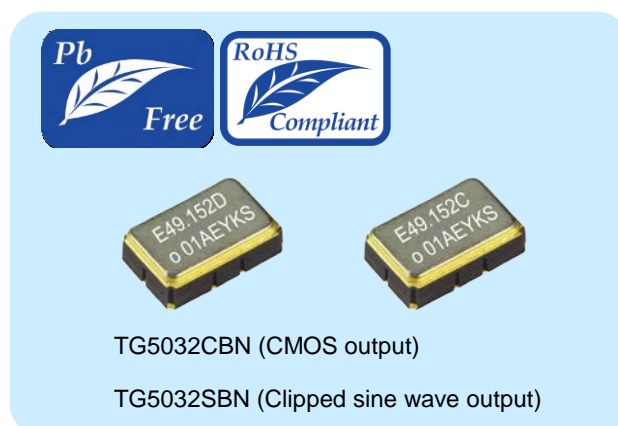


Ultra high stability temperature compensated crystal oscillator

Product name : TG5032CBN / TG5032SBN

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







Applications

- Stratum3
- Microwave BTS,
- Network synchronization 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 Stratum3. This product is small size package of Epson product TG-5500CA.

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

	► Pb free.
	► 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.)
	► 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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/ 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.

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	-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 (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	
	C _c	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

(V_{CC}=Typ., GND=0.0 V, V_C=Typ. V, Load=Typ., T_{use}=+25°C)

Parameter	Symbol	Unit	Min.	Typ.	Max	Notes
Output frequency	f _o	MHz	10	-	50	
Frequency tolerance *2 (T _{use} =+25°C +/-2°C) (Reflow cycles : 2 times)	f _{tol}	× 10 ⁻⁶	-1.0	-	+1.0	f _o ≤ 40 MHz
Frequency / temperature characteristics (Reference to +25°C)	fo-Tc	× 10 ⁻⁶	-0.28	-	+0.28	T _{use} =-40°C to +85°C,
			-0.25	-	+0.25	T _{use} =-40°C to +85°C (Option Spec.)
Frequency / load coefficient	fo-Load	× 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}	× 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	-	× 10 ⁻⁶ /°C	-0.1	-	+0.1	Operating temperature range (1 °C/minute max.)
Hysteresis	-	× 10 ⁻⁶	-0.2	-	+0.2	Frequency measured before and after at +25°C.
Frequency aging	f _{age}	× 10 ⁻⁶	-0.5	-	+0.5	T _{use} =+25°C, First year (~40MHz)
			-1.0	-	+1.0	T _{use} =+25°C, First year (~50MHz)
			-3.0	-	+3.0	T _{use} =+25°C, 20 years
Holdover stability (Constant temperature)	-	× 10 ⁻⁶	-0.01	-	+0.01	T _{use} =+25°C, 1 day *3
Holdover stability (Free-run accuracy)	-	× 10 ⁻⁶	-0.04	-	+0.04	T _{use} =+25°C, 1 day *4
Acceleration sensitivity	-	× 10 ⁻⁹ /G	-	2.0	-	*5 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_{CC}=Typ., GND=0.0 V, V_C=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	V _C =1.5V+/-1.0V, at V _{CC} =2.85 to 3.3V V _C =2.5V+/-2.0V, at V _{CC} =5.0V
			+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

(V_{CC}=Typ., GND=0.0 V, V_C=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)
Start up time	t _{str}	s	-	0.4	2.0	Filter ON (Standard)
			-	0.001	0.005	Filter OFF (Option)
Rise time	tr	ns	-	-	8.0	10%V _{CC} to 90%V _{CC} level
			-	-	5.0	CMOS output
Fall time	tf	ns	-	-	8.0	90%V _{CC} to 10%V _{CC} level
			-	-	5.0	CMOS output
Symmetry	SYM	%	45	50	55	50% V _{CC} 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% V _{CC}	CMOS output
Output level	V _{p-p}	V _{p-p}	0.8	-	-	Clipped sine wave
Phase noise (20MHz)	L(f)	dBc/ Hz	-	-67	-53	1 Hz offset *6, *7
			-	-95	-83	10 Hz offset *6
			-	-100	-88	10 Hz offset *7
			-	-118	-108	100 Hz offset *6
			-	-127	-117	100 Hz offset *7
			-	-139	-131	1 kHz offset *6
			-	-146	-138	1 kHz offset *7
			-	-154	-148	10 kHz offset *6, *7
			-	-156	-150	100 kHz offset *6, *7
Phase noise (26MHz)	L(f)	dBc/ Hz	-	-64	-50	1 Hz offset *6, *7
			-	-92	-80	10 Hz offset *6
			-	-95	-83	10 Hz offset *7
			-	-115	-105	100 Hz offset *6
			-	-122	-102	100 Hz offset *7
			-	-137	-129	1 kHz offset *6
			-	-143	-135	1 kHz offset *7
			-	-155	-149	10 kHz offset *6, *7
			-	-157	-151	100 kHz offset *6, *7
Phase noise (50MHz)	L(f)	dBc/ Hz	-	-56	-42	1 Hz offset *6, *7
			-	-84	-72	10 Hz offset *6
			-	-85	-73	10 Hz offset *7
			-	-109	-99	100 Hz offset *6
			-	-112	-102	100 Hz offset *7
			-	-131	-123	1 kHz offset *6
			-	-134	-126	1 kHz offset *7
			-	-149	-143	10 kHz offset *6, *7
			-	-156	-150	100 kHz offset *6, *7
-	-157	-151	1 MHz offset *6, *7			

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

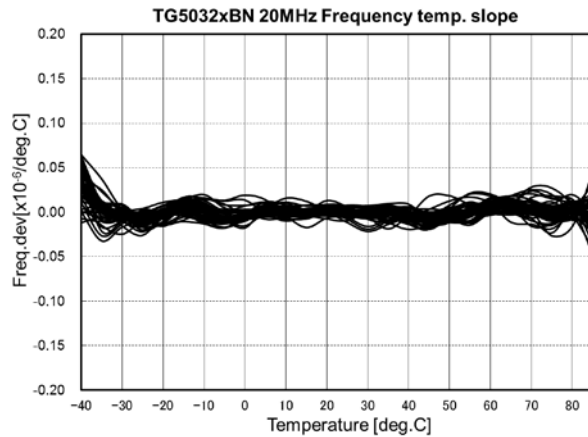
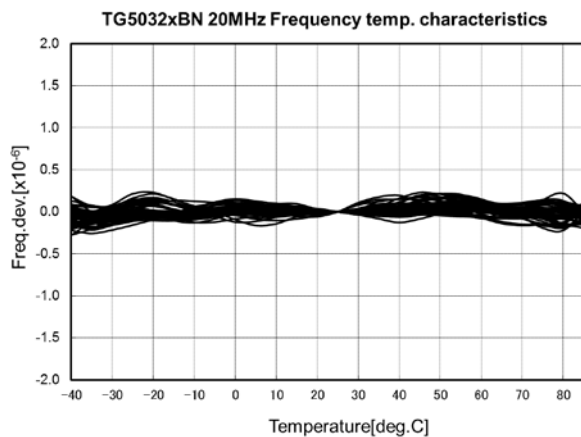
5) Enable/disable input

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

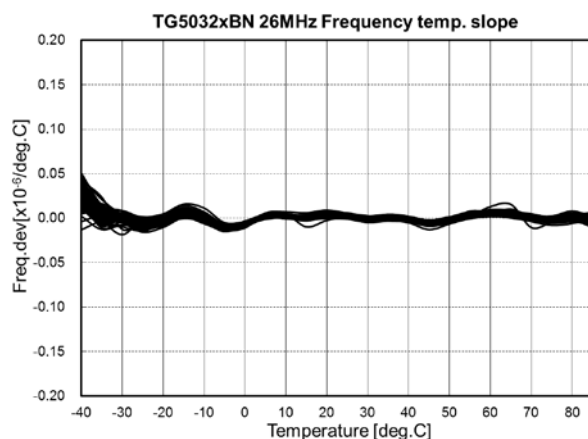
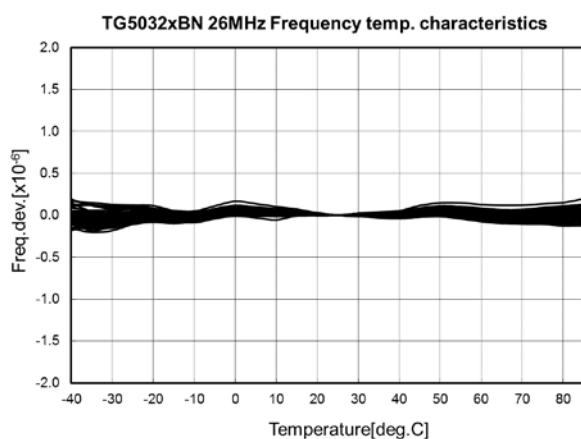
2. Characteristics

2-1) “Frequency / temperature characteristics” and “Frequency / temperature slope”

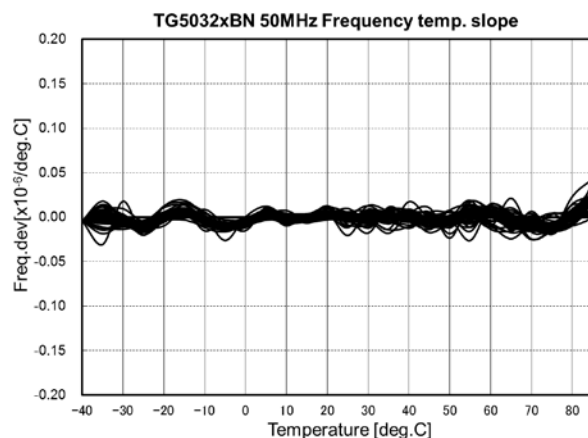
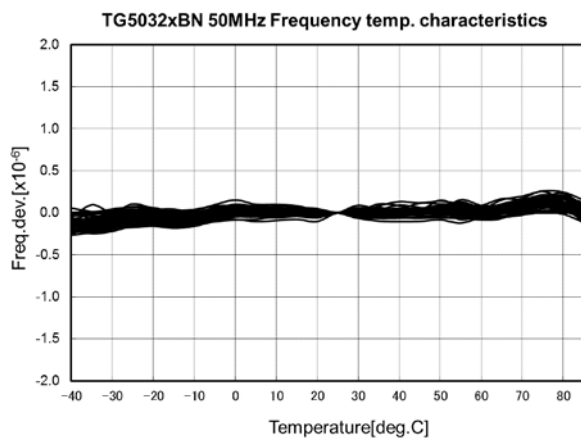
20MHz [N=40pcs]



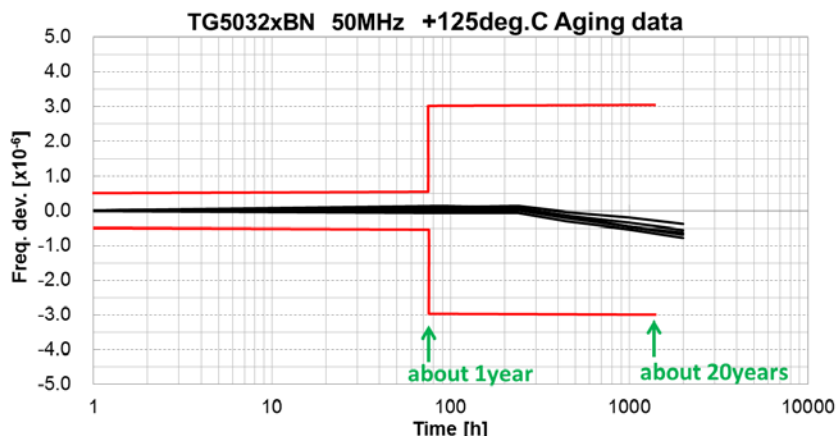
26MHz [N=40pcs]



50MHz [N=40pcs]



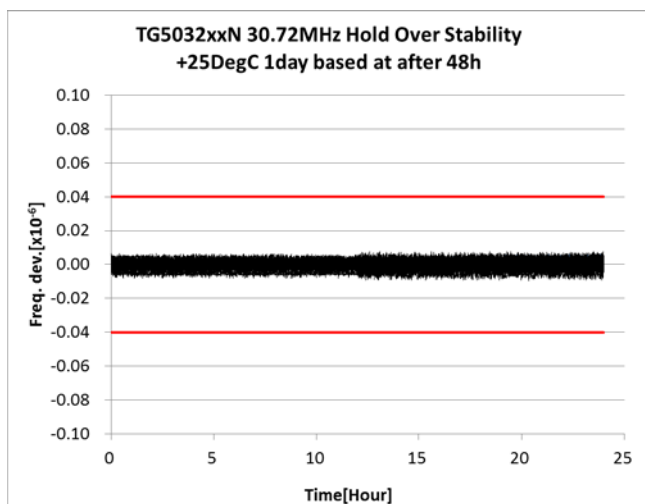
2-2) Frequency aging (50MHz) [N=5pcs]



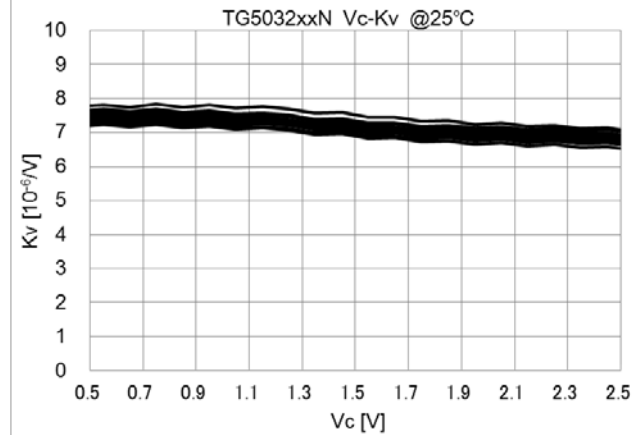
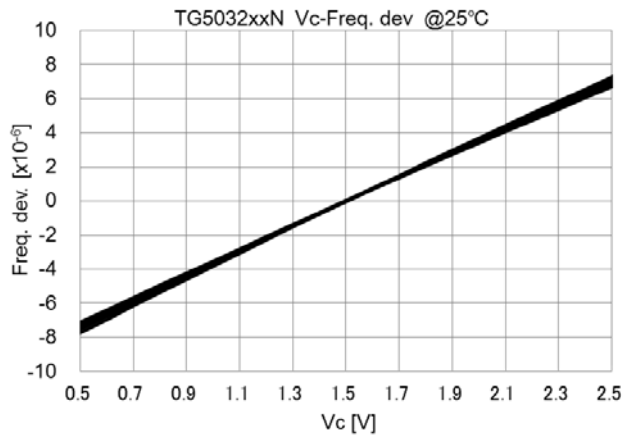
about 1year
 Ave. : $+0.05 \times 10^{-6}$
 Max. : $+0.14 \times 10^{-6}$
 Min. : -0.06×10^{-6}

about 20years
 Ave. : -0.50×10^{-6}
 Max. : -0.28×10^{-6}
 Min. : -0.65×10^{-6}

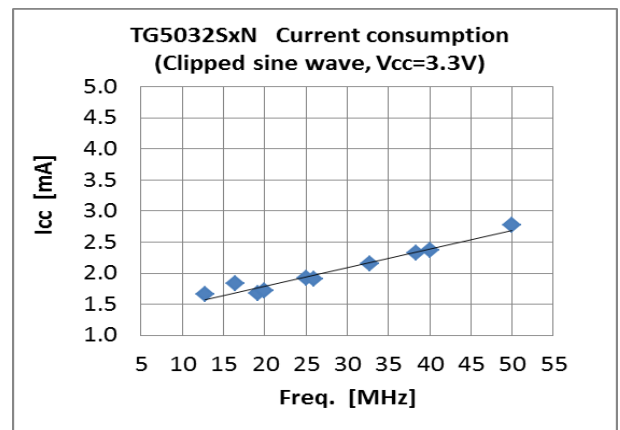
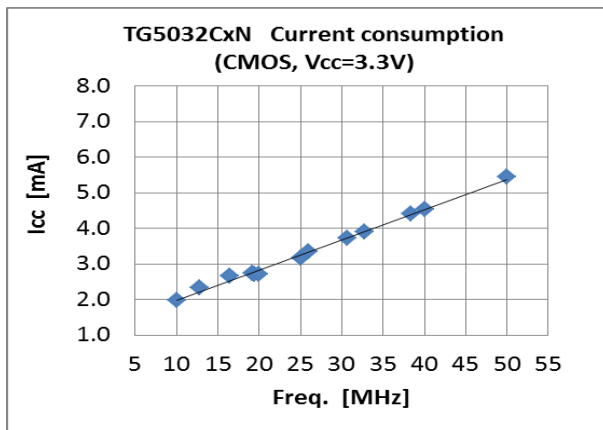
2-3) Holdover stability (30.72MHz) [N=40pcs]



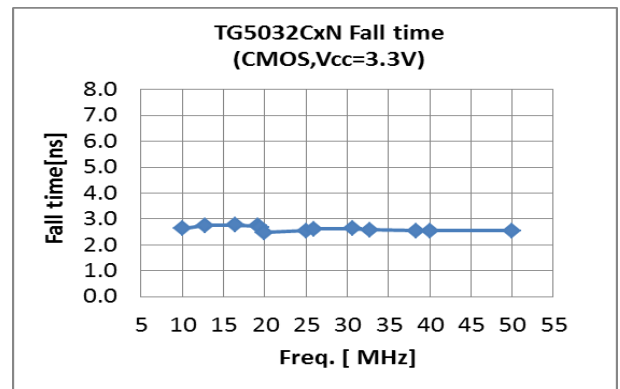
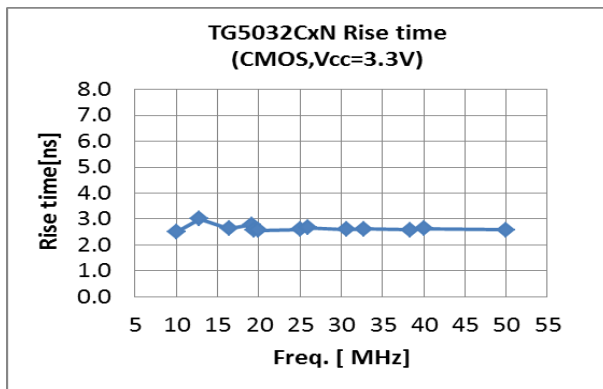
2-4) Frequency control characteristics [N=40pcs]



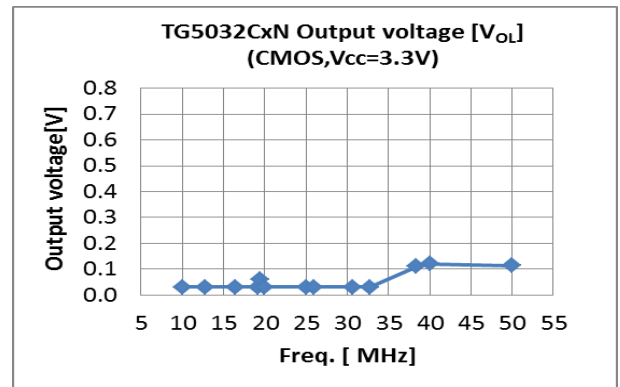
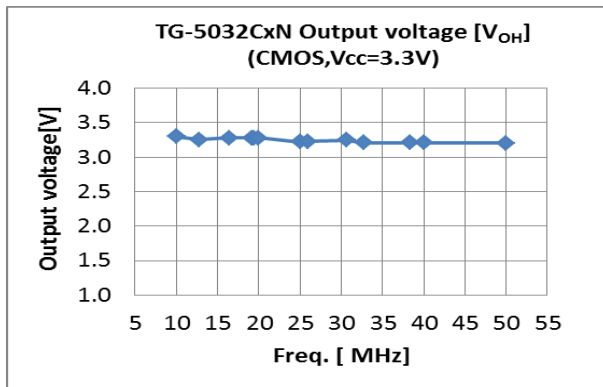
2-5) current consumption



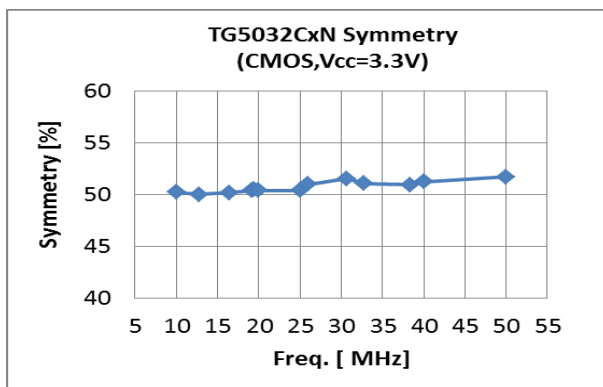
2-6) Rise time / Fall time (at CMOS output)



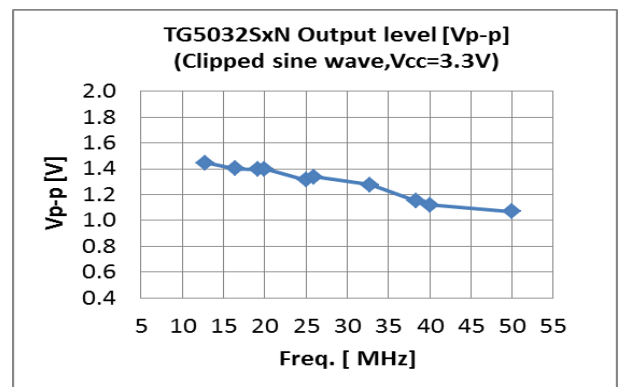
2-7) Output voltage [V_{OH}, V_{OL}] (at CMOS output)



2-8) Symmetry (at CMOS output)

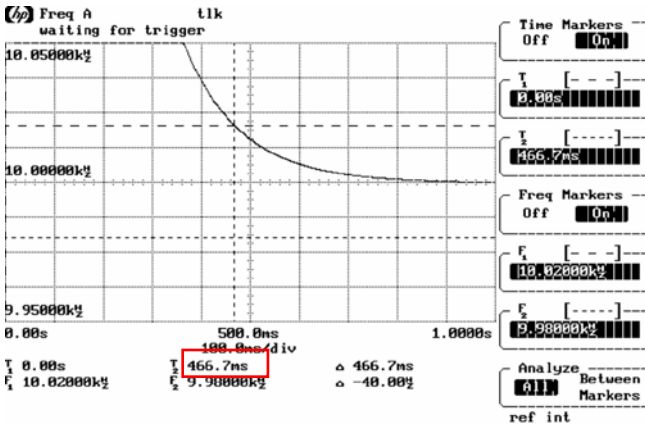


2-9) Output level [V_{P-P}] (at Clipped sine wave)

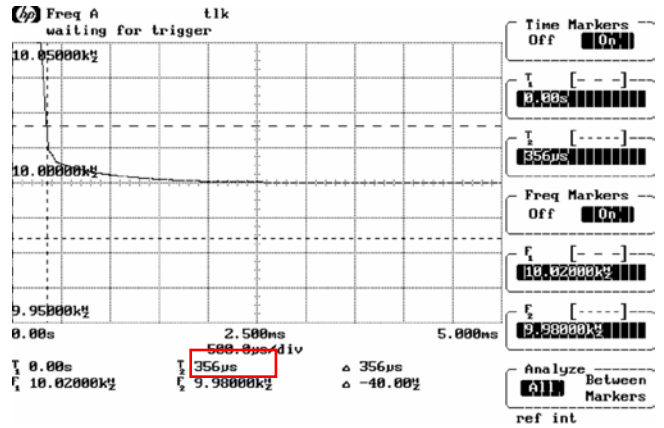


2-10) start up time(20MHz, 26MHz, 50MHz, Type: Filter ON or Filter OFF)

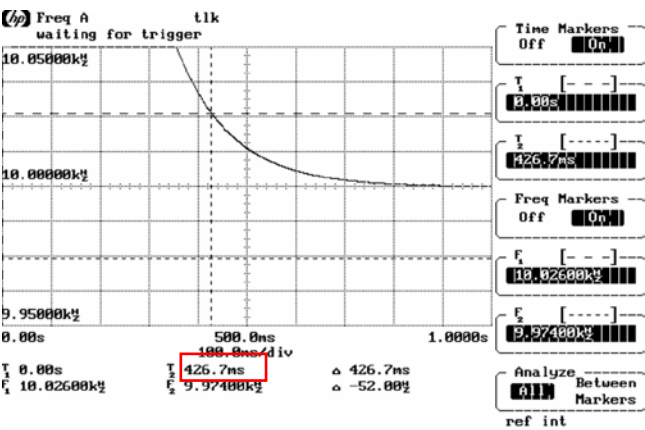
20MHz (Filter ON)



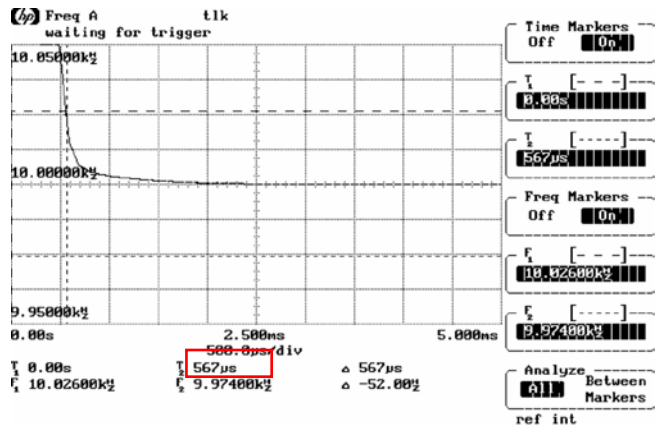
20MHz (Filter OFF)



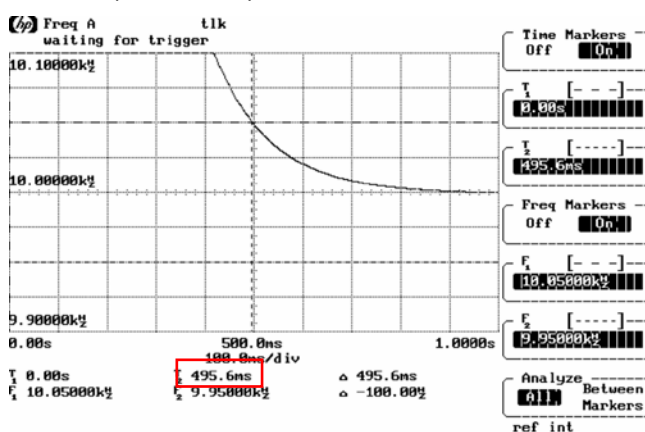
26MHz (Filter ON)



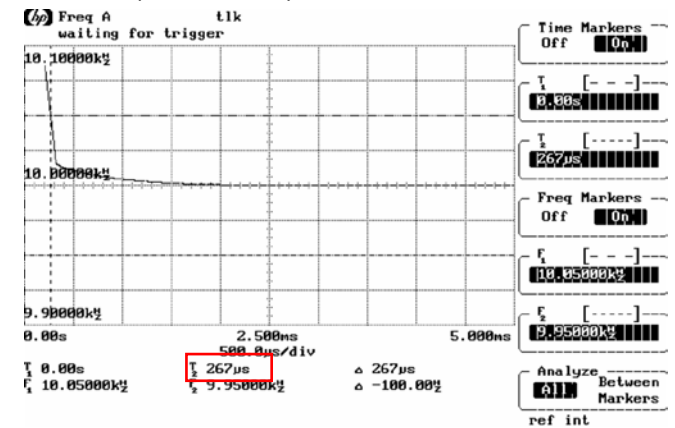
26MHz (Filter OFF)



50MHz (Filter ON)



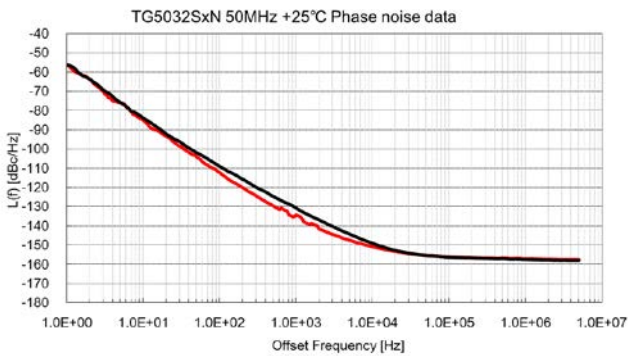
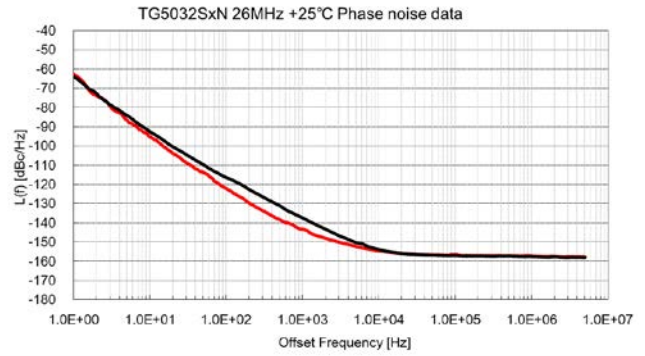
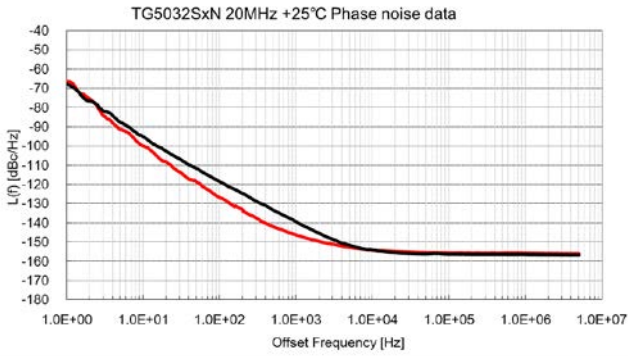
50MHz (Filter OFF)



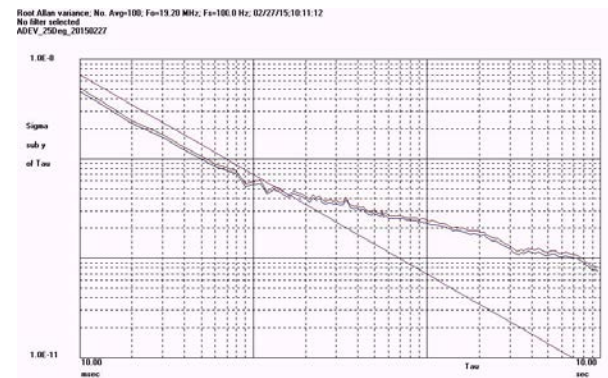
2-11) Phase noise (20MHz, 26MHz, 50MHz, refer to data of Page3.)

Red line : TCXO with an external filter capacitor

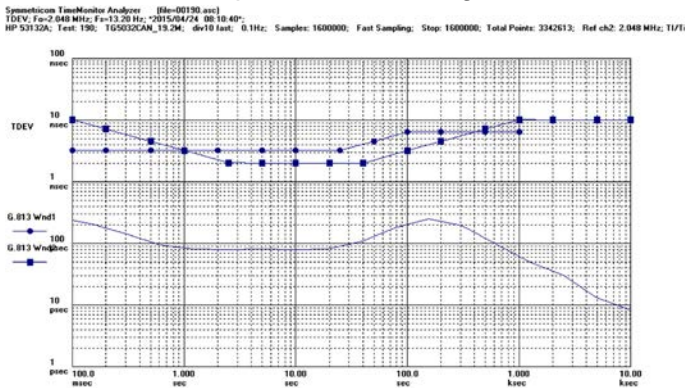
Black line : TCXO only



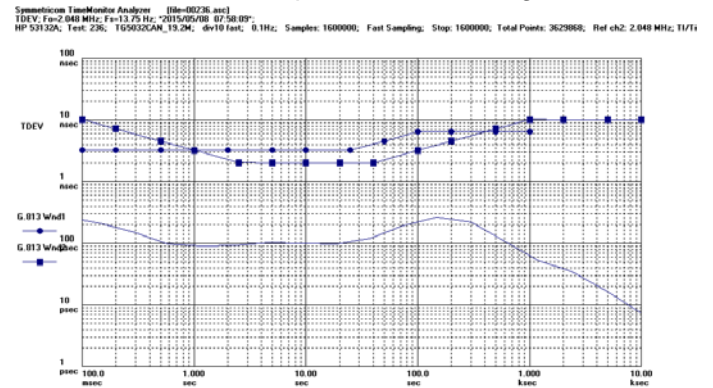
2-12) Short term stability [ADEV] (19.2MHz)



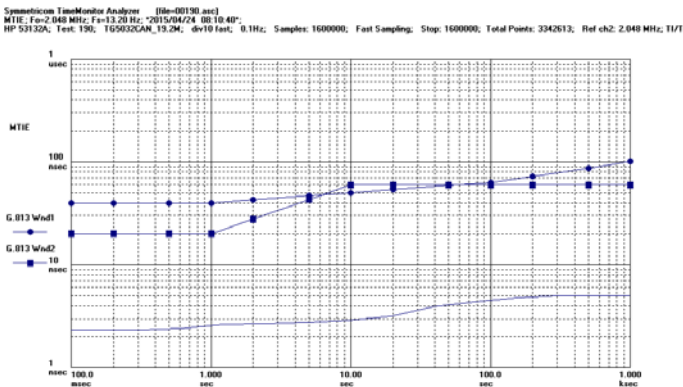
2-13) TDEV (19.2MHz, Loop BW=0.1Hz) Constant temperature : +25 deg.C



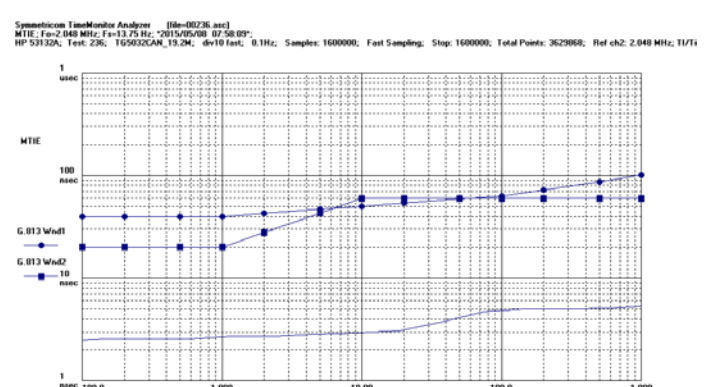
Constant temperature : +70 deg.C



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



Constant temperature : +70 deg.C

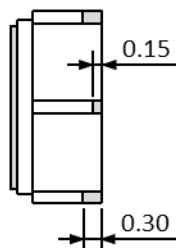
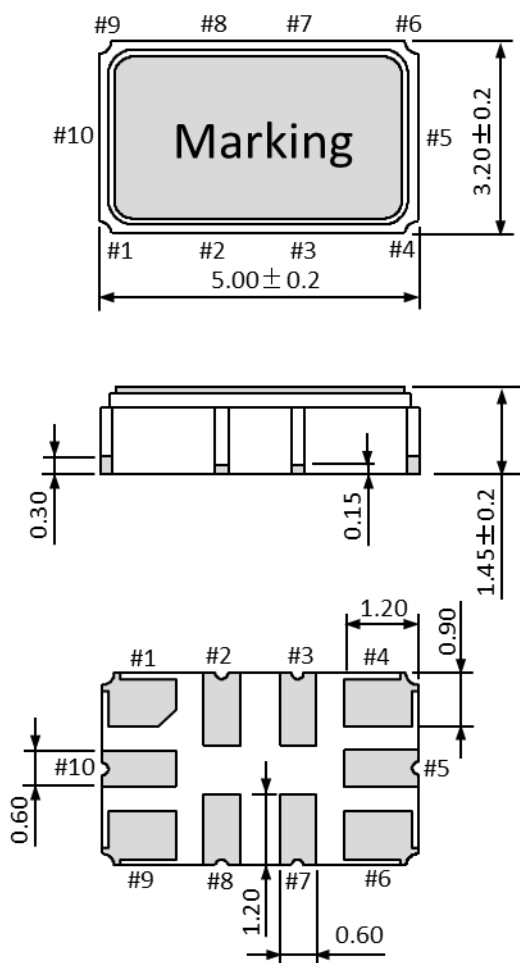


Compliant with G.813 option1 and 2

3. Outline

3-1) Outline dimensions and Pin information

TG5032CBN/SBN



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)

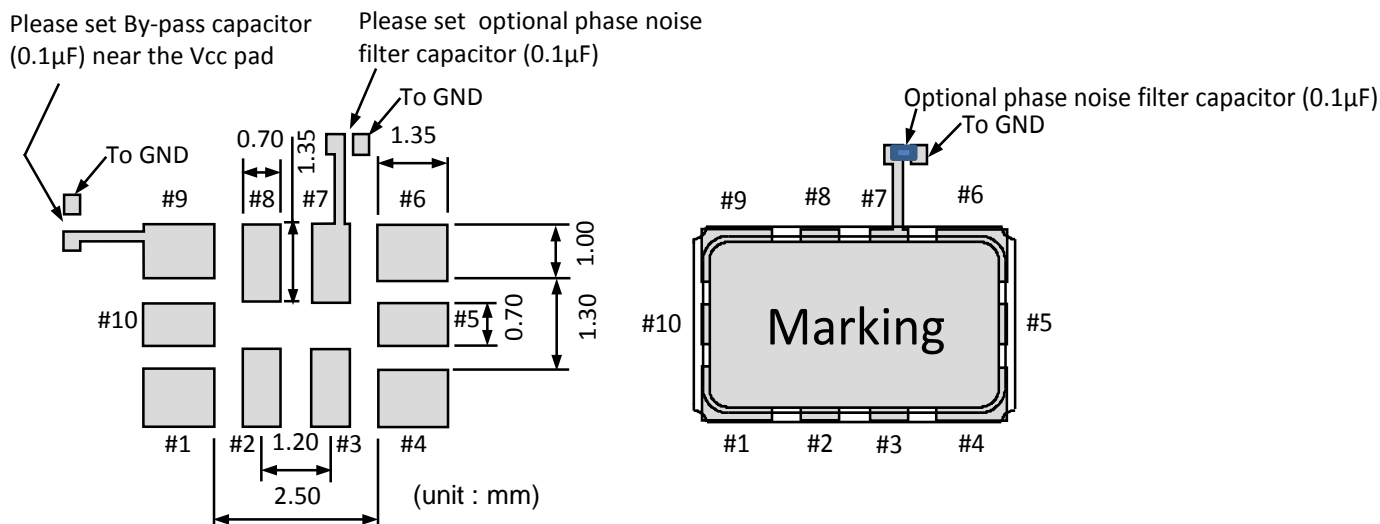
If OE Function does not use ,

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.

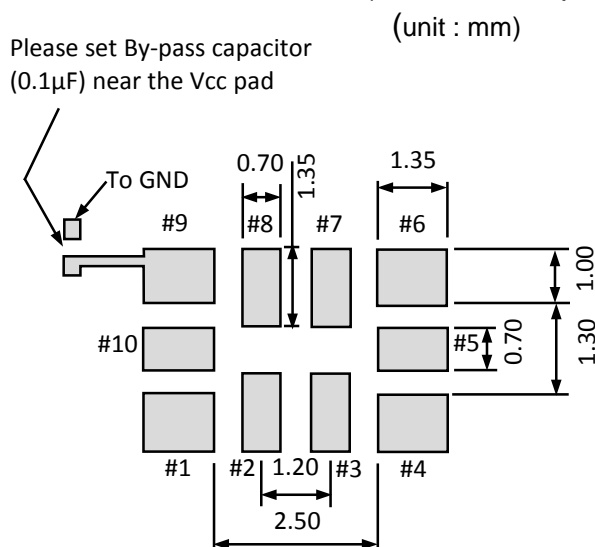
3-2-1) Soldering pattern of TG5032CBN/SBN (Filter input pattern)



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).

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.

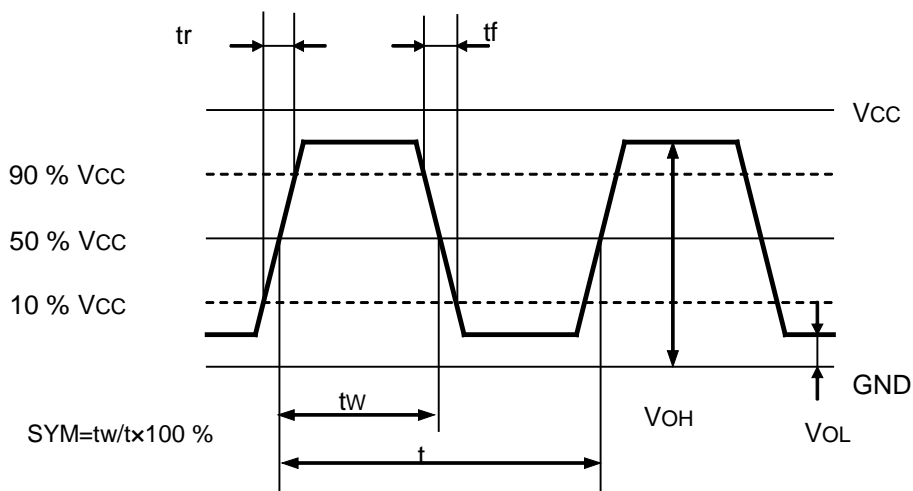
3-2-2) Soldering pattern of TG5032CBN/SBN (Without filter pattern)



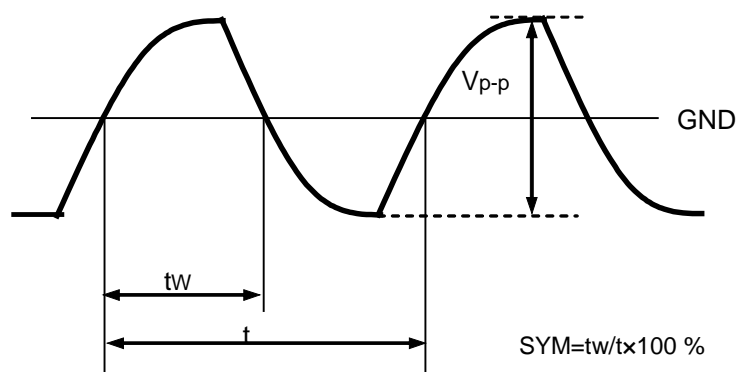
To maintain stable operation, provide a 0.1µF by-pass capacitor at a location as near as possible to the power source terminal of the crystal product (between Vcc - GND).

4. Timing chart

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



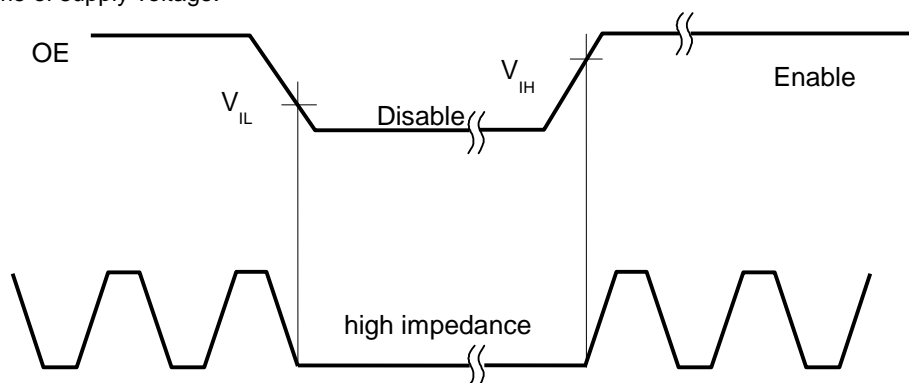
4-1-2) Output waveform (Clipped sine wave output)



4-2) OE function and timing

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

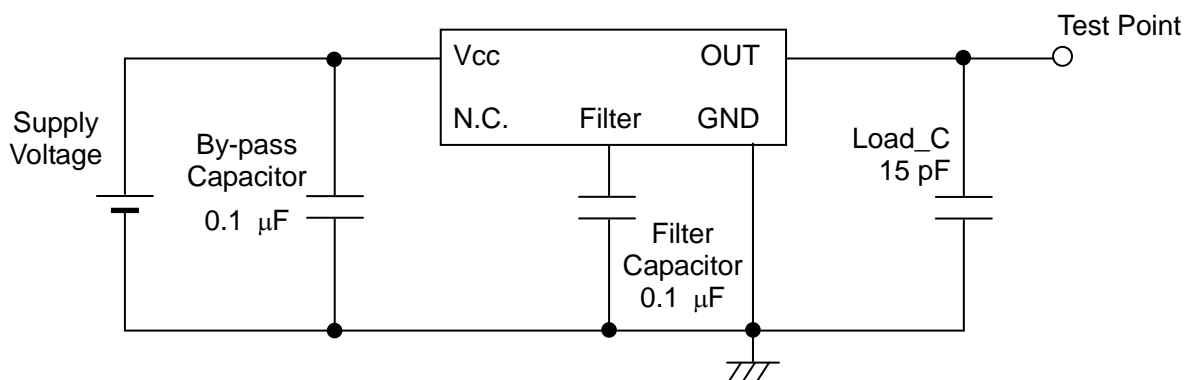
* OE input voltage must be lower than V_{CC}. Note that rise-up time of OE input voltage must not be shorter than the rise-up time of supply voltage.



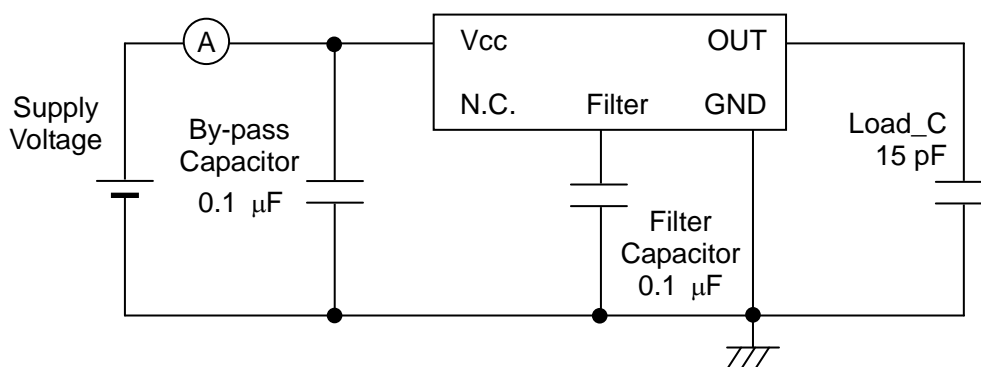
5. Test circuit

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

1) Output Load : 15 pF



2) Current consumption



3) Conditions

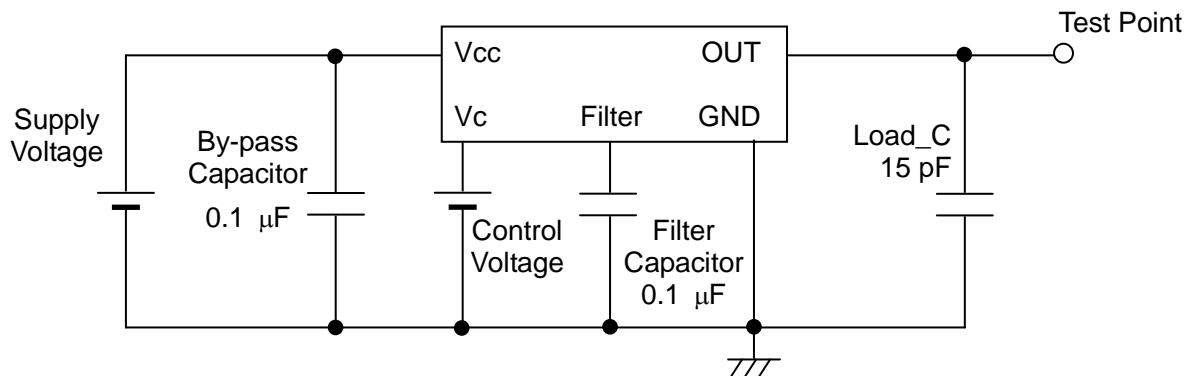
- | | |
|----------------------------|--------------|
| 1. Oscilloscope: Impedance | Min. 1 MΩ |
| Input capacitance | Max. 10 pF |
| Band width | Min. 300 MHz |

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.)

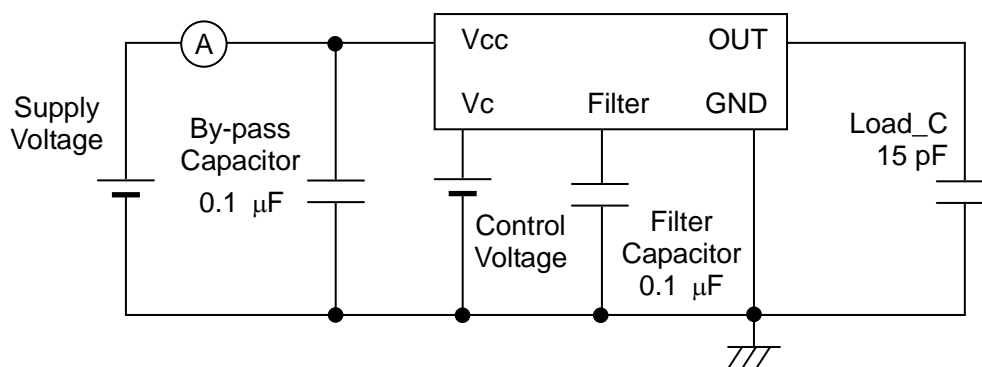
2. Load_C includes probe capacitance.
3. A capacitor (By-pass: 0.1 μF) is placed between V_{CC} and GND, and closely to TCXO.
4. Use the current meter whose internal impedance value is small.
5. Power Supply
Impedance of power supply should be as low as possible.
6. GND pin should be connected to low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

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

1) Output Load : 15 pF



2) Current consumption



3) Conditions

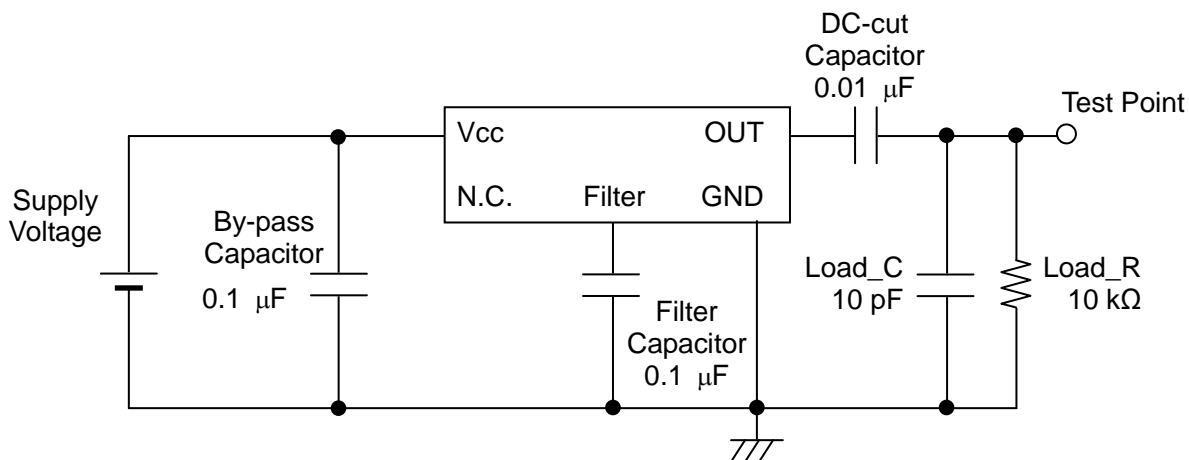
- | | |
|----------------------------|--------------|
| 1. Oscilloscope: Impedance | Min. 1 MΩ |
| Input capacitance | Max. 10 pF |
| Band width | Min. 300 MHz |

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.)

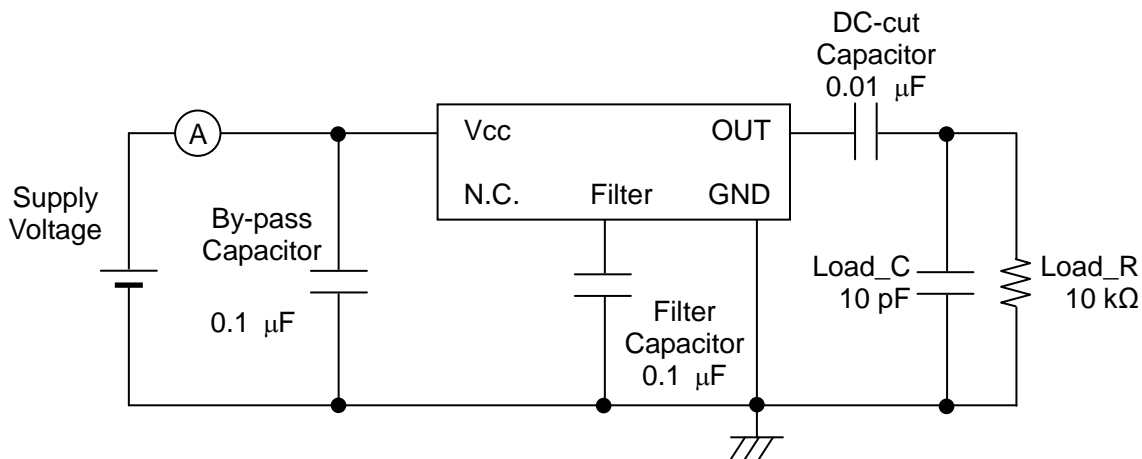
2. Load_C includes probe capacitance.
3. A capacitor (By-pass: 0.1 μF) is placed between V_{CC} and GND, and closely to TCXO.
4. Use the current meter whose internal impedance value is small.
5. Power Supply
Impedance of power supply should be as low as possible.
6. GND pin should be connected to low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

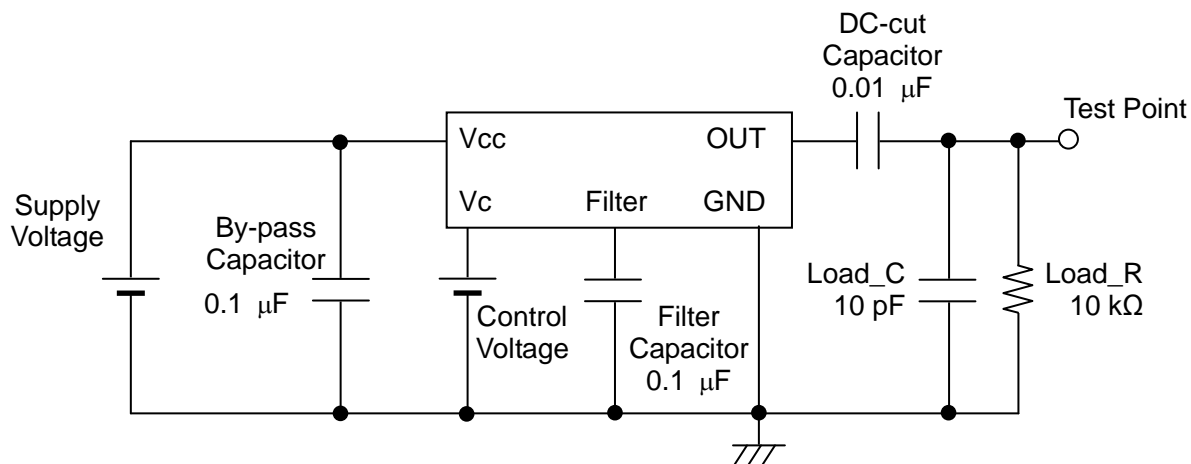
- | | |
|----------------------------|--------------|
| 1. Oscilloscope: Impedance | Min. 1 MΩ |
| Input capacitance | Max. 10 pF |
| Band width | Min. 300 MHz |

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.)

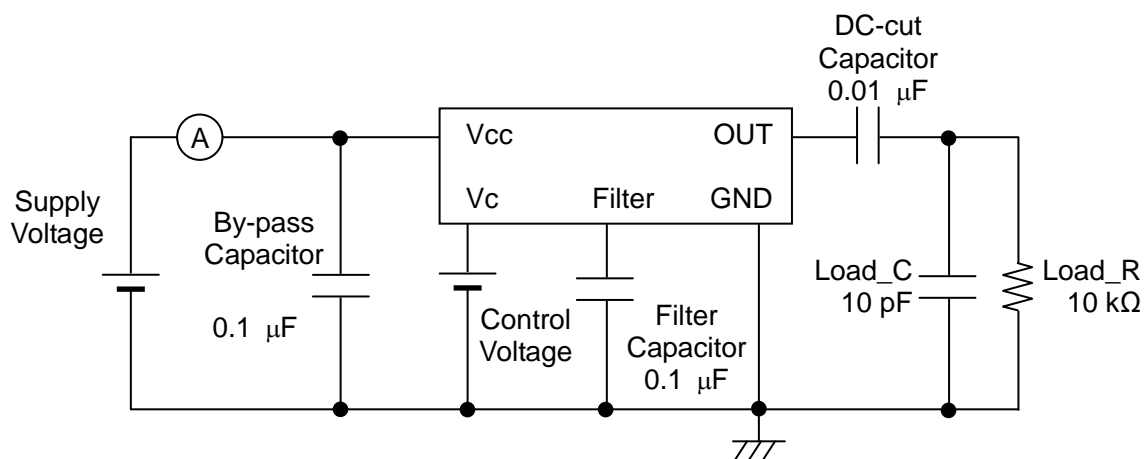
2. Load_C includes probe capacitance.
3. A capacitor (By-pass: 0.1 μF) is placed between V_{CC} and GND, and closely to TCXO.
4. Use the current meter whose internal impedance value is small.
5. Power Supply
Impedance of power supply should be as low as possible.
6. GND pin should be connected to low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

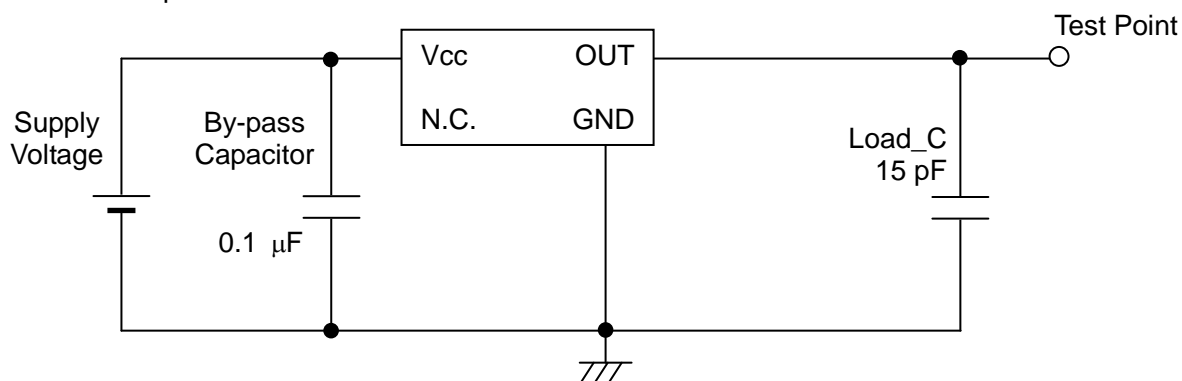
1. Oscilloscope: Impedance	Min. 1 MΩ
Input capacitance	Max. 10 pF
Band width	Min. 300 MHz

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.)

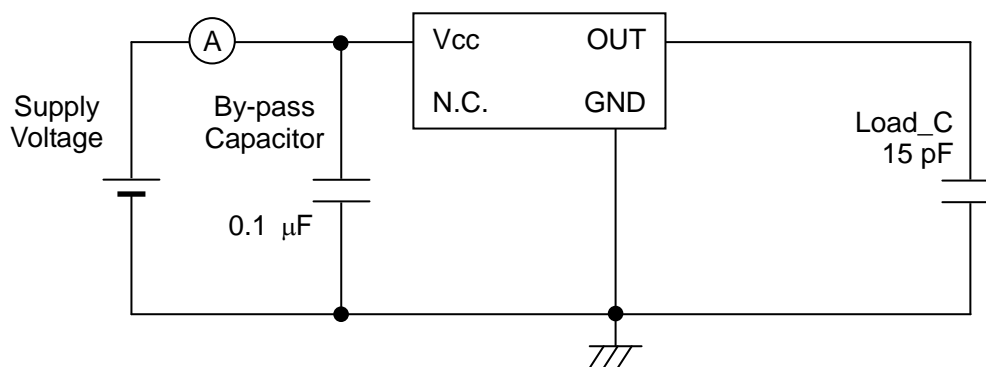
2. Load_C includes probe capacitance.
3. A capacitor (By-pass: 0.1 μF) is placed between V_{CC} and GND, and closely to TCXO.
4. Use the current meter whose internal impedance value is small.
5. Power Supply
Impedance of power supply should be as low as possible.
6. GND pin should be connected to low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

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

1) Output Load : 15 pF



2) Current consumption



3) Conditions

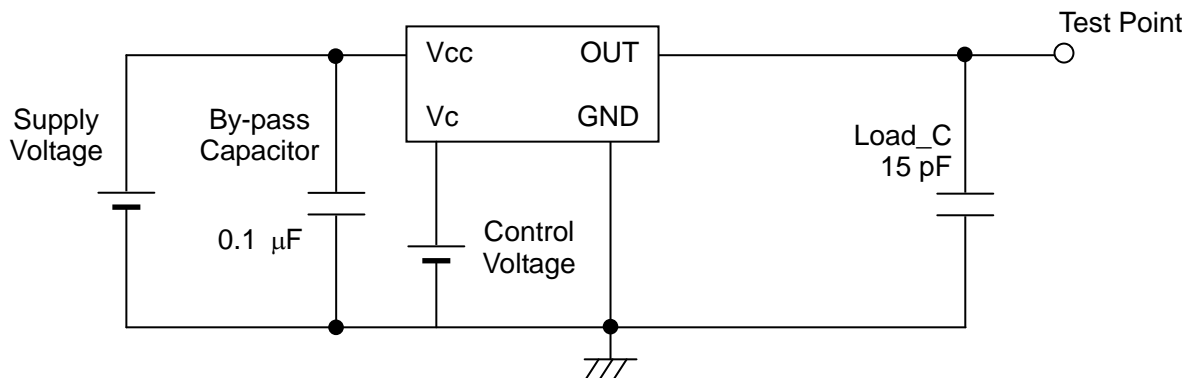
- | | |
|----------------------------|--------------|
| 1. Oscilloscope: Impedance | Min. 1 MΩ |
| Input capacitance | Max. 10 pF |
| Band width | Min. 300 MHz |

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.)

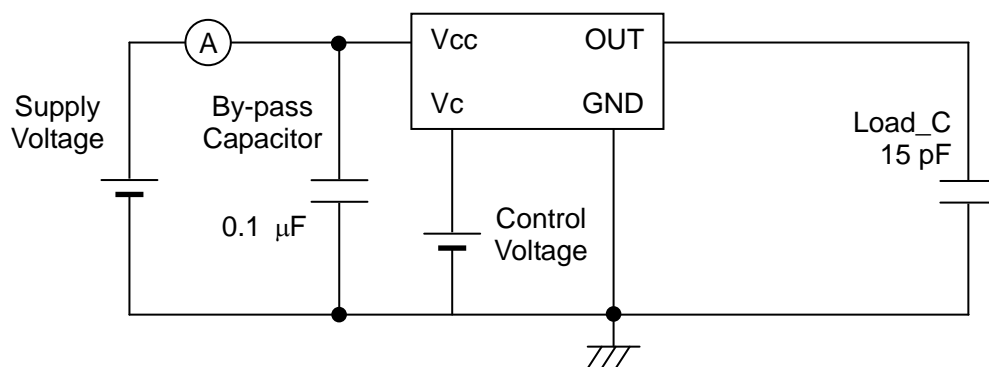
2. Load_C includes probe capacitance.
3. A capacitor (By-pass: 0.1 μF) is placed between V_{CC} and GND, and closely to TCXO.
4. Use the current meter whose internal impedance value is small.
5. Power Supply
Impedance of power supply should be as low as possible.
6. GND pin should be connected to low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

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

1) Output Load : 15 pF



2) Current consumption



3) Conditions

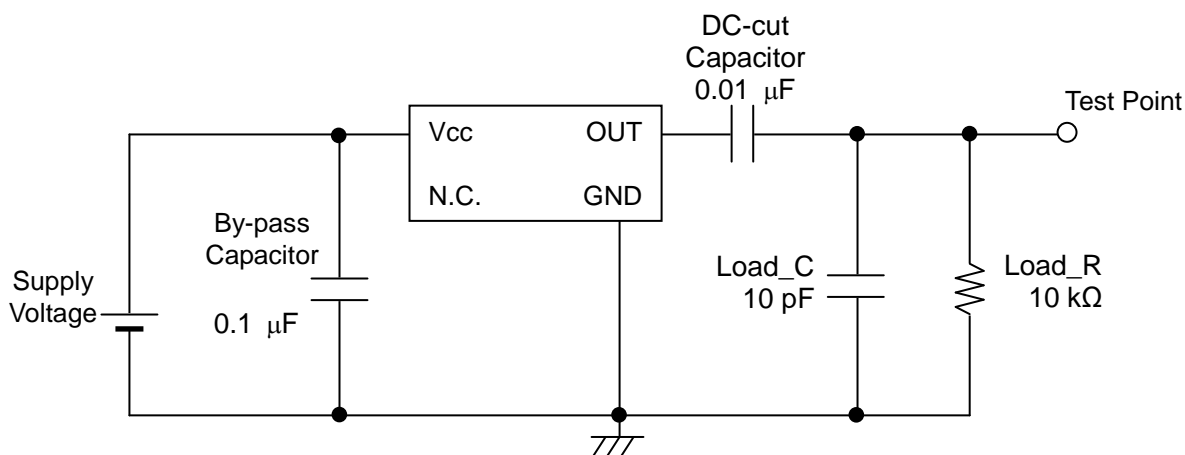
- | | |
|----------------------------|--------------|
| 1. Oscilloscope: Impedance | Min. 1 MΩ |
| Input capacitance | Max. 10 pF |
| Band width | Min. 300 MHz |

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.)

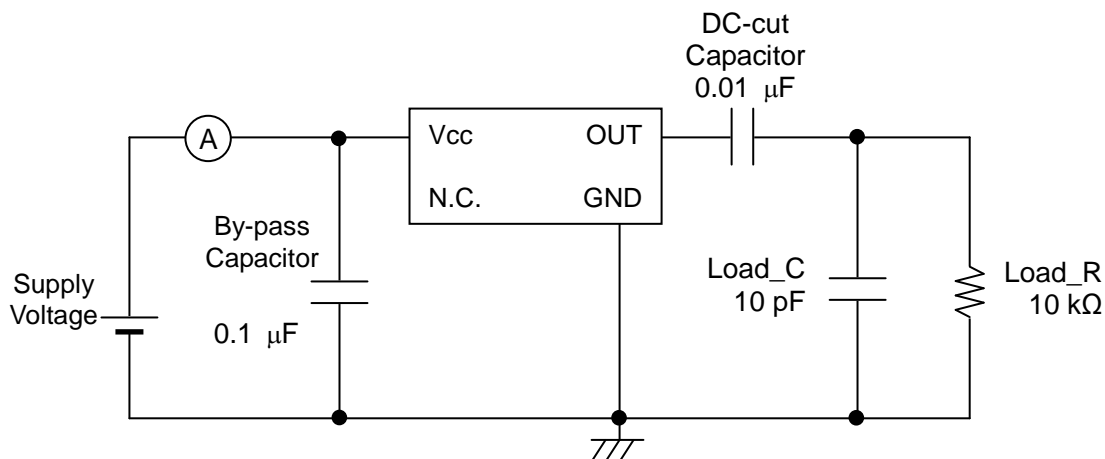
2. Load_C includes probe capacitance.
3. A capacitor (By-pass: 0.1 μF) is placed between V_{CC} and GND, and closely to TCXO.
4. Use the current meter whose internal impedance value is small.
5. Power Supply
Impedance of power supply should be as low as possible.
6. GND pin should be connected to low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

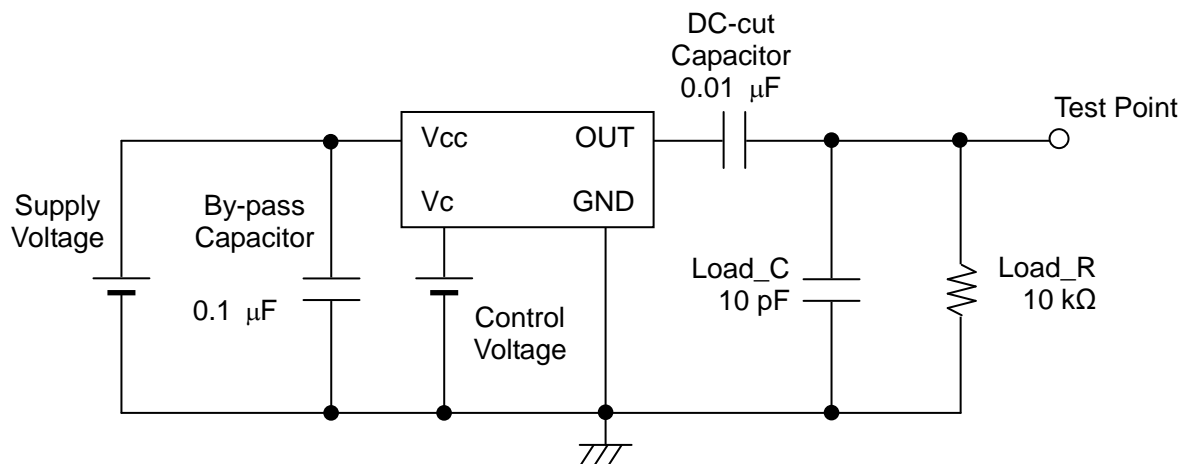
5. Power Supply

Impedance of power supply should be as low as possible.

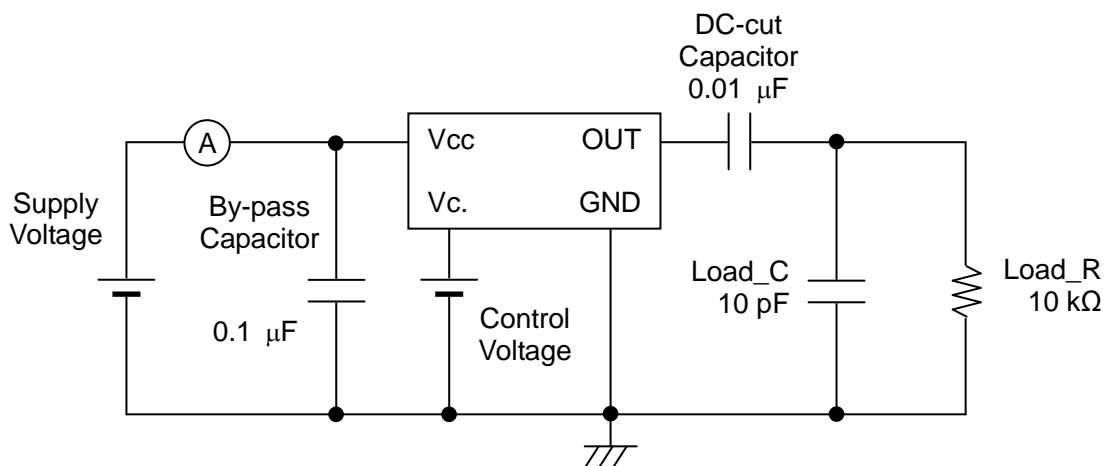
6. GND pin should be connected to low impedance GND.

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.

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