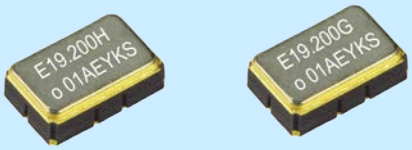
Ultra high stability temperature compensated crystal oscillator

Product name : TG5032CGN / TG5032SGN

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 (10pads)
- Pb free.
- Complies with EU RoHS directive.



TG5032CGN (CMOS output)

TG5032SGN (Clipped sine wave output)

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	►Pb free.
RoHS Compliant	►Complies with EU RoHS directive. *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.)
For Automotive	►Designed for automotive applications such as Car Multimedia, Body Electronics, Remote Keyless Entry etc.
Automotive Safety	►Designed for automotive applications related to driving safety (Engine Control Unit, Air Bag, ESC etc).

[Notice]

Seiko Epson Corporation
Document No.: TG5032xGN_AE_Ver. 1.00
Date: Mar. 1st 2017

1. Electrical characteristics

1) Absolute maximum ratings

Parameter	Symbol	Unit	Min.	Typ.	Max	Notes
Supply voltage	V_{CC}-GND	V	-0.5	-	+4.0	
Storage temperature	T_stg	°C	-40	-	+90	Store as bare product after packing
Frequency control voltage	V_C-GND	V	-0.5	-	V_{CC}+0.5	V_C Terminal

2) Operating conditions

Parameter	Symbol	Unit	Min.	Typ.	Max	Notes
Supply voltage	V_{CC}	V	2.375	-	3.63	Supply voltage range
			2.375	2.5	2.625	V_{CC}=2.5 V Type
			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
	GND		0.0	-	0.0	
Operating temperature range	T_use	°C	-40	+25	+85	
Frequency control voltage	V_C	V	GND	N.C.	-	V_C Terminal / TCXO
			0.5	1.5	2.5	V_C Terminal / VC-TCXO
			0.65	1.65	2.65	
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 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	-	40	
Frequency tolerance *2 (T_use=+25°C +/-2°C) (Reflow cycles : 2 times)	f_tol	$\times 10^{-6}$	-1.0	-	+1.0	
Frequency / temperature characteristics (Reference to (fmax+fmin)/2.)	fo-Tc	$\times 10^{-6}$	-0.10	-	+0.10	T_use=-40°C to +85°C (Standard)
			-0.14	-	+0.14	T_use=-40°C to +85°C
			-0.25	-	+0.25	T_use=-40°C to +85°C
			-0.28	-	+0.28	T_use=-40°C to +85°C
Frequency / load coefficient	fo-Load	$\times 10^{-6}$	-0.10	-	+0.10	Load +/-10%
			-0.05	-	+0.05	Load +/-2%
Frequency / voltage coefficient	fo- V_{CC}	$\times 10^{-6}$	-0.10	-	+0.10	V_{CC} +/-5%
			-0.05	-	+0.05	V_{CC} +/-2%
Frequency slope	-	$\times 10^{-6}$ /°C	-0.10	-	+0.10	Minimum of 1 frequency reading every 2°C, over the operating temperature range (1°C/minute max.)
Hysteresis	-	$\times 10^{-6}$	-0.20	-	+0.20	Frequency measured before and after at +25°C.
Frequency aging	f_age	$\times 10^{-6}$	-0.5	-	+0.5	T_use=+25°C, First year
			-3.0	-	+3.0	T_use=+25°C, 20 years
Holdover stability (Constant temperature)	-	$\times 10^{-6}$	-0.01	-	+0.01	T_use=+25°C, 1 day *3
			-0.04	-	+0.04	T_use=+25°C, 1 day *4
Holdover stability (Free-run accuracy)	-	$\times 10^{-6}$	-4.6	-	+4.6	*5
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 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)

Parameter	Symbol	Unit	Min.	Typ.	Max	Notes
Frequency control range	f_cont	× 10^{-6}	-10.0	-	-5.0	Vc=1.5V+/-1.0V, Vc=1.65V+/-1.0V
			+5.0	-	+10.0	
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)
			-	-	3.0	Clipped sine wave (**Option**)
			-	-	5.0	CMOS output(~26MHz)
			-	-	6.0	CMOS output(~40MHz)
Start up time	t_str	s	-	0.001	0.005	Filter OFF (Standard)
			-	0.4	2.0	Filter ON (**Option**)
Rise time	tr	ns	-	-	8.0	10%Vcc to 90%Vcc level CMOS output
Fall time	tf	ns	-	-	8.0	90%Vcc to 10%Vcc level CMOS output
Symmetry	SYM	%	45	50	55	50%Vcc level CMOS output
			40	50	60	GND level(DC-cut) 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	-	-60	-46	1 Hz offset *6, *7
			-	-90	-78	10 Hz offset *6
			-	**-91**	**-79**	**10 Hz offset *7**
			-	-116	-106	100 Hz offset *6
			-	**-117**	**-107**	**100 Hz offset *7**
			-	-139	-131	1 kHz offset *6
			-	**-140**	**-132**	**1 kHz offset *7**
			-	-153	-147	10 kHz offset *6, *7
			-	-154	-148	100 kHz offset *6, *7
			-	-155	-149	1 MHz offset *6, *7
Phase noise (30.72MHz)	L(f)	dBc/ Hz	-	-59	-44	1 Hz offset *6, *7
			-	-89	-77	10 Hz offset *6
			-	**-90**	**-78**	**10 Hz offset *7**
			-	-116	-106	100 Hz offset *6
			-	**-118**	**-108**	**100 Hz offset *7**
			-	-137	-129	1 kHz offset *6
			-	**-139**	**-131**	**1 kHz offset *7**
			-	-152	-146	10 kHz offset *6, *7
			-	-154	-148	100 kHz offset *6, *7
			-	-156	-150	1 MHz offset *6, *7
Phase noise (40MHz)	L(f)	dBc/ Hz	-	-57	-43	1 Hz offset *6, *7
			-	-87	-75	10 Hz offset *6
			-	**-88**	**-76**	**10 Hz offset *7**
			-	-113	-103	100 Hz offset *6
			-	**-114**	**-104**	**100 Hz offset *7**
			-	-135	-127	1 kHz offset *6
			-	**-136**	**-128**	**1 kHz offset *7**
			-	-151	-145	10 kHz offset *6, *7
			-	-153	-147	100 kHz offset *6, *7
			-	-155	-149	1 MHz offset *6, *7

*6 This value without optional phase noise filter capacitor. *7 This value within optional phase noise filter capacitor.

5) Enable/disable input

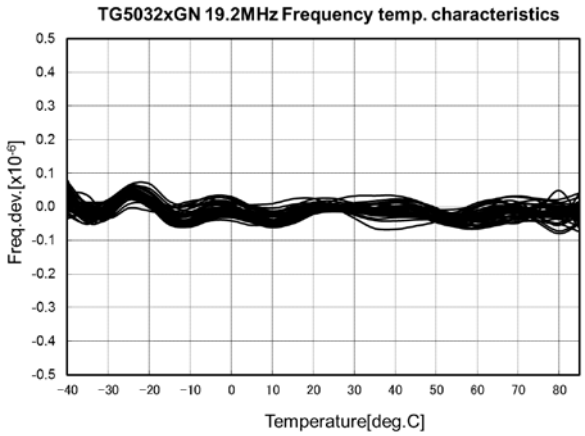
Parameter	Symbol	Unit	Min.	Typ.	Max	Notes
Enable voltage	V_{IH}	V	70% Vcc	-	Vcc	OE terminal (Enable voltage)
Disable voltage	V_{IL}	V	-	-	30% Vcc	OE terminal (Disable voltage)
Input impedance	-	kΩ	50	-	-	Vcc=typ.

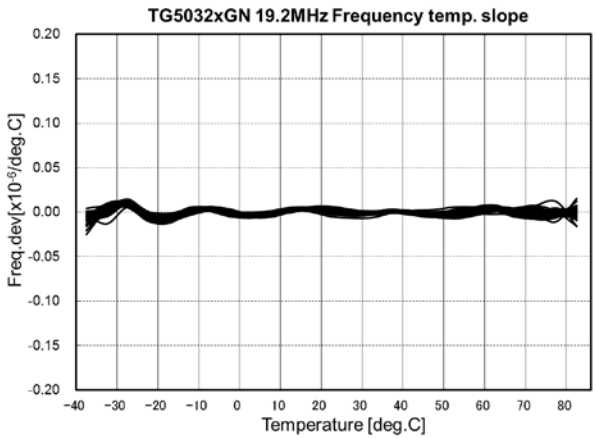
2. Characteristics

2-1) “Frequency / temperature characteristics”

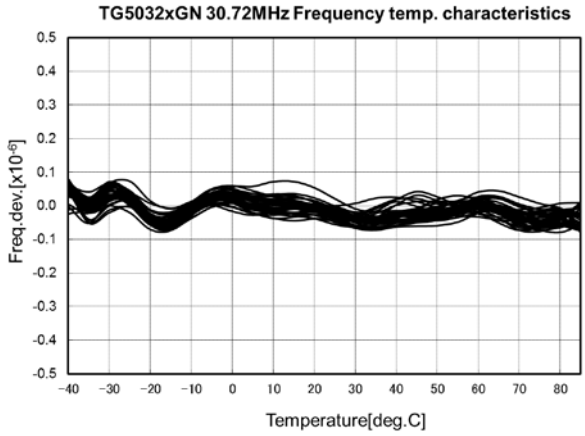
2-1-1) Standard spec : +/-0.1 × 10^{-6} Max. (T_use=-40°C to +85°C)

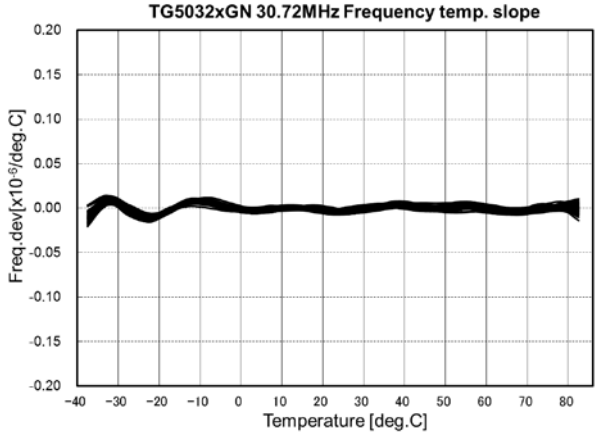
19.2MHz [N=40pcs]



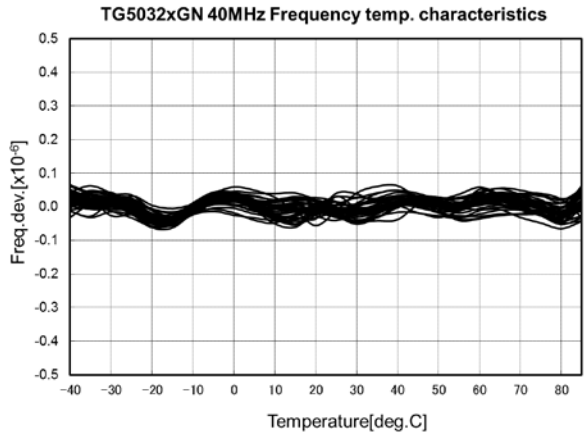


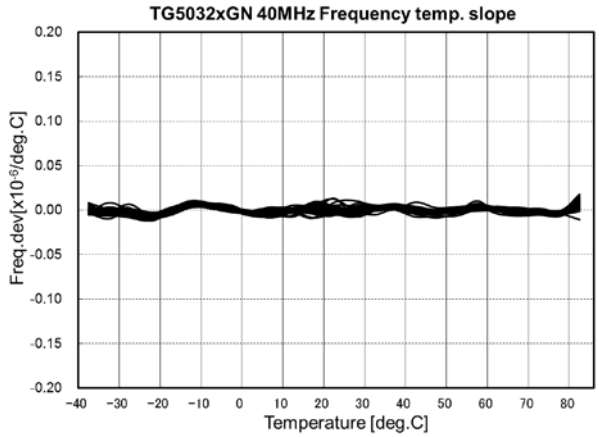
30.72MHz [N=40pcs]



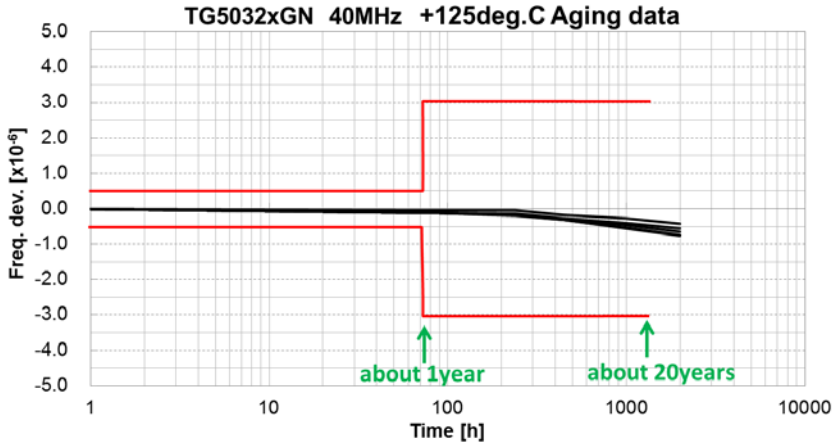


40MHz [N=40pcs]





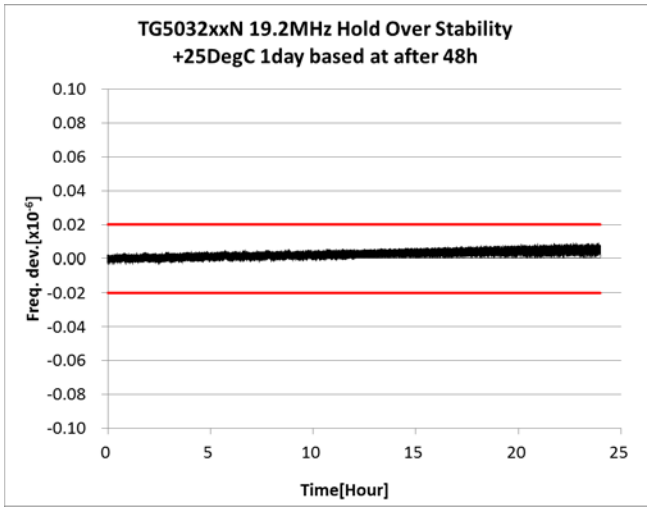
2-2) Frequency aging (40MHz) [N=5pcs]



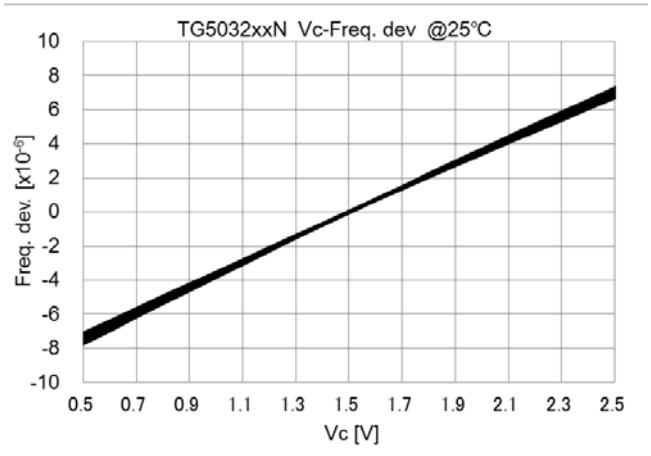
about 1year
Ave. : +0.10 x 10^{-6}
Max. : -0.05 x 10^{-6}
Min. : -0.12 x 10^{-6}

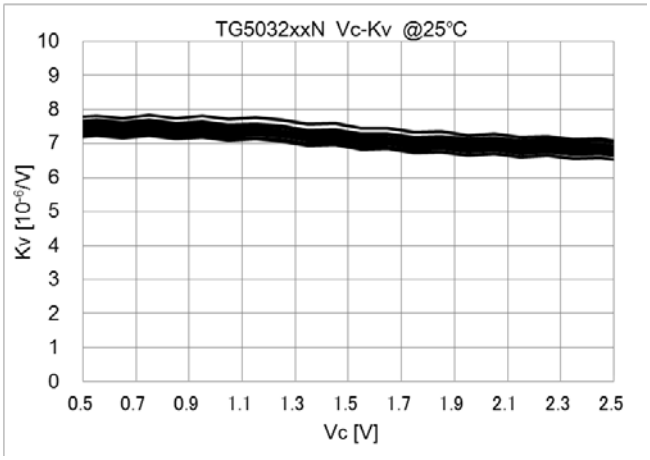
about 20years
Ave. : -0.54 x 10^{-6}
Max. : -0.35 x 10^{-6}
Min. : -0.66 x 10^{-6}

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

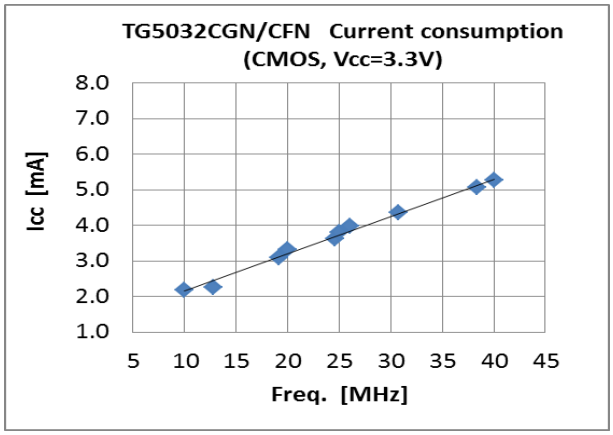


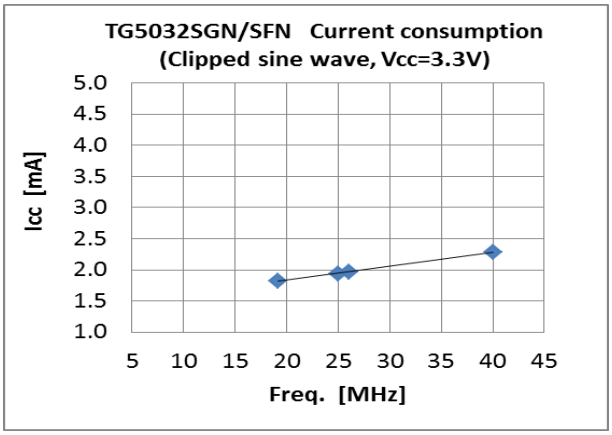
2-4) Frequency control characteristics [N=40pcs]



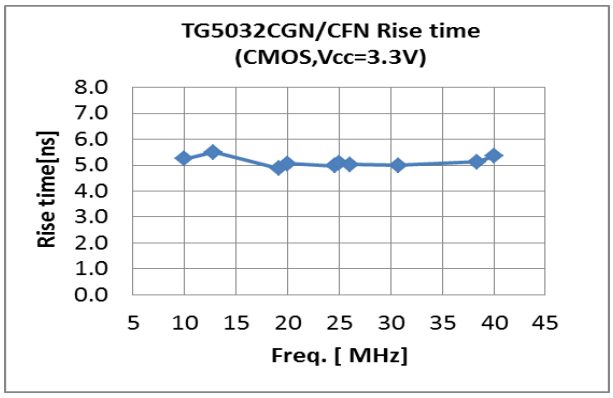


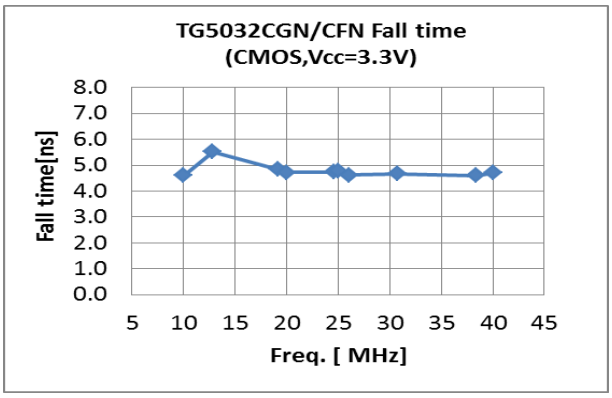
2-5) current consumption



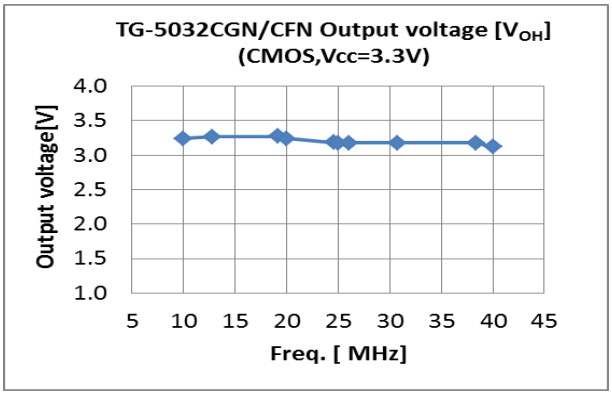


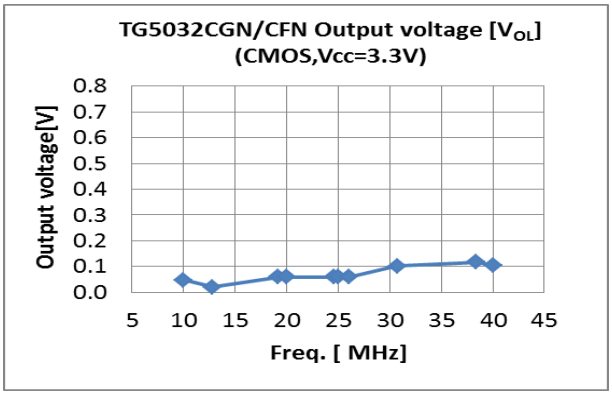
2-6) Rise time / Fall time (at CMOS output)



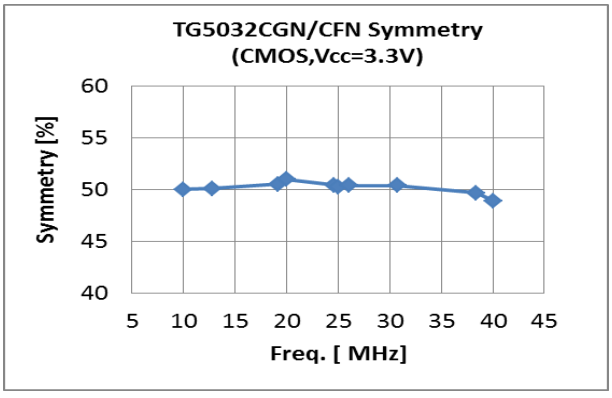


2-7) Output voltage [V_{OH}, V_{OL}] (at CMOS output)

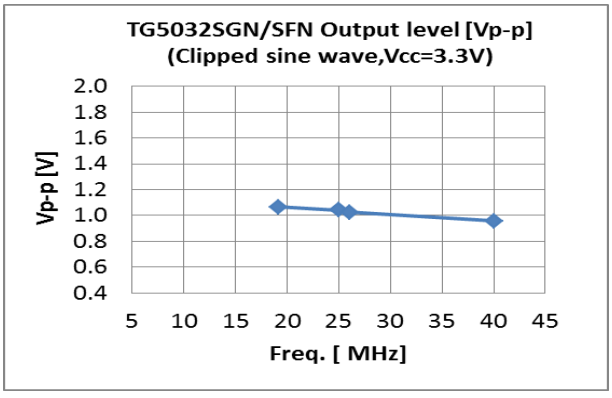




2-8) Symmetry (at CMOS output)

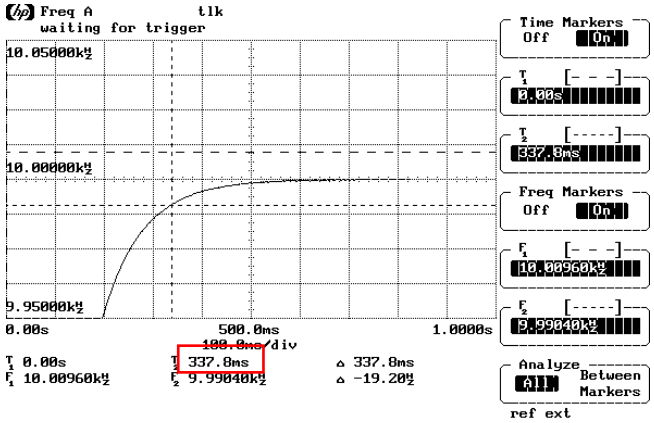


2-9) Output level [V_{P-P}] (at Clipped sine wave)

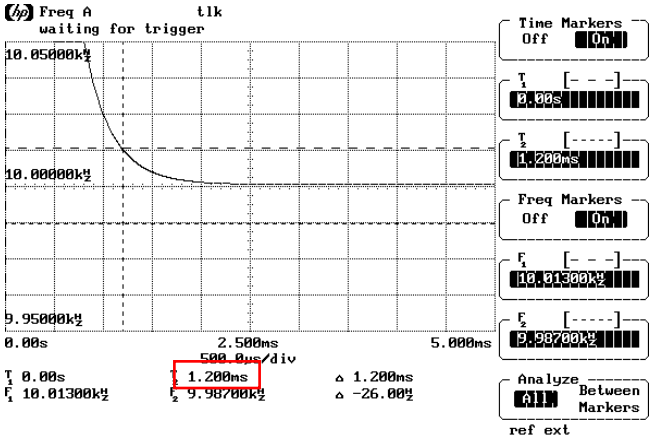


2-10) start up time(19.2MHz, 40MHz, Type: Filter ON or Filter OFF)

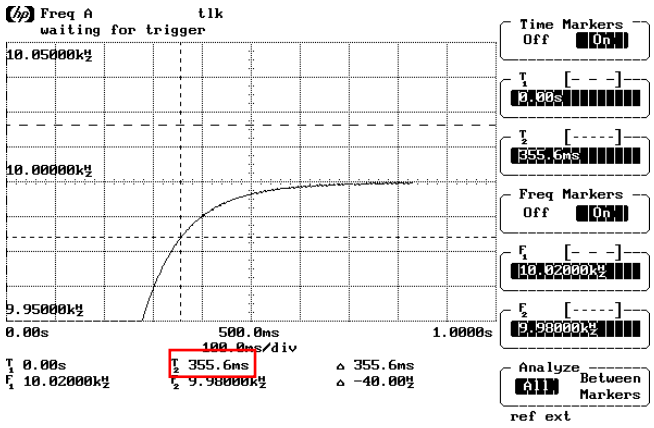
19.2MHz (Filter ON)



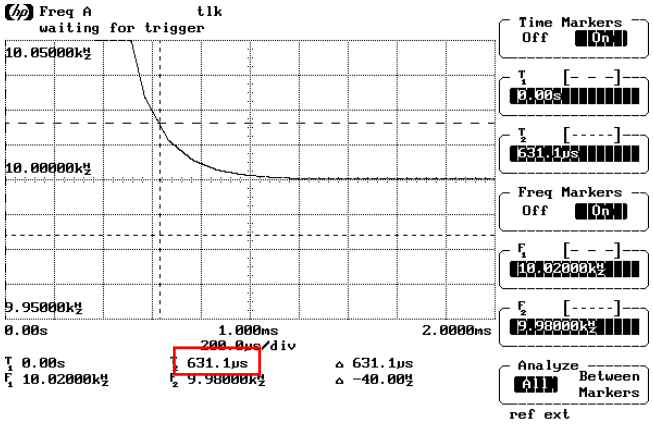
19.2MHz (Filter OFF)



40MHz (Filter ON)

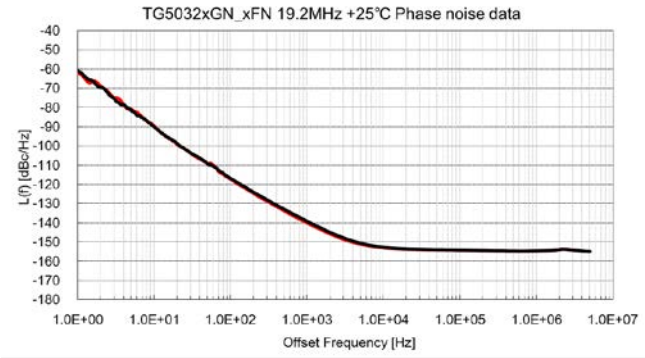


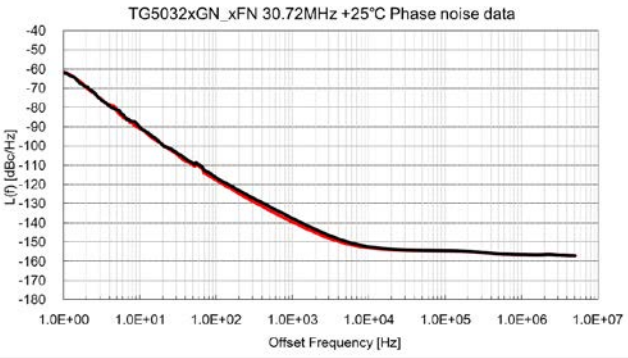
40MHz (Filter OFF)

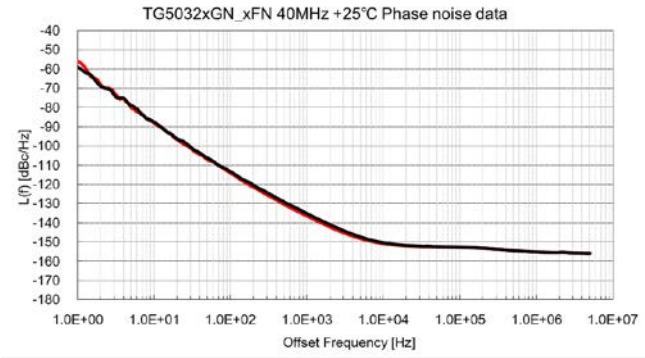


2-11) Phase noise (19.2MHz, 30.72MHz, 40MHz, refer to data of Page3.)

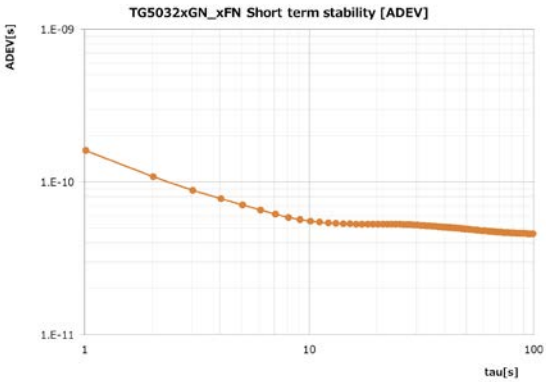
Red line : TCXO with an external filter capacitor **Black line : TCXO only**





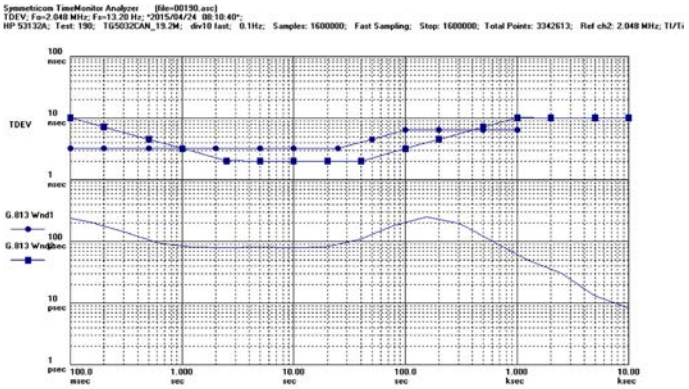


2-12) Short term stability [ADEV] (19.2MHz)

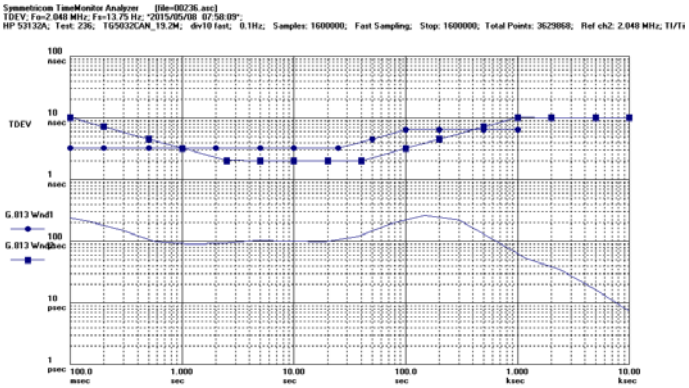


2-13) TDEV (19.2MHz, Loop BW=0.1Hz)

Constant temperature : +25 deg.C

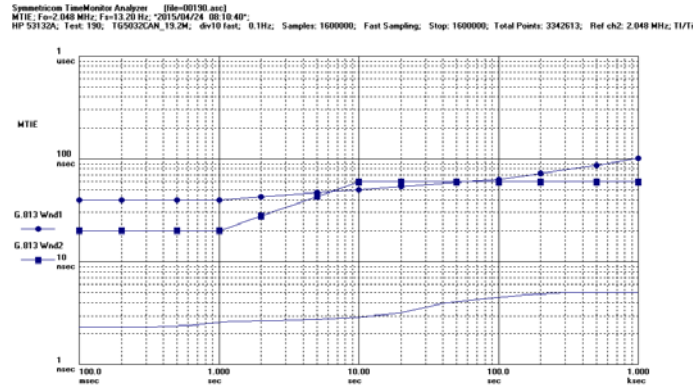


Constant temperature : +70 deg.C

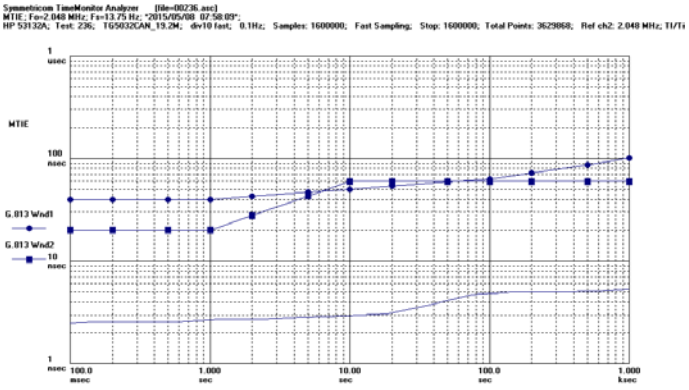


2-14) MTIE (19.2MHz, Loop BW=0.1Hz)

Constant temperature : +25 deg.C



Constant temperature : +70 deg.C



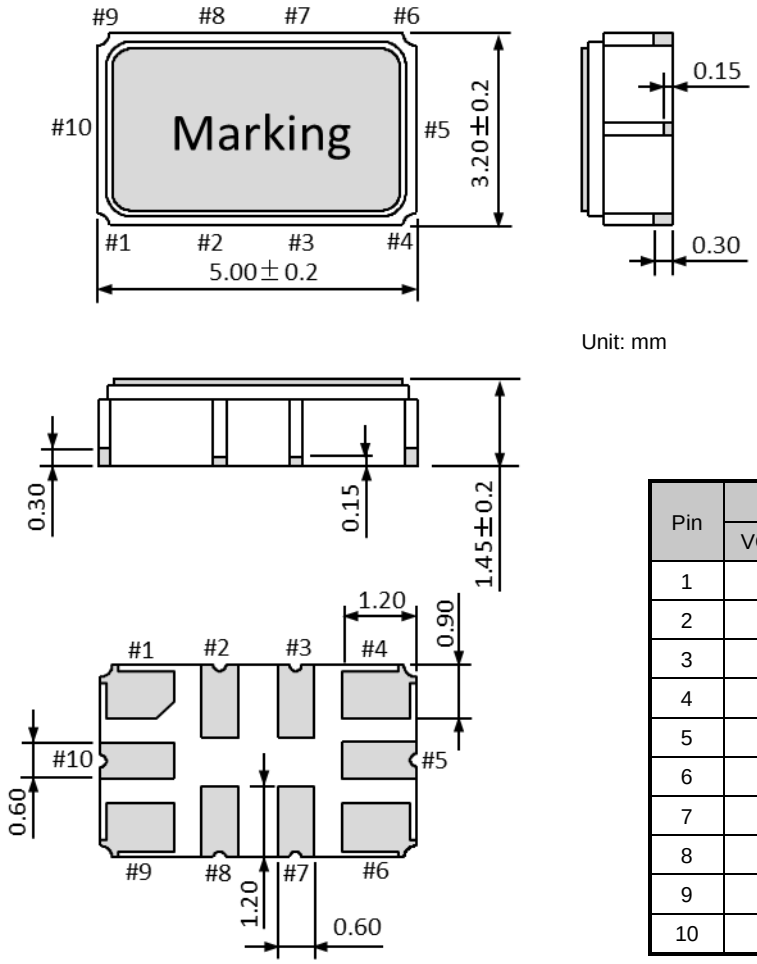
Compliant with G.813 option1 and 2

Seiko Epson Corporation
Document No.: TG5032xGN_AE_Ver. 1.00
Date: Mar. 1st 2017

3. Outline

3-1) Outline dimensions and Pin information

TG5032CGN/SGN



Unit: mm

Pin	Connections	
	VC-TCXO	TCXO
1	V_C	N.C.
2	N.C.	
3	OE	
4	GND	
5	N.C.	
6	OUT	
7	N.C. or Filter	
8	N.C.	
9	V_{CC}	
10	N.C.	

OE pin = "H" or "open": Specified frequency output.
OE pin = "L" : Output is high impedance.

Do not connect “N.C.” pin with any other leads (also mutually)

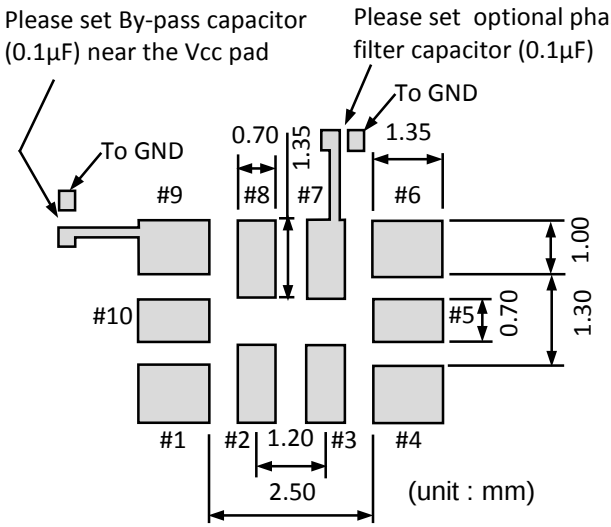
If OE Function does not use ,

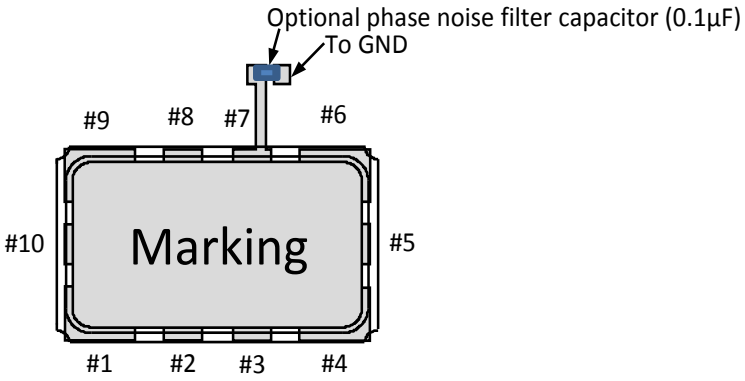
We recommended connecting OE(#3pin) to Vcc (#9pin)

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.

3-2-1) Soldering pattern of TG5032CGN/SGN (Filter input pattern)



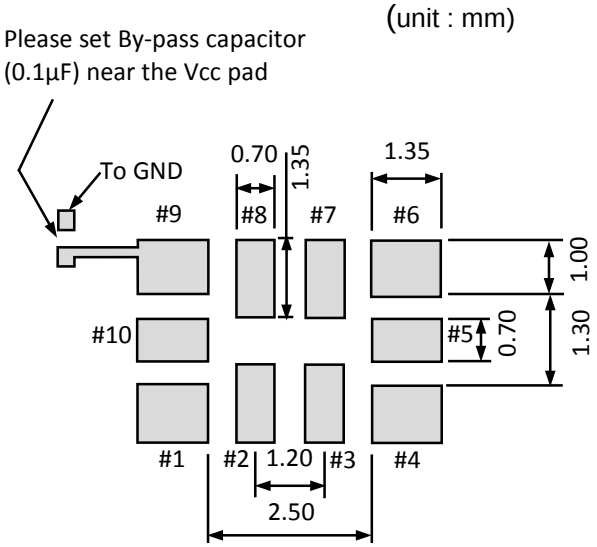


To maintain stable operation, provide a 0.1uF by-pass capacitor at a location as near as possible to the power source terminal of the crystal product (between Vcc - GND).

The phase noise of 10pads TCXO can be improved by adding an external filter capacitor between #7 pin and GND.
The recommend capacitor value is 0.1µF.

3-2-2) Soldering pattern of TG5032CGN/SGN (Without filter pattern)

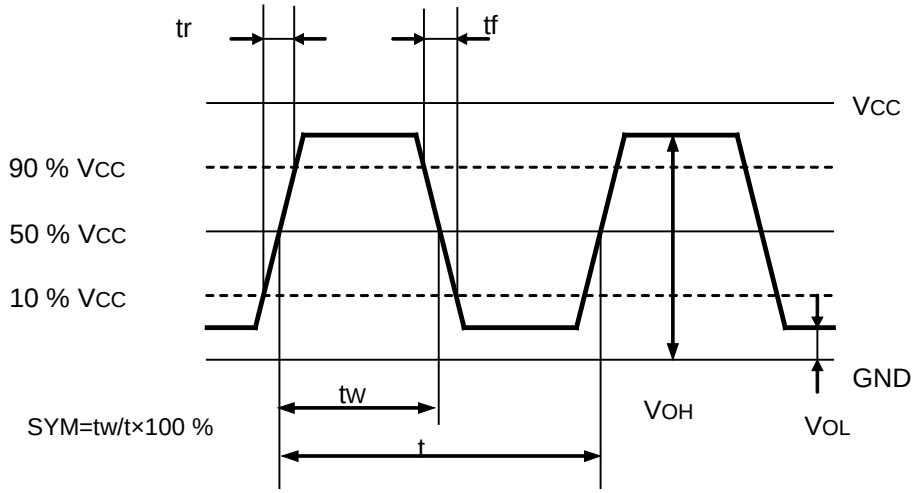
(unit : mm)



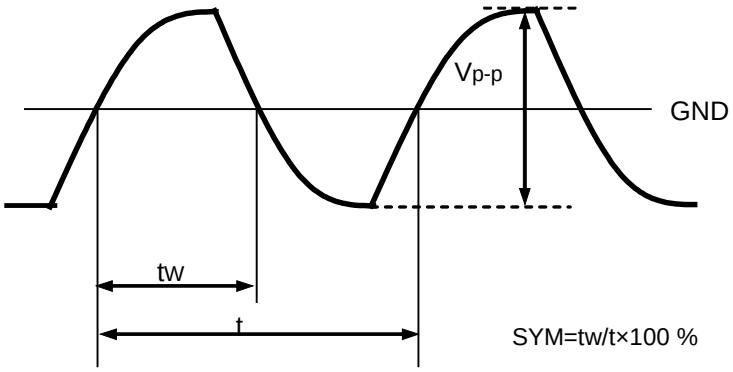
To maintain stable operation, provide a 0.1uF by-pass capacitor at a location as near as possible to the power source terminal of the crystal product (between Vcc - GND).

4. Timing chart

4-1-1) Output waveform (CMOS output)



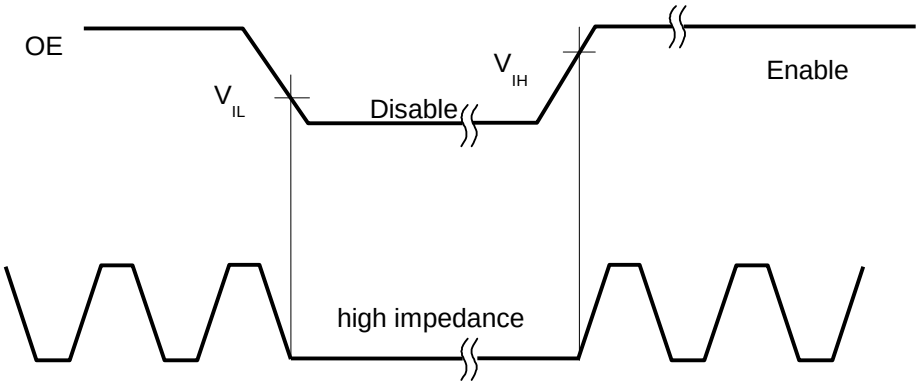
4-1-2) Output waveform (Clipped sine wave output)



4-2) OE function and timing

OE input level	Oscillation	Outputs
“H” or “Open”	Enable	Enable : specified frequency
“L”	Enable	Disable : high impedance

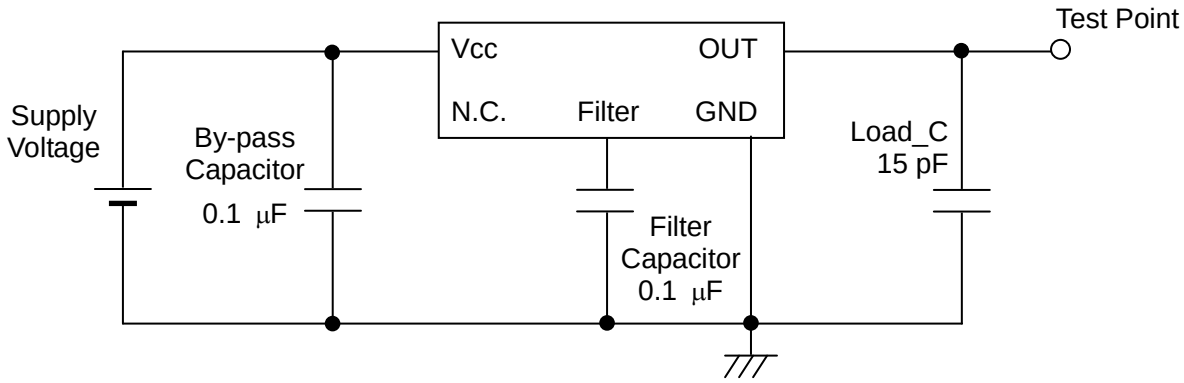
* OE input voltage must be lower than Vcc. Note that rise-up time of OE input voltage must not be shorter than the rise-up time of supply voltage.



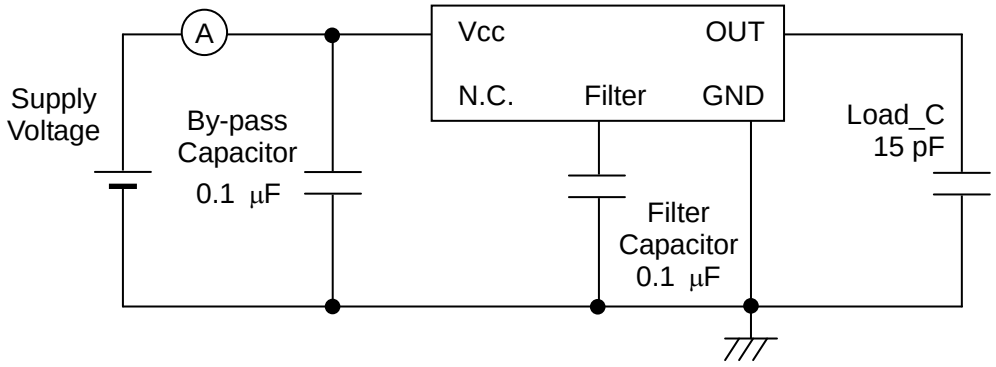
5. Test circuit

5-1) CMOS output for TCXO (Within filter capacitor)

1) Output Load : 15 pF



2) Current consumption



3) Conditions

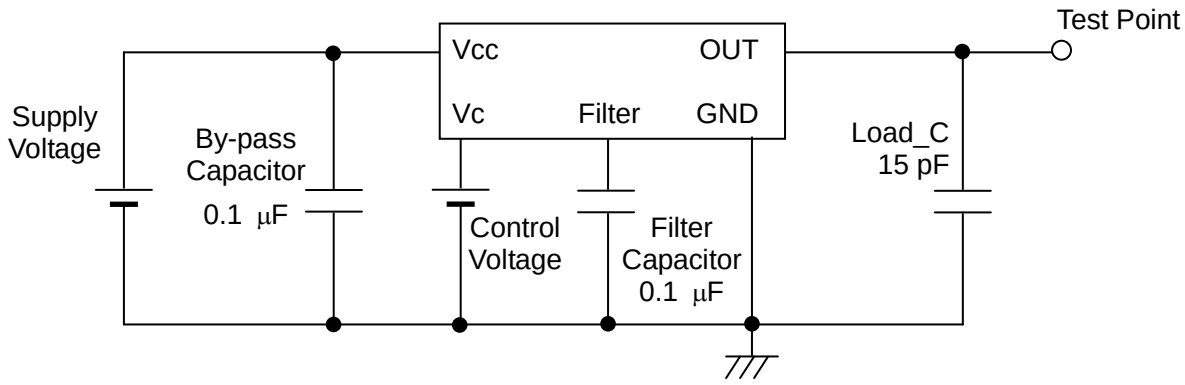
1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz

   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

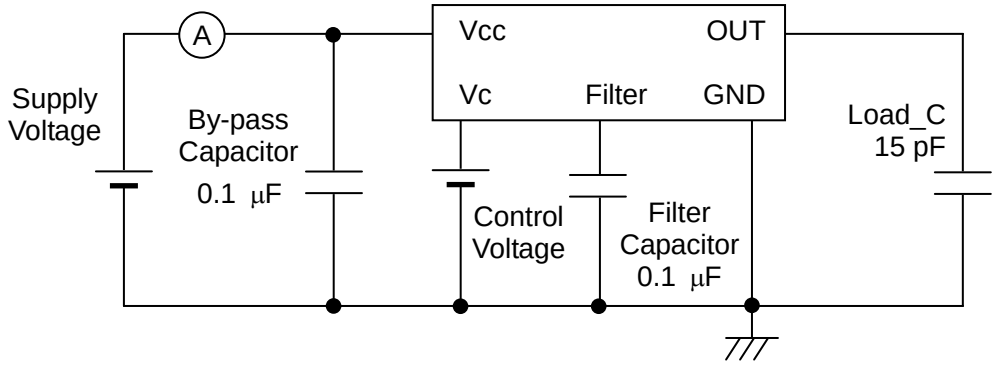
   Impedance of power supply should be as low as possible.
6. GND pin should be connected to low impedance GND.

5-2) CMOS output for VC-TCXO (Within filter capacitor)

1) Output Load : 15 pF



2) Current consumption



3) Conditions

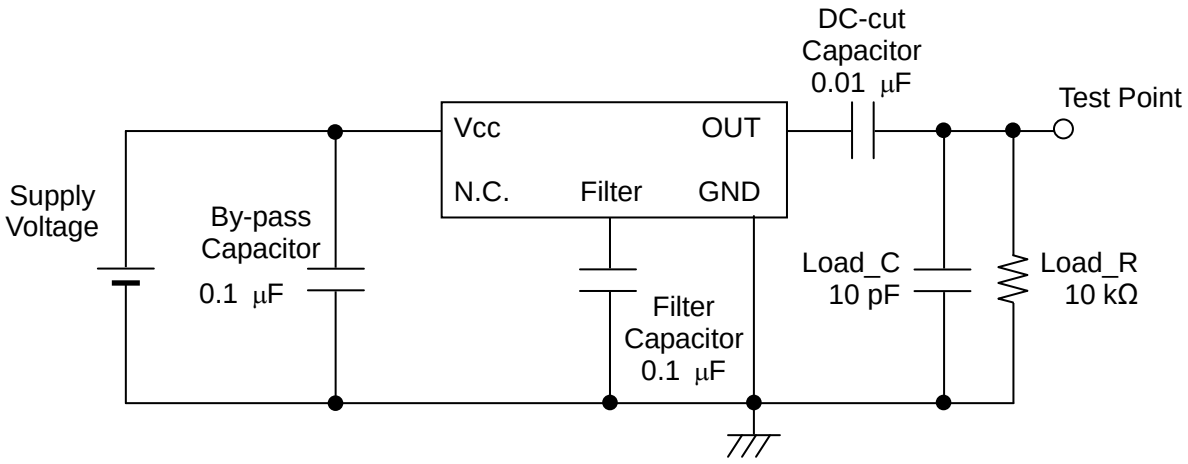
1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz

   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

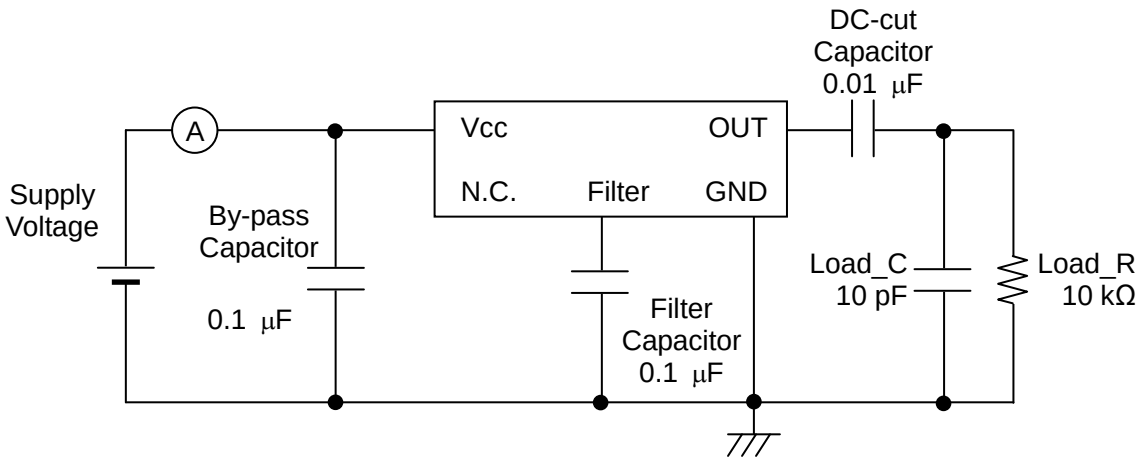
   Impedance of power supply should be as low as possible.
6. GND pin should be connected to low impedance GND.

5-3) Clipped sine wave output for TCXO (Within filter capacitor)

1) Output Load : 10 kΩ // 10 pF



2) Current consumption

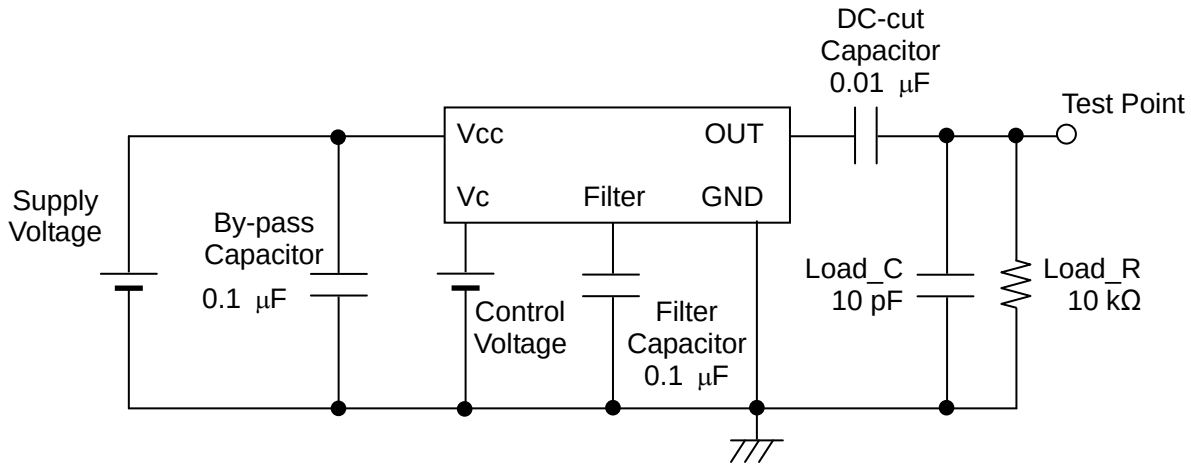


3) Conditions

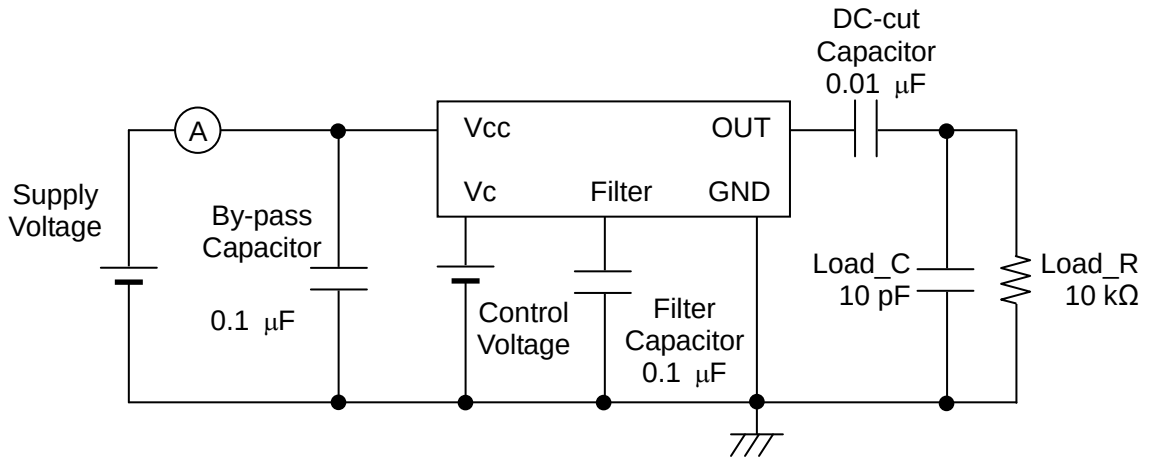
1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz
   Impossible to measure both frequency and wave form at the same time.(In case of using oscilloscope's amplifier output, possible to measure both at the same time.)
2. Load_C includes probe capacitance.
3.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

1) Output Load : 10 kΩ // 10 pF



2) Current consumption



3) Conditions

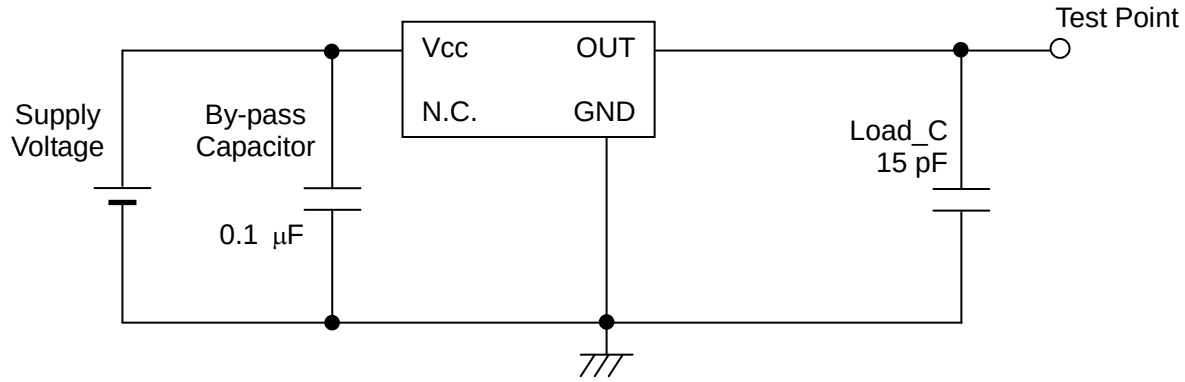
1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz

   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

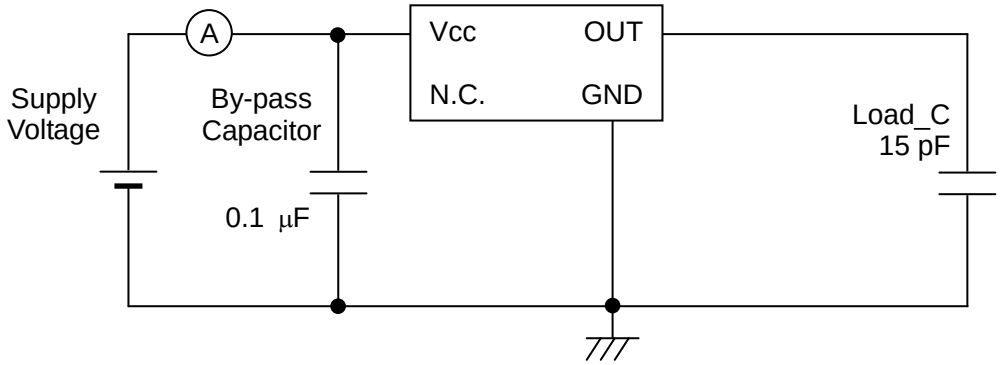
   Impedance of power supply should be as low as possible.
6. GND pin should be connected to low impedance GND.

5-5) CMOS output for TCXO (Without filter capacitor)

1) Output Load : 15 pF



2) Current consumption



3) Conditions

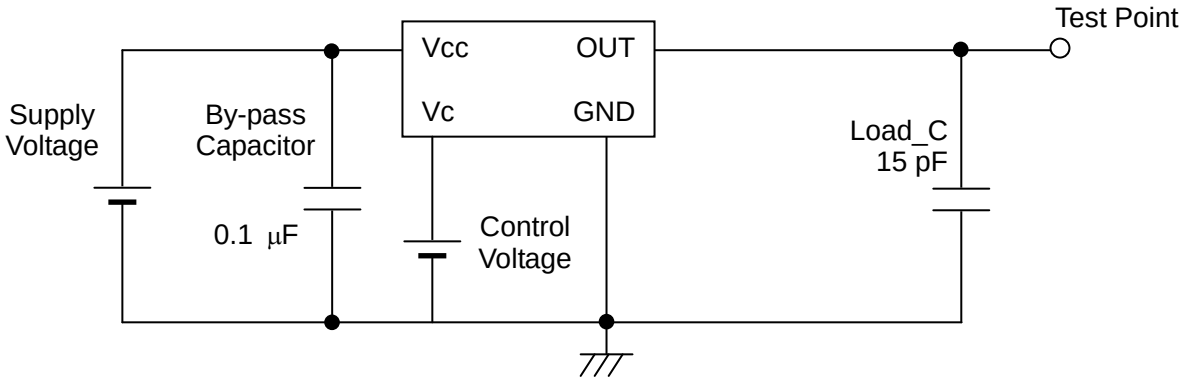
1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz

   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

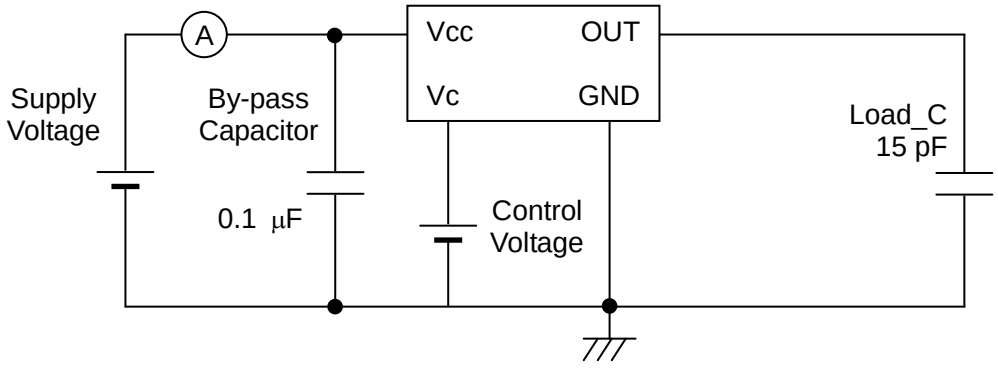
   Impedance of power supply should be as low as possible.
6. GND pin should be connected to low impedance GND.

5-6) CMOS output for VC-TCXO (Without filter capacitor)

1) Output Load : 15 pF



2) Current consumption



3) Conditions

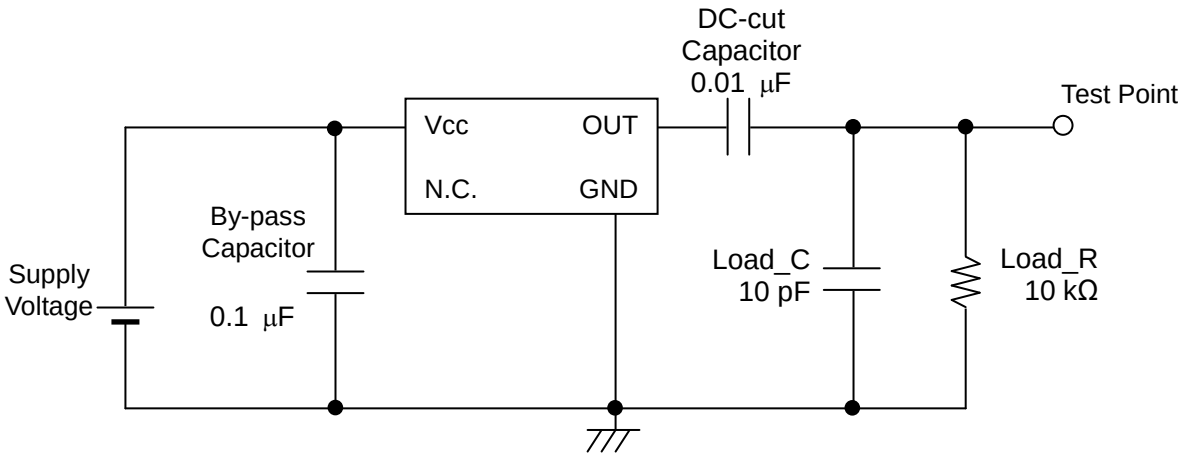
1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz

   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

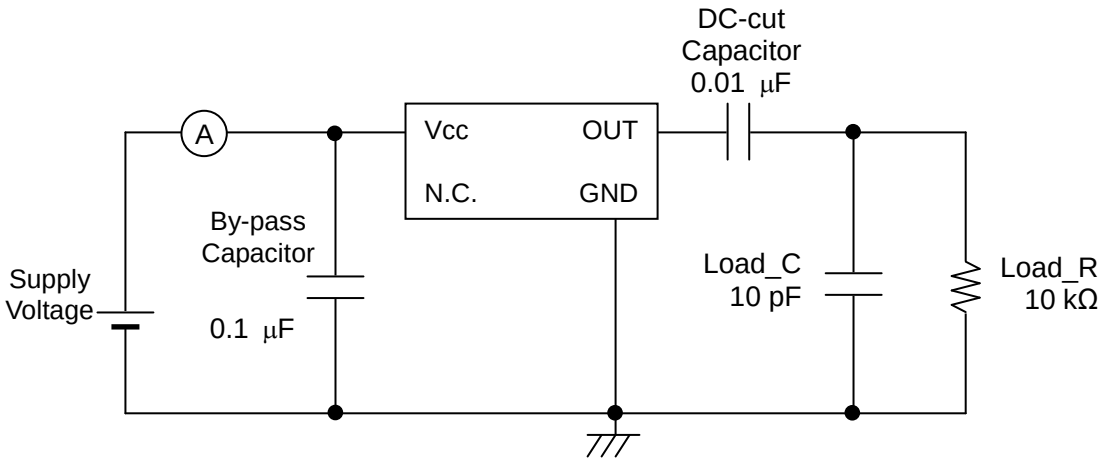
   Impedance of power supply should be as low as possible.
6. GND pin should be connected to low impedance GND.

5-7) Clipped sine wave output for TCXO (Without filter capacitor)

1) Output Load : 10 kΩ // 10 pF



2) Current consumption



3) Conditions

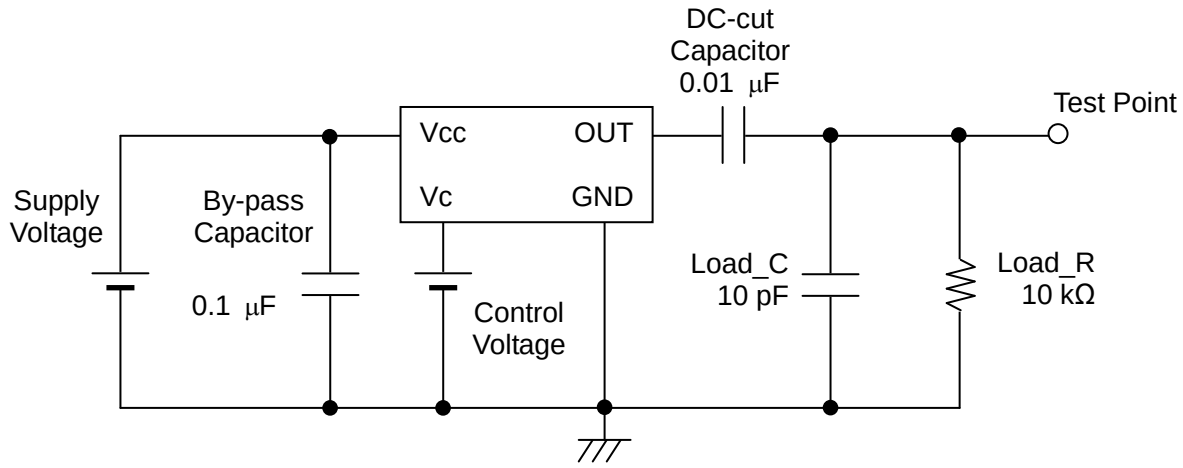
1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz

   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

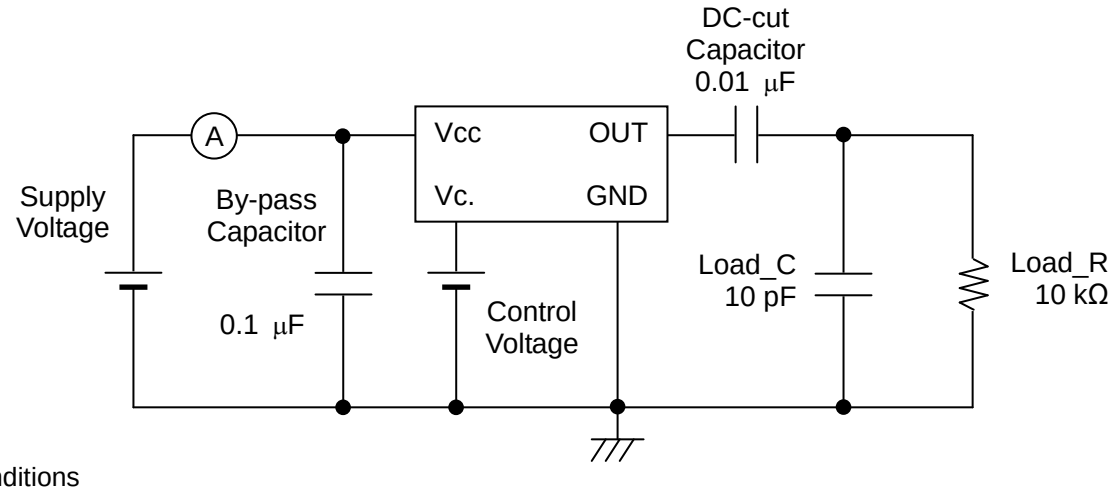
   Impedance of power supply should be as low as possible.
6. GND pin should be connected to low impedance GND.

5-8) Clipped sine wave output for VC-TCXO (Without filter capacitor)

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