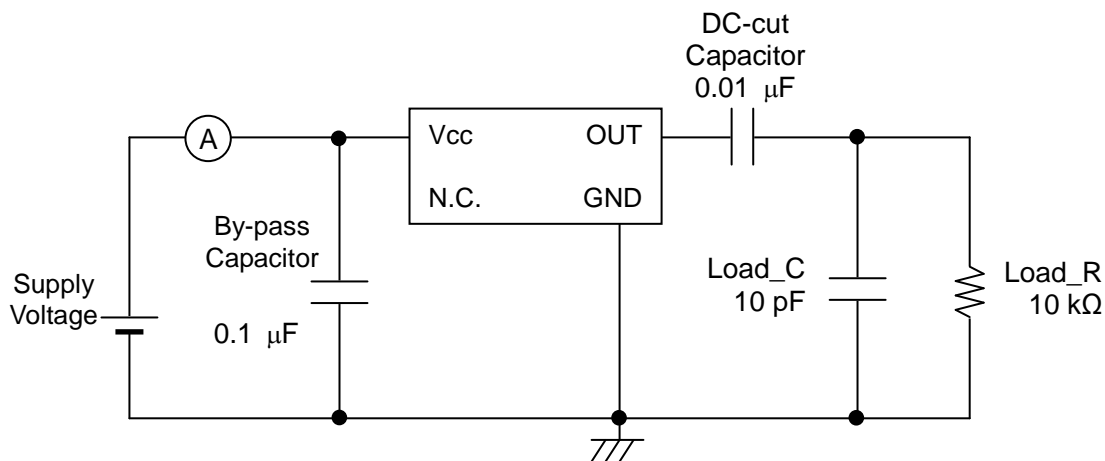
2. Load\_C includes probe capacitance.
3. A capacitor (By-pass: 0.1 μF) is placed between V<sub>CC</sub> and GND, and closely to TCXO.
4. Use the current meter whose internal impedance value is small.
5. Power Supply  
Impedance of power supply should be as low as possible.
6. GND pin should be connected to low impedance GND.

### 5-3) Clipped sine wave output for TCXO

1) Output Load : 10 kΩ // 10 pF



2) Current consumption



3) Conditions

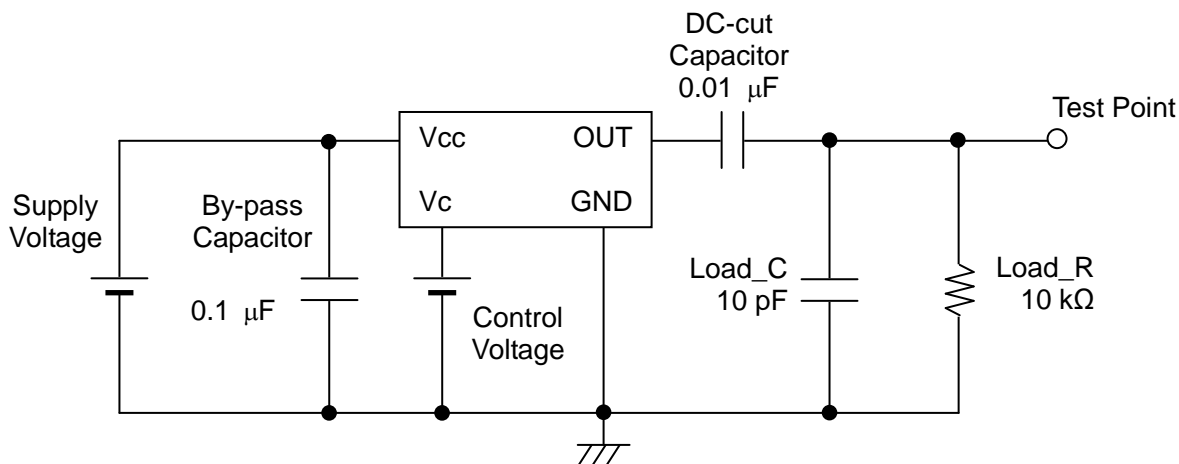
- |                            |              |
|----------------------------|--------------|
| 1. Oscilloscope: Impedance | Min. 1 MΩ    |
| Input capacitance          | Max. 10 pF   |
| Band width                 | Min. 300 MHz |

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.)

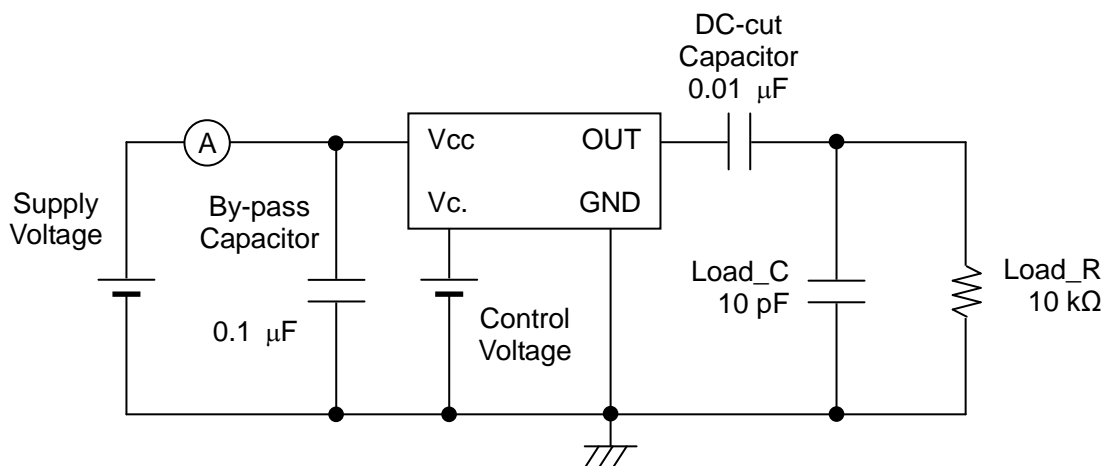
2. Load\_C includes probe capacitance.
3. A capacitor (By-pass: 0.1 μF) is placed between V<sub>CC</sub> and GND, and closely to TCXO.
4. Use the current meter whose internal impedance value is small.
5. Power Supply  
Impedance of power supply should be as low as possible.
6. GND pin should be connected to low impedance GND.

## 5-4) Clipped sine wave output for VC-TCXO

1) Output Load : 10 kΩ // 10 pF



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<sub>CC</sub> 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.

## 7. Contact

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