# Ultra high stability temperature compensated crystal oscillator

## Product name : TG5032CDN / TG5032SDN

### Features

- Ultra high stability
- Low phase noise
- Frequency range : 10 MHz to 50 MHz
- Output : CMOS, Clipped sine wave
- Supply voltage : 2.7 to 5.5 V
- External dimensions : 5.0 × 3.2 × 1.45 mm
- Small size package (4pads)
- Pb free.
- Complies with EU RoHS directive.




TG5032CDN (CMOS output)

TG5032SDN (Clipped sine wave output)

### Applications

- Femtocell
- Small Cells
- 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 50 MHz, and it is suitable for the reference clock include Femtocell and Small Cells.

►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 ). |

### [Notice]

This material is subject to change without notice.
Any part of this material may not be reproduced or duplicated in any form or any means without the written permission of Seiko Epson.
The information about applied data, circuitry, software, usage, etc. written in this material is intended for reference only. Seiko Epson does not assume any liability for the occurrence of customer damage or infringing on any patent or copyright of a third party. This material does not authorize the licensing for any patent or intellectual copyrights.
When exporting the products or technology described in this material, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations.
You are requested not to use the products (and any technical information furnished, if any) for the development and/or manufacture of weapon of mass destruction or for other military purposes. You are also requested that you would not make the products available to any third party who may use the products for such prohibited purposes.
These products are intended for general use in electronic equipment. When using them in specific applications that require extremely high reliability, such as the applications stated below, you must obtain permission from Seiko Epson in advance.
/ Space equipment (artificial satellites, rockets, etc.) / 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.



Seiko Epson Corporation
Document No.: TG5032xDN_AE_Ver. 1.03
Date: Jan. 25th 2018

# 1. Electrical characteristics

## 1) Absolute maximum ratings

| Parameter | Symbol | Unit | Min. | Typ. | Max | Notes |
|---|---|---|---|---|---|---|
| Supply voltage | $V_{CC}$-GND | V | -0.6 | - | +6.0 | |
| Storage temperature | T_stg | °C | -40 | - | +90 | Store as bare product after packing |
| Frequency control voltage | $V_C$-GND | V | -0.6 | - | $V_{CC}$+0.6 | $V_C$ Terminal |

## 2) Operating conditions

| Parameter | Symbol | Unit | Min. | Typ. | Max | Notes |
|---|---|---|---|---|---|---|
| Supply voltage | $V_{CC}$ | V | 2.7 | 2.85 | 3.0 | $V_{CC}$=2.85 V Type |
| | | | 2.85 | 3.0 | 3.15 | $V_{CC}$=3.0 V Type |
| | | | 3.135 | 3.3 | 3.465 | $V_{CC}$=3.3 V Type |
| | | | 4.75 | 5.0 | 5.25 | $V_{CC}$=5.0 V Type |
| | GND | | 0.0 | - | 0.0 | |
| Operating temperature range | T_use | °C | 0 | +25 | +70 | Standard |
| | | | -40 | +25 | +85 | (**Option**) |
| Frequency control voltage | $V_C$ | V | GND | N.C. | - | $V_C$ Terminal / TCXO |
| | | | 0.5 | 1.5 | 2.5 | $V_C$ Terminal / VC-TCXO ($V_{CC}$=2.85, 3.0, 3.3 V Type) |
| | | | 0.65 | 1.65 | 2.65 | |
| | | | 0.5 | 2.5 | 4.5 | $V_C$ Terminal / VC-TCXO ($V_{CC}$=5.0 V Type) |
| Output load condition | Load_C | pF | 13.5 | 15 | 16.5 | CMOS output |
| | Load_C | pF | 9 | 10 | 11 | Clipped sine wave |
| | Load_R | kΩ | 9 | 10 | 11 | |
| | Cc | 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

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

| Parameter | Symbol | Unit | Min. | Typ. | Max | Notes |
|---|---|---|---|---|---|---|
| Output frequency | fo | MHz | 10 | - | 50 | |
| Frequency tolerance *2<br>(T_use=+25°C +/-2°C)<br>(Reflow cycles : 2 times) | f_tol | $\times 10^{-6}$ | -2.0 | - | +2.0 | Standard |
| | | | -1.0 | - | +1.0 | (**Option**) |
| Frequency / temperature characteristics<br>(Reference to (fmax+fmin)/2.) | fo-Tc | $\times 10^{-6}$ | -0.10 | - | +0.10 | T_use=0°C to +70°C (Standard) |
| | | | -0.25 | - | +0.25 | T_use=-40°C to +85°C (**Option**) |
| Frequency / load coefficient | fo-Load | $\times 10^{-6}$ | -0.1 | - | +0.1 | Load +/-10% (~40MHz) |
| | | | -0.2 | - | +0.2 | Load +/-10% (~50MHz) |
| | | | -0.05 | - | +0.05 | Load +/-10% (Clipped sine wave) |
| | | | -0.05 | - | +0.05 | Load +/-2% (~40MHz) |
| | | | -0.1 | - | +0.1 | Load +/-2% (~50MHz) |
| | | | -0.02 | - | +0.02 | Load +/-2% (Clipped sine wave) |
| Frequency / voltage coefficient | fo- $V_{CC}$ | $\times 10^{-6}$ | -0.1 | - | +0.1 | $V_{CC}$ +/-5% (~40MHz) |
| | | | -0.2 | - | +0.2 | $V_{CC}$ +/-5% (~50MHz) |
| | | | -0.05 | - | +0.05 | $V_{CC}$ +/-5% (Clipped sine wave) |
| | | | -0.05 | - | +0.05 | $V_{CC}$ +/-2% (~40MHz) |
| | | | -0.1 | - | +0.1 | $V_{CC}$ +/-2% (~50MHz) |
| | | | -0.02 | - | +0.02 | $V_{CC}$ +/-2% (Clipped sine wave) |
| Frequency slope | - | $\times 10^{-6}$ /°C | -0.1 | - | +0.1 | Minimum of 1 frequency reading every 2°C, over the operating temperature range (1°C/minute max.) |
| Hysteresis | - | $\times 10^{-6}$ | -0.2 | - | +0.2 | Frequency measured before and after at +25°C. |
| Frequency aging *3 | f_age | $\times 10^{-6}$ | -0.02 | - | +0.02 | T_use=+25°C, 24 hours |
| | | | -1.0 | - | +1.0 | T_use=+25°C, First year |
| | | | -0.2 | - | +0.2 | T_use=+25°C, 1 month(**Option**) |
| | | | -2.0 | - | +2.0 | T_use=+25°C, 3 years(**Option**) |
| Acceleration sensitivity | - | $\times 10^{-9}$ /G | - | 2.0 | - | 3 axes, 30-1500 Hz |

*2 Measured in the elapse of 24 hours after reflow soldering. *3 After 48 hours of continuous operation.

## 3-2) Frequency control characteristics

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

| Parameter | Symbol | Unit | Min. | Typ. | Max | Notes |
|---|---|---|---|---|---|---|
| Frequency control range | f_cont | × $10^{-6}$ | -10.0 | - | -5.0 | Vc=1.5V+/-1.0V, at Vcc=2.85 to 3.3V |
| | | | +5.0 | - | +10.0 | Vc=2.5V+/-2.0V, at Vcc=5.0V |
| Linearity | - | % | -10 | - | +10 | |
| Input impedance | $Z_{IN}$ | kΩ | 100 | - | - | $V_C$-GND(DC), $V_C$=Typ. |
| Frequency change polarity | - | - | Positive polarity | | | |

## 4) Electrical Characteristics

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

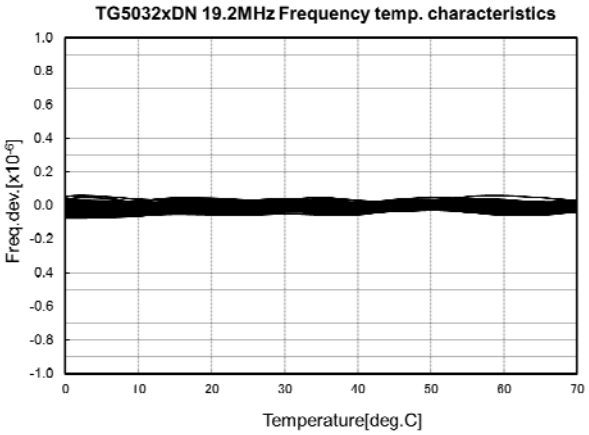
| Parameter | Symbol | Unit | Min. | Typ. | Max | Notes |
|---|---|---|---|---|---|---|
| Current consumption | $I_{CC}$ | mA | - | - | 5.0 | Clipped sine wave (Standard) |
| | | | - | - | 4.0 | Clipped sine wave (**Option**) |
| | | | - | - | 5.0 | $V_{CC}$=2.85, 3.0, 3.3V (~26MHz) |
| | | | - | - | 6.0 | $V_{CC}$=2.85, 3.0, 3.3V (~40MHz) |
| | | | - | - | 8.0 | $V_{CC}$=2.85, 3.0, 3.3V (~50MHz) |
| | | | - | - | 6.0 | $V_{CC}$=5.0V (~26MHz) |
| | | | - | - | 8.0 | $V_{CC}$=5.0V (~40MHz) |
| | | | - | - | 10.0 | $V_{CC}$=5.0V (~50MHz) |
| Start up time | t_str | ms | - | 1.0 | 5.0 | t=0 at 90%Vcc |
| Rise time | tr | ns | - | - | 8.0 | 10%Vcc to 90%Vcc level |
| | | | - | - | 5.0 | CMOS output |
| Fall time | tf | ns | - | - | 8.0 | 90%Vcc to 10%Vcc level |
| | | | - | - | 5.0 | CMOS output |
| Symmetry | SYM | % | 45 | 50 | 55 | 50% Vcc level<br>CMOS output |
| | | | 40 | 50 | 60 | GND level(DC-cut)<br>Clipped sine wave (**Option**) |
| High output voltage | $V_{OH}$ | V | 90% $V_{CC}$ | - | - | CMOS output |
| Low output voltage | $V_{OL}$ | V | - | - | 10% Vcc | CMOS output |
| Output level | Vp-p | Vp-p | 0.8 | - | - | Clipped sine wave |
| Phase noise (19.2MHz) | L(f) | dBc/Hz | - | -68 | -54 | 1 Hz offset |
| | | | - | -96 | -84 | 10 Hz offset |
| | | | - | -119 | -109 | 100 Hz offset |
| | | | - | -140 | -132 | 1 kHz offset |
| | | | - | -152 | -146 | 10 kHz offset |
| | | | - | -154 | -148 | 100 kHz offset |
| | | | - | -156 | -150 | 1 MHz offset |
| Phase noise (30.72MHz) | L(f) | dBc/Hz | - | -64 | -50 | 1 Hz offset |
| | | | - | -91 | -79 | 10 Hz offset |
| | | | - | -115 | -105 | 100 Hz offset |
| | | | - | -135 | -127 | 1 kHz offset |
| | | | - | -152 | -146 | 10 kHz offset |
| | | | - | -156 | -150 | 100 kHz offset |
| | | | - | -157 | -151 | 1 MHz offset |
| Phase noise (50MHz) | L(f) | dBc/Hz | - | -56 | -42 | 1 Hz offset |
| | | | - | -84 | -72 | 10 Hz offset |
| | | | - | -109 | -99 | 100 Hz offset |
| | | | - | -131 | -123 | 1 kHz offset |
| | | | - | -149 | -143 | 10 kHz offset |
| | | | - | -156 | -150 | 100 kHz offset |
| | | | - | -157 | -151 | 1 MHz offset |

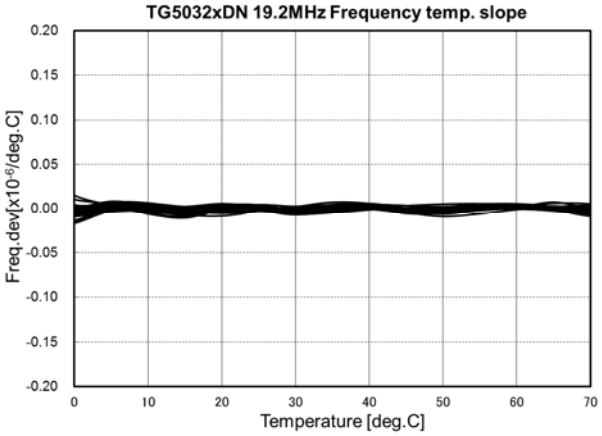
## 2. Characteristics

### 2-1) “Frequency / temperature characteristics”

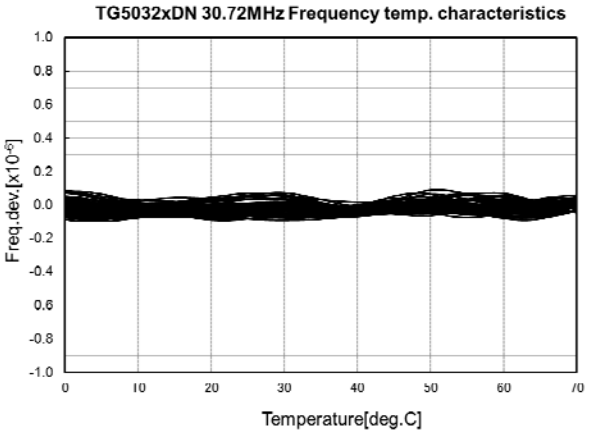
2-1-1) Standard spec : +/-0.1 × $10^{-6}$ Max. (T_use=0°C to +70°C)

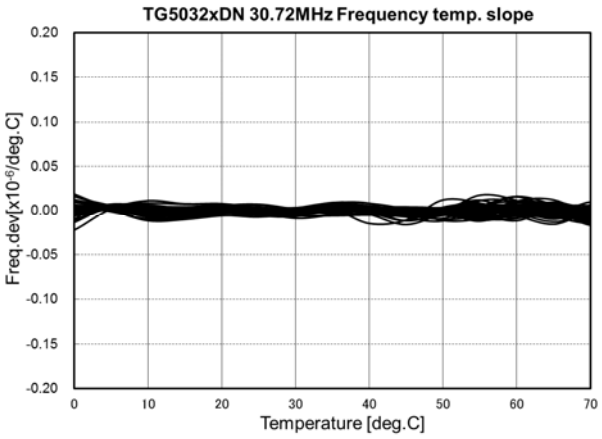
19.2MHz [N=40pcs]



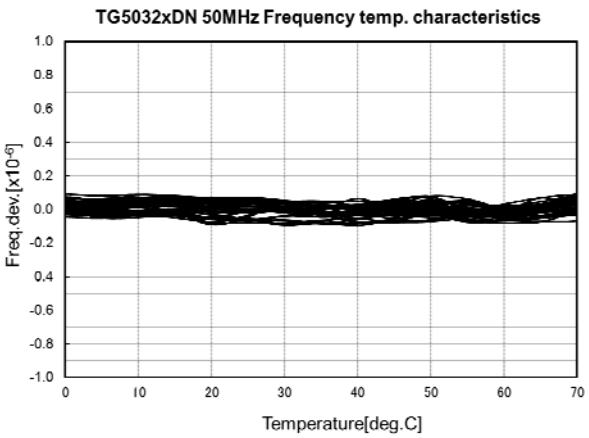



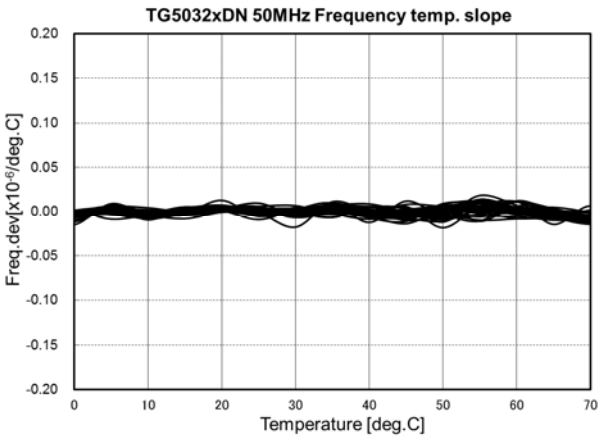

30.72MHz [N=40pcs]



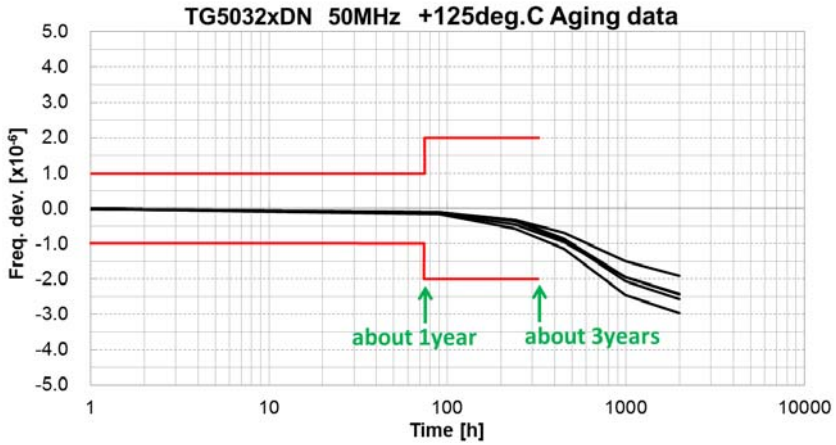




50MHz [N=40pcs]



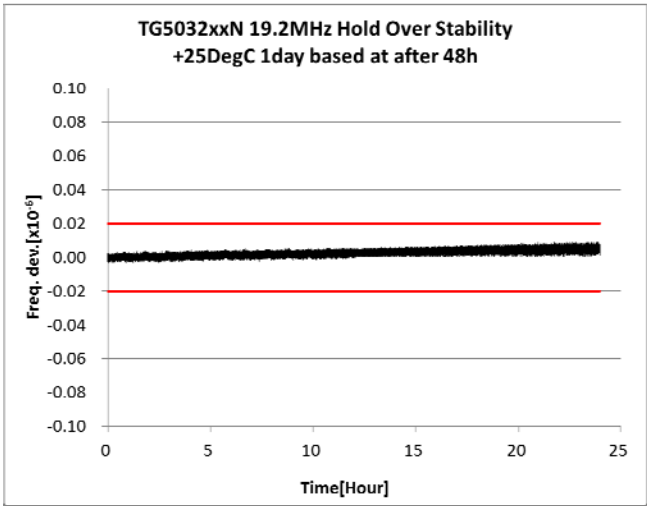
## 2-2) Frequency aging (50MHz) [N=5pcs]



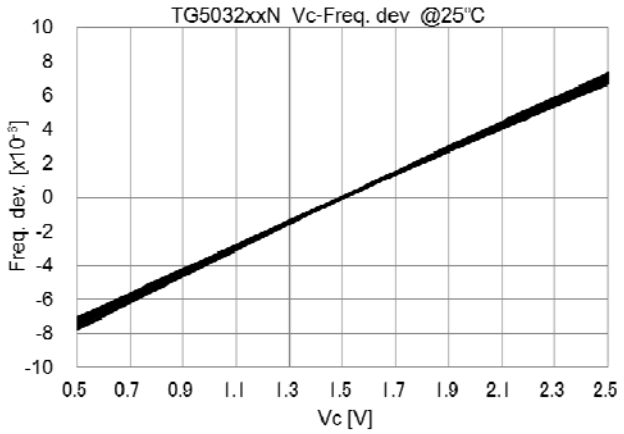

about 1year
Ave. : -0.12 x $10^{-6}$
Max. : -0.10 x $10^{-6}$
Min. : -0.16 x $10^{-6}$

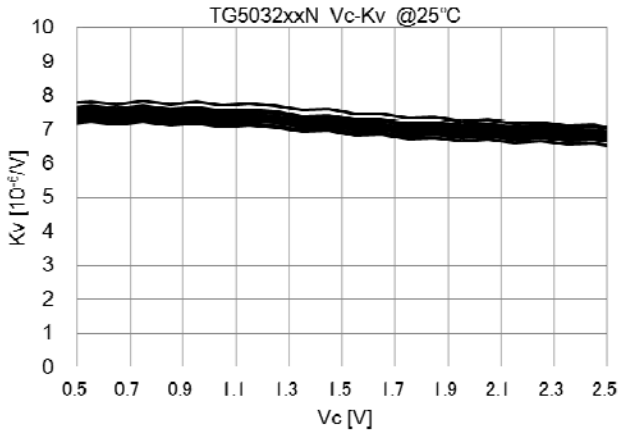
about 3years
Ave. : -0.41 x $10^{-6}$
Max. : -0.32 x $10^{-6}$
Min. : -0.57 x $10^{-6}$

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

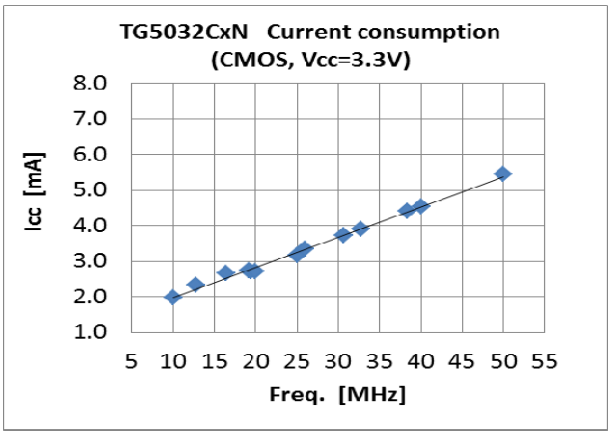


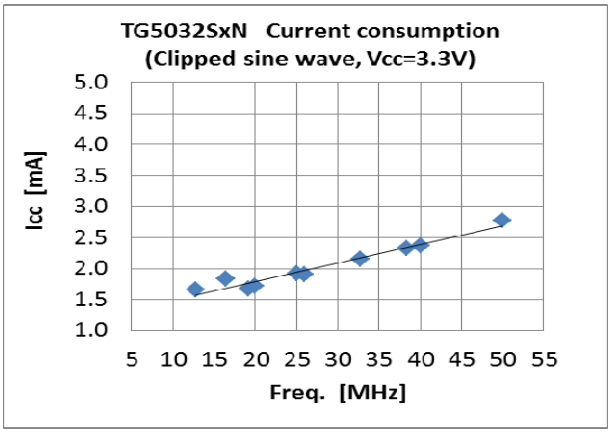

## 2-4) Frequency control characteristics [N=40pcs]



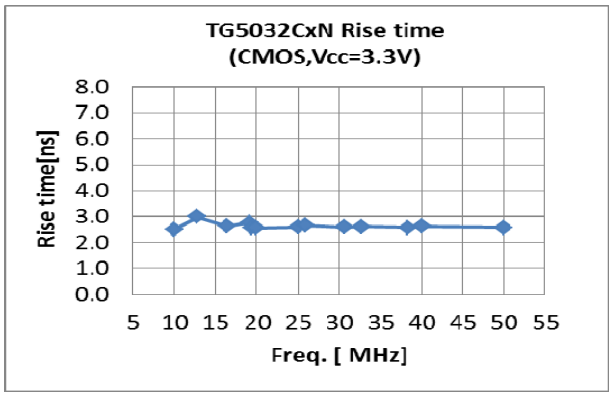



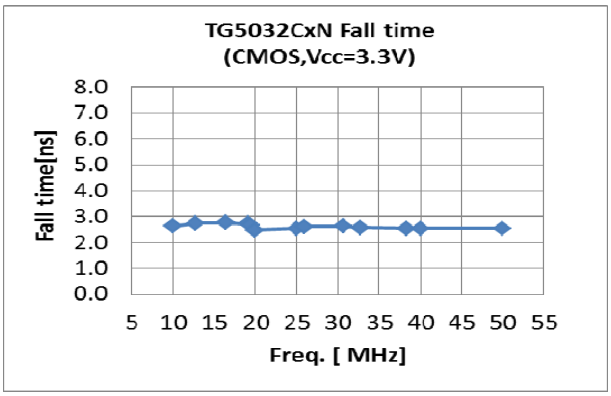
## 2-5) current consumption



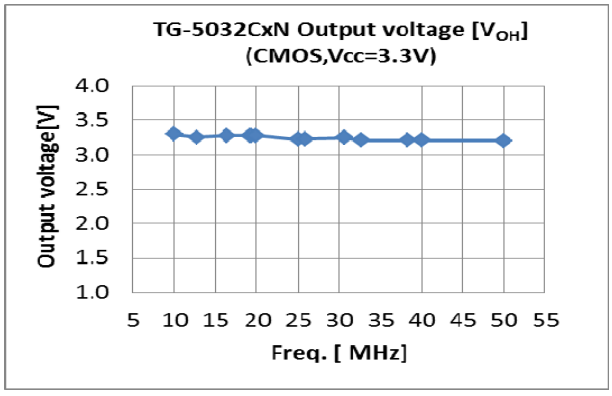



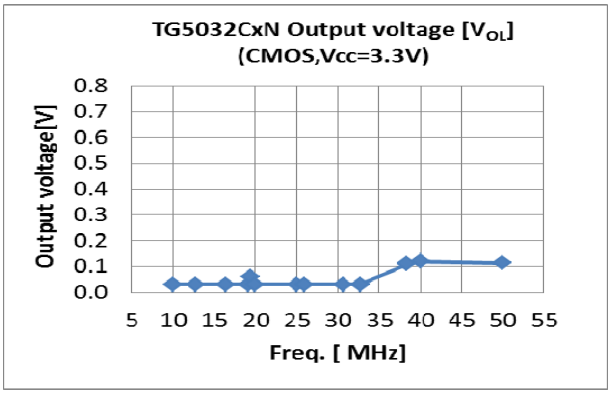

## 2-6) Rise time / Fall time (at CMOS output)



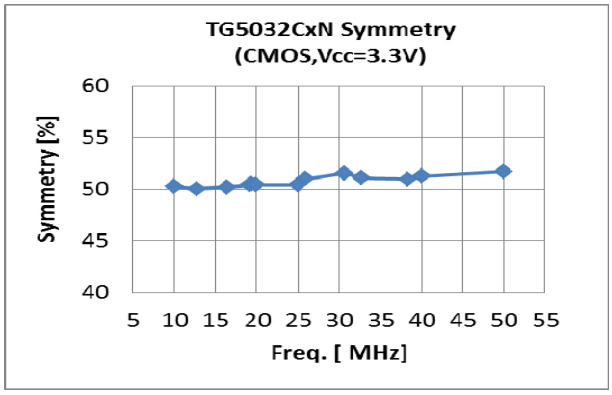




## 2-7) Output voltage [$V_{OH}$, $V_{OL}$] (at CMOS output)

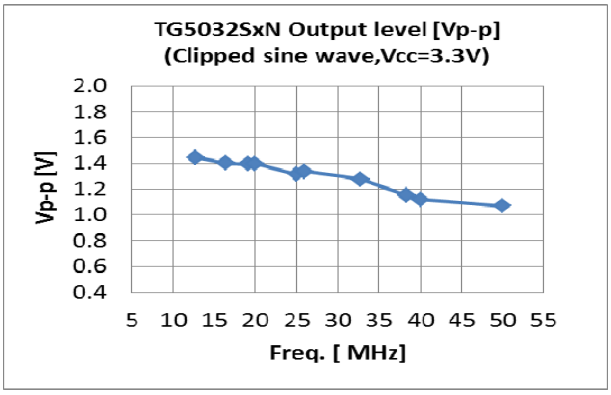



## 2-8) Symmetry (at CMOS output)

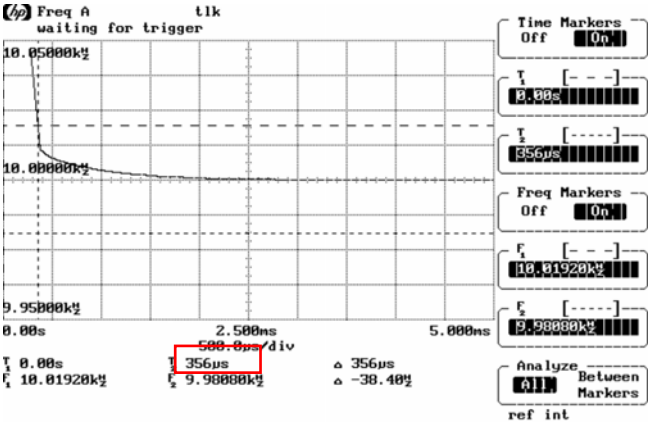



## 2-9) Output level [$V_{P-P}$] (at Clipped sine wave)

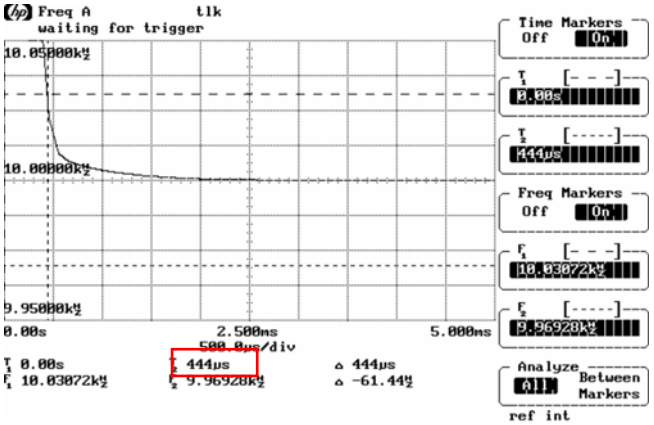


## 2-10) start up time(19.2MHz, 30.72MHz, 50MHz)

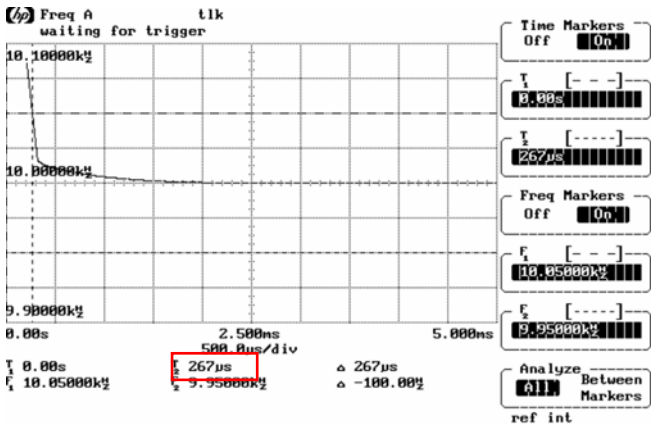
19.2MHz



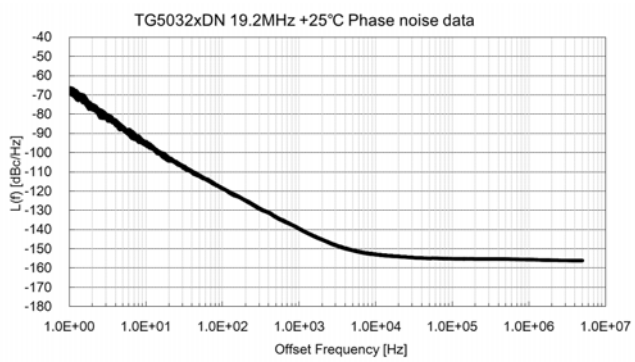

30.72MHz

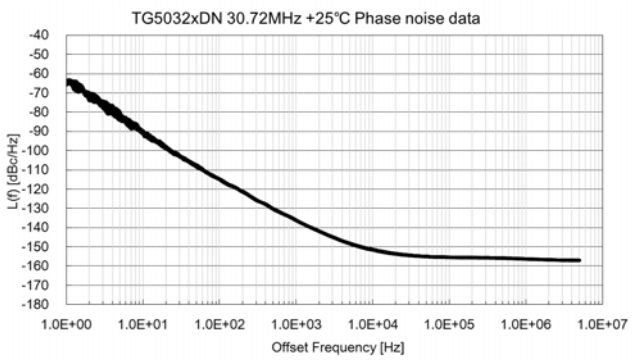


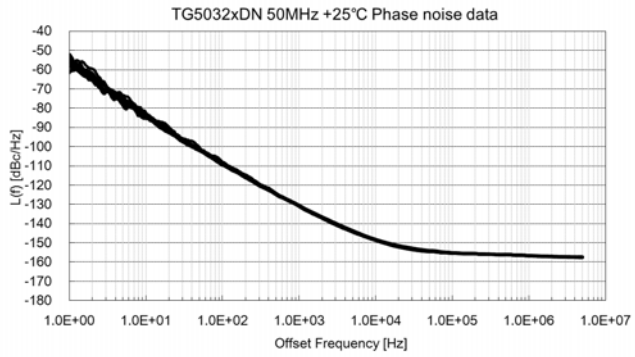

50MHz



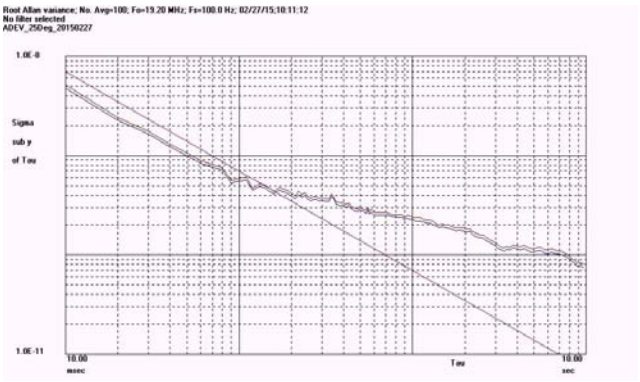
## 2-11) Phase noise (19.2MHz, 30.72MHz, 50MHz, refer to data of Page3.) [N=10pcs]



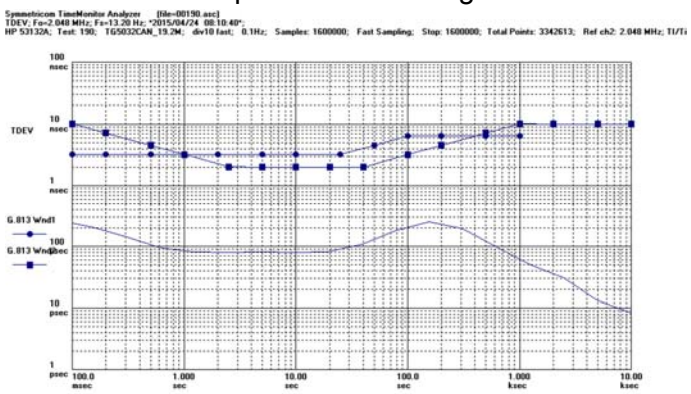




## 2-12) Short term stability [ADEV] (19.2MHz)

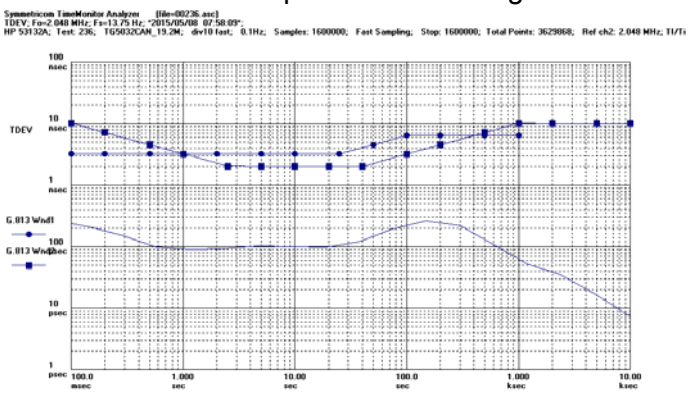


## 2-13) TDEV (19.2MHz, Loop BW=0.1Hz)

Constant temperature : +25 deg.C

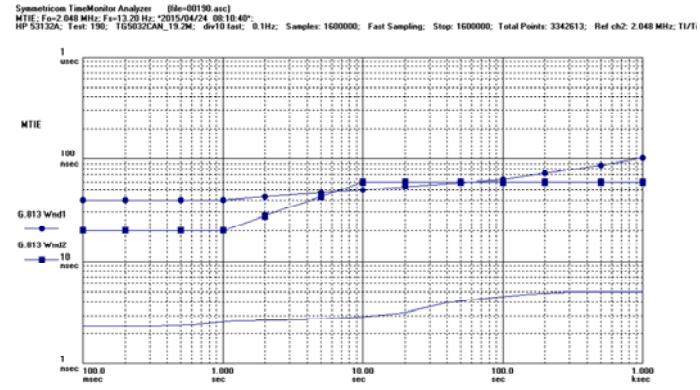


Constant temperature : +70 deg.C

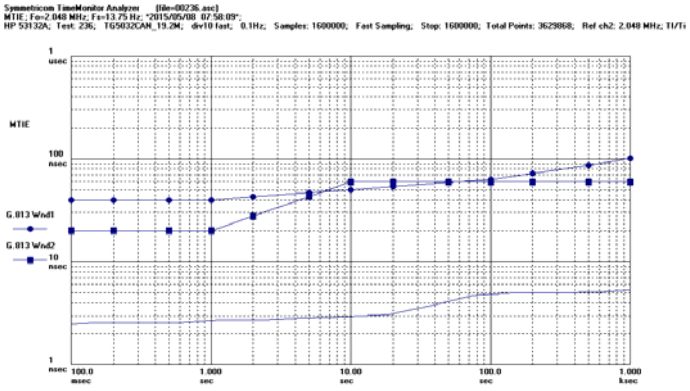


## 2-14) MTIE (19.2MHz, Loop BW=0.1Hz)

Constant temperature : +25 deg.C



Constant temperature : +70 deg.C

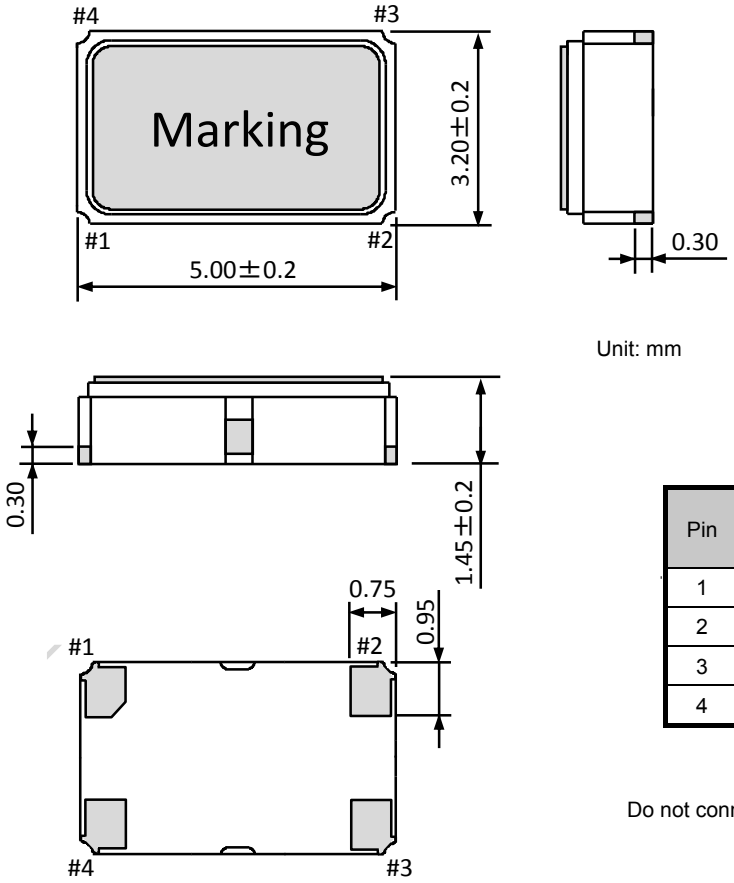


Compliant with G.813 option1 and 2

# 3. Outline

## 3-1) Outline dimensions and Pin information

### TG5032CDN/SDN




Unit: mm

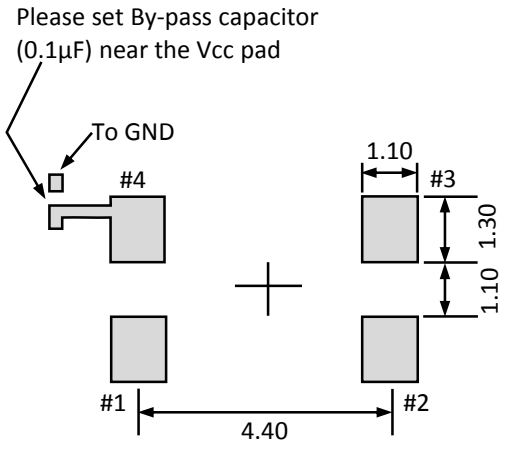
| Pin | Connections | |
|---|---|---|
| | VC-TCXO | TCXO |
| 1 | $V_C$ | N.C. |
| 2 | GND | |
| 3 | OUT | |
| 4 | $V_{CC}$ | |

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.

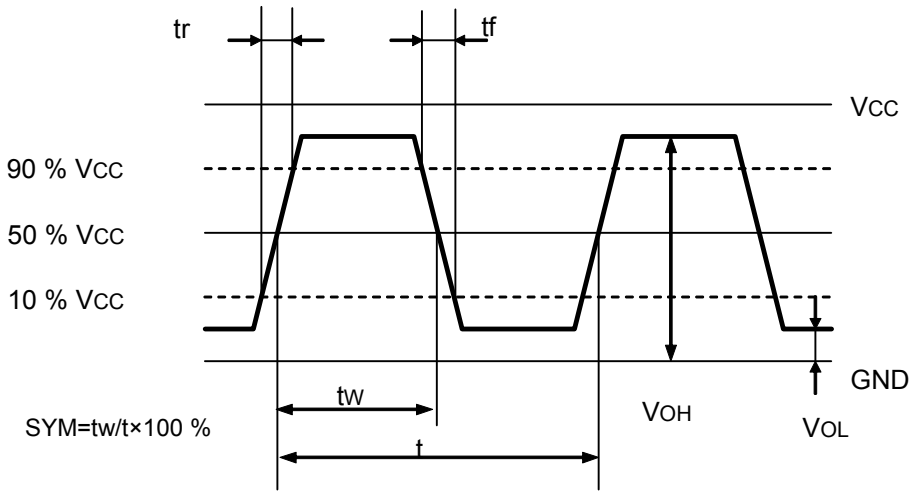
Soldering pattern of TG5032CDN/SDN unit : mm



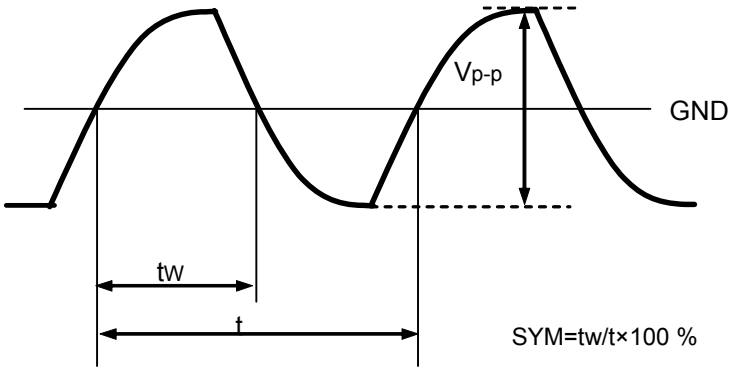

To maintain stable operation, provide a 0.1uF by-pass capacitor at a location as near as possible to the power source terminal of the crystal product (between Vcc - GND).

## 4. Timing chart

4-1) Output waveform (CMOS output)



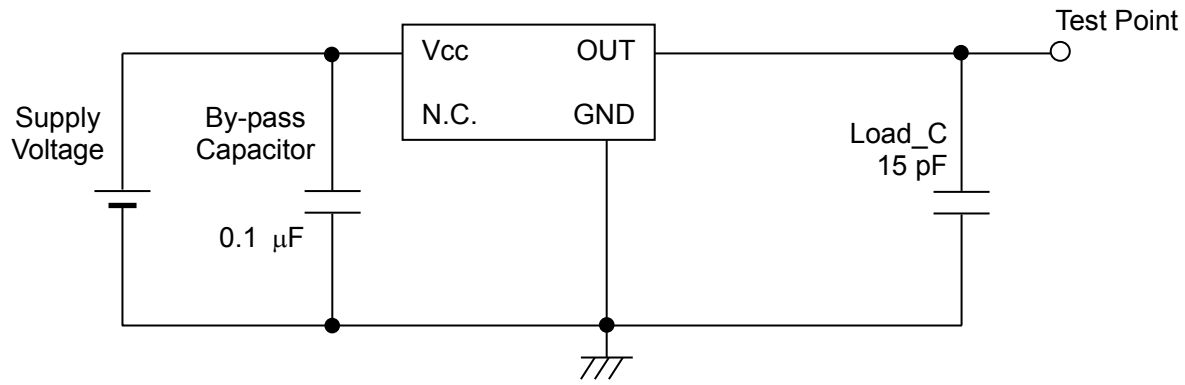

4-2) Output waveform (Clipped sine wave output)



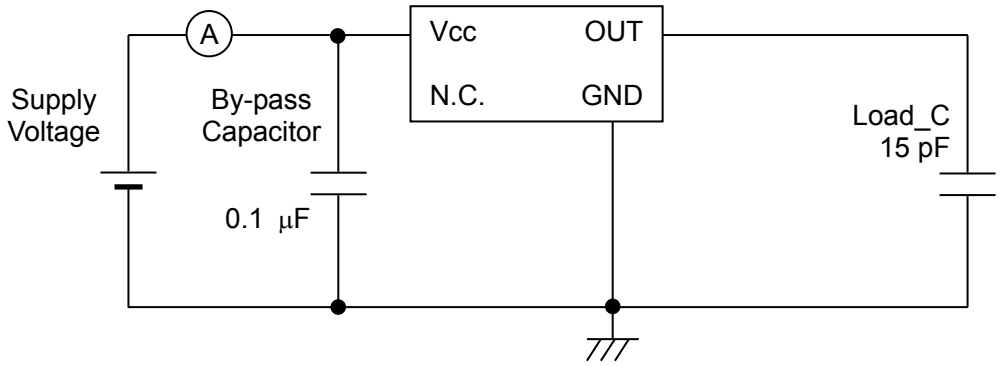
## 5. Test circuit

### 5-1) CMOS output for TCXO

1) Output Load : 15 pF




2) Current consumption

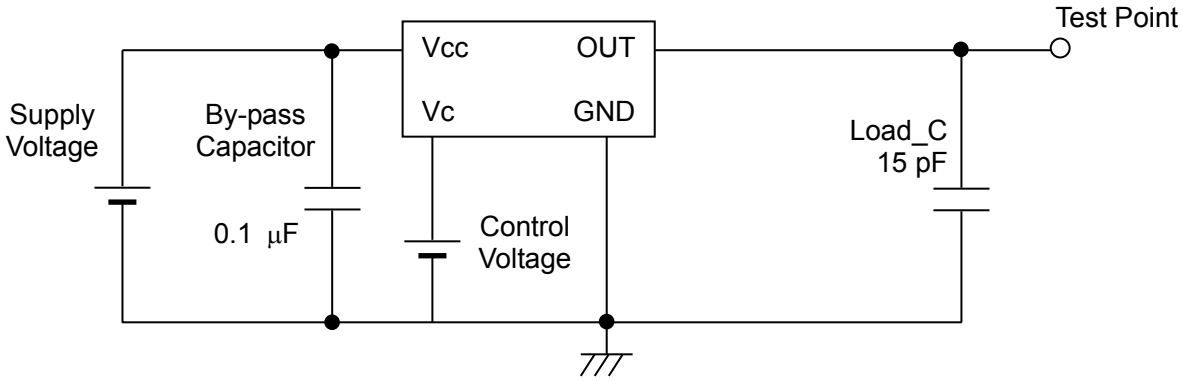



3) Conditions

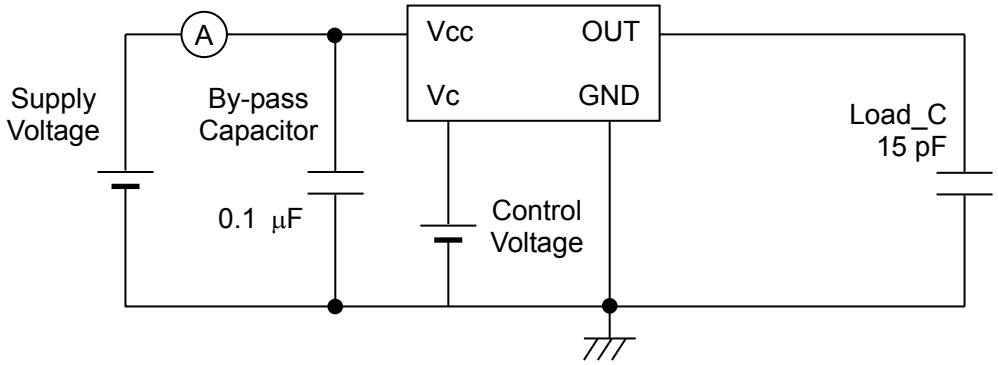
1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz
   Impossible to measure both frequency and wave form at the same time.(In case of using oscilloscope's amplifier output, possible to measure both at the same time.)
2. Load_C includes probe capacitance.
3. A capacitor (By-pass: 0.1 µF) is placed between $V_{CC}$ 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.

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

1) Output Load : 15 pF




2) Current consumption

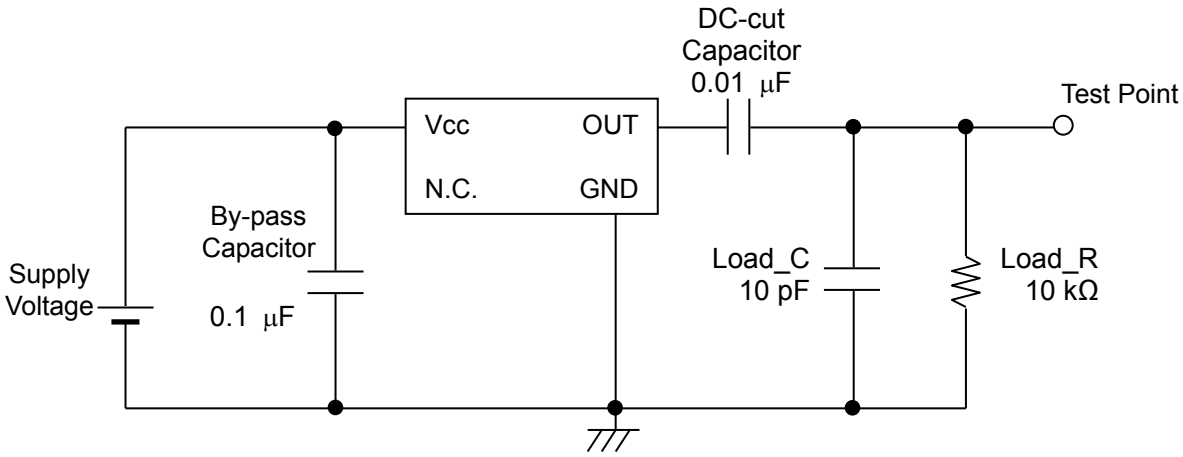



3) Conditions

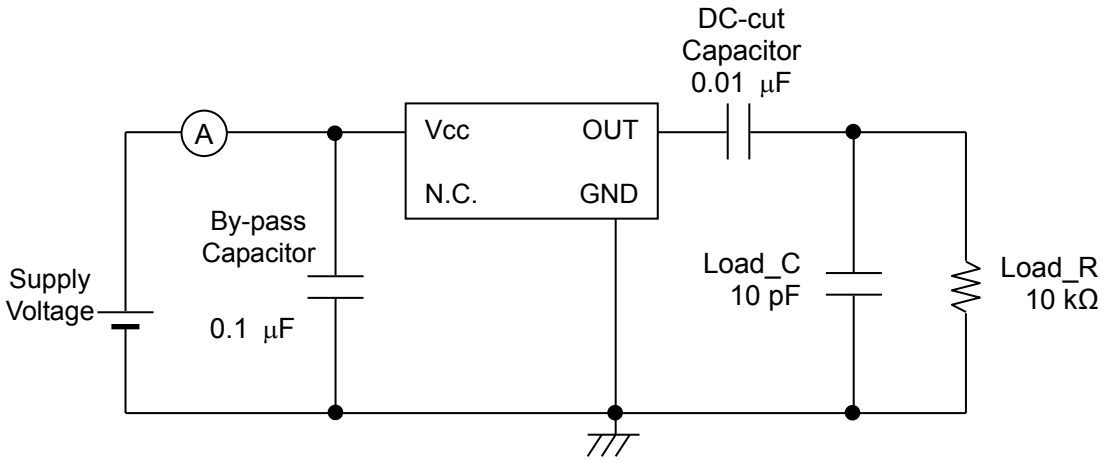
1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz
   Impossible to measure both frequency and wave form at the same time.(In case of using oscilloscope's amplifier output, possible to measure both at the same time.)
2. Load_C includes probe capacitance.
3. 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 kΩ // 10 pF




2) Current consumption

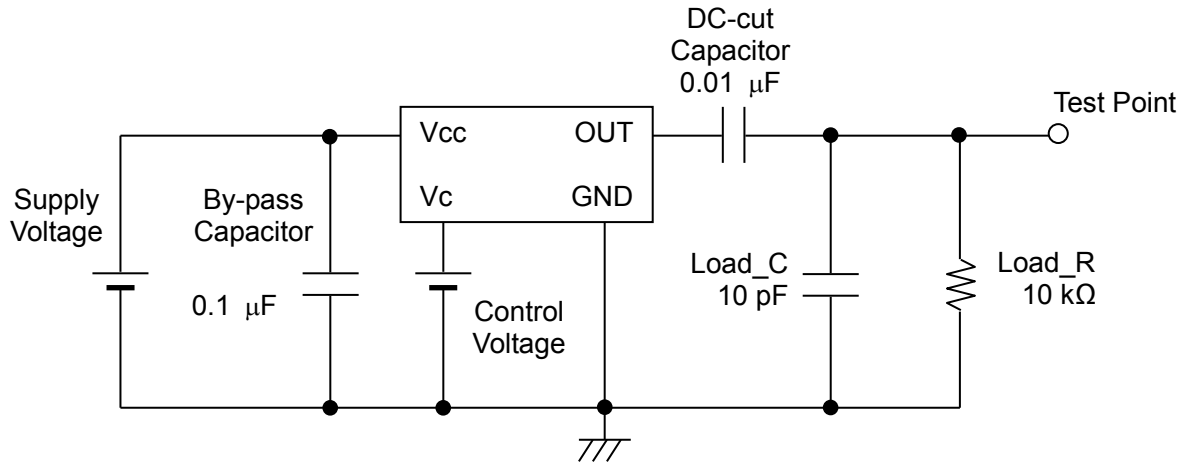



3) Conditions

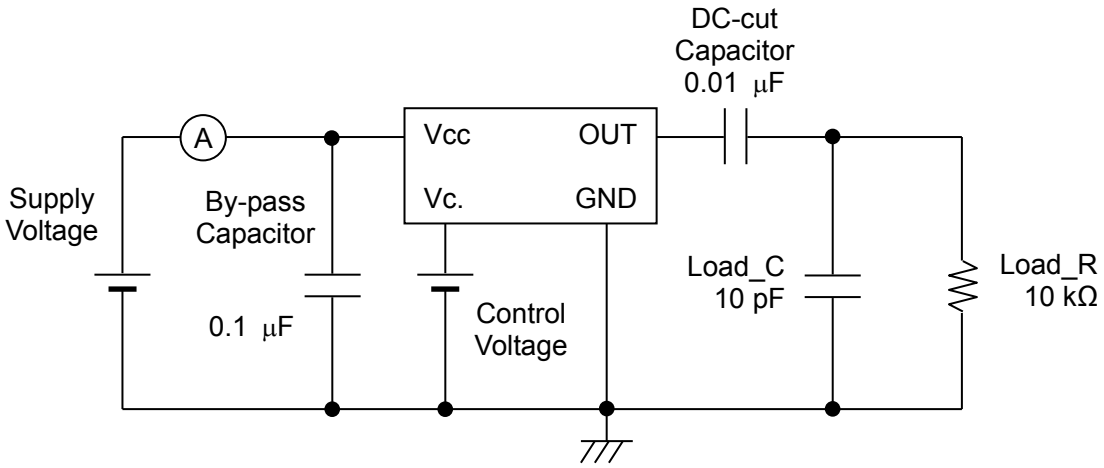
1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz
   Impossible to measure both frequency and wave form at the same time.(In case of using oscilloscope's amplifier output, possible to measure both at the same time.)
2. Load_C includes probe capacitance.
3. A capacitor (By-pass: 0.1 µF) is placed between $V_{CC}$ 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




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.

## 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

**America**

Epson Electronics America, Inc.
214 Devcon Drive, San Jose, CA 95112, U.S.A.
Phone: +1-800-228-3964 FAX: +1-408-922-0238

**Europe**

Epson Europe Electronics GmbH
Riesstrasse 15, 80992 Munich, Germany
Phone: +49-89-14005-0 FAX: +49-89-14005-110

**Asia**

Epson (China) Co., Ltd.
7F, Jinbao Bldg., No.89 Jinbao Street Dongcheng District, Beijing, China, 100005
Phone: +86-10-8522-1199 FAX: +86-10-8522-1120

Shanghai Branch
High-Tech Building, 900 Yishan Road, Shanghai 200233, China
Phone: +86-21-5423-5577 FAX: +86-21-5423-4677

Shenzhen Branch
12/F, Dawning Mansion, #12 Keji South Road, Hi-Tech Park, Shenzhen, China
Phone: +86-755-2699-3828 FAX: +86-755-2699-3838

Epson Hong Kong Ltd.
Unit 715-723 7/F, Trade Square, 681 Cheung Sha Wan Road, Kowloon, Hong Kong
Phone: (86) 755-26993828 (Shenzhen Branch)
FAX: (86) 755-26993838 (Shenzhen Branch)

Epson Taiwan Technology & Trading Ltd.
14F, No. 7, Song Ren Road, Taipei 110, Taiwan
Phone: +886-2-8786-6688 FAX: +886-2-8786-6660

Epson Singapore Pte., Ltd.
No 1 HarbourFront Place, #03-02 HarbourFront Tower One, Singapore 098633
Phone: +65-6586-5500 FAX: +65-6271-3182

Seiko Epson Corp. Korea Office
19F, (63 Bldg., Yoido-dong) 50, 63-ro, Yeongdeungpo-gu, Seoul 150-763, Korea
Phone: +82-2-784-6027 FAX: +82-2-767-3677