High stability temperature compensated crystal oscillator

Product name : TG3225CEN / TG2520CEN

Features

- High stability
- Frequency range : 12 MHz to 52 MHz
- Output : CMOS
- Supply voltage : 2.375 to 3.63 V
- External dimensions : 3.2 × 2.5 × 0.9mm
  : 2.5 × 2.0 × 0.8 mm
- Small size package (4pads)
- Pb free.
- Complies with EU RoHS directive.



TG3225CEN

(3.2 x 2.5 x 0.9mm)



TG2520CEN

(2.5 x 2.0 x 0.8mm)

Applications

- Measurement machine
- Wireless communication devices
- Smart meter
- Telemeter etc..

Description

These products are high stability temperature compensated crystal oscillator of CMOS outputs using fundamental oscillation of Crystal unit.

This has realized a low phase noise in frequency 12 to 52 MHz, and it is suitable for the reference clock for measurement machine and wireless communication devices.

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	Vc-GND	V	-0.5	-	V_{CC}+0.5	Vc Terminal

2) Operating conditions

Parameter	Symbol	Unit	Min.	Typ.	Max	Notes
Supply voltage	V_{CC}	V	2.375	-	3.63	Supply voltage range
			2.66	2.8	2.94	V_{CC}=2.8 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	Vc	V	GND	N.C.	-	Vc Terminal / TCXO
			0.4	1.4	2.4	Vc Terminal / VC-TCXO
			0.5	1.5	2.5	
			0.65	1.65	2.65	
Output load condition	Load_C	pF	13.5	15	16.5	

3-1) Frequency characteristics

(V_{CC}= Typ., GND= 0 V, Vc= Typ. V, Load= Typ., T_use= +25°C)

Parameter	Symbol	Unit	Min.	Typ.	Max	Notes
Output frequency	fo	MHz	12	-	52	
Frequency tolerance *1 (T_use=+25°C +/-2°C) (Reflow cycles : 2 times) *2	f_tol	× 10^{-6}	-2.0	-	+2.0	(Standard)
			-1.5	-	+1.5	(**Option**)
Frequency / temperature characteristics (Reference to +25°C.)	fo-Tc	× 10^{-6}	-2.0	-	+2.0	T_use = -40°C to +85°C
Frequency / load coefficient	fo-Load	× 10^{-6}	-0.2	-	+0.2	Load +/-10%
Frequency / voltage coefficient	fo- V_{CC}	× 10^{-6}	-0.3	-	+0.3	V_{CC} +/-5% *3
Hysteresis	-	× 10^{-6}	-0.6	-	+0.6	Frequency measured before and after at +25°C.
Frequency aging (12 MHz ≤ f0 ≤ 20 MHz, 24 MHz ≤ f0 ≤ 40 MHz)	f_age	× 10^{-6}	-1.0	-	+1.0	T_use=+25°C, First year (Standard)
			-0.7	-	+0.7	T_use=+25°C, First year (**Option**)
			-2.0	-	+2.0	T_use=+25°C, 3 years (Standard)
			-1.5	-	+1.5	T_use=+25°C, 3 years (**Option**)
			-3.0	-	+3.0	T_use=+25°C, 5 years (Standard)
			-2.0	-	+2.0	T_use=+25°C, 5 years (**Option**)
			-5.0	-	+5.0	T_use=+25°C, 10 years (Standard)
			-3.5	-	+3.5	T_use=+25°C, 10 years (**Option**)
Frequency aging (20 MHz < f0 < 24 MHz, 40 MHz < f0 ≤ 52 MHz)	f_age	× 10^{-6}	-1.5	-	+1.5	T_use=+25°C, First year
			-2.5	-	+2.5	T_use=+25°C, 3 years
			-3.0	-	+3.0	T_use=+25°C, 5 years
			-5.0	-	+5.0	T_use=+25°C, 10 years

*1 Include initial frequency tolerance and frequency deviation after reflow cycles.

*2 Measured in the elapse of 24 hours after reflow soldering.

*3 V_{CC} +/- 5% must be in operating supply voltage range.

3-2) Frequency control characteristics

(V_{CC}= Typ., GND= 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}	-15.0	-	-8.0	Vc=1.4V+/-1.0V, Vc=1.5V+/-1.0V, Vc=1.65V+/-1.0V
			+8.0	-	+15.0	
Linearity	-	%	-10	-	+10	
Input impedance	Z_{IN}	kΩ	500	-	-	Vc-GND(DC), Vc=Typ.
Frequency change polarity	-	-	Positive polarity			

4) Electrical Characteristics

(Vcc= Typ., GND= 0 V, Vc= Typ. V, Load= Typ., T_use= +25°C)

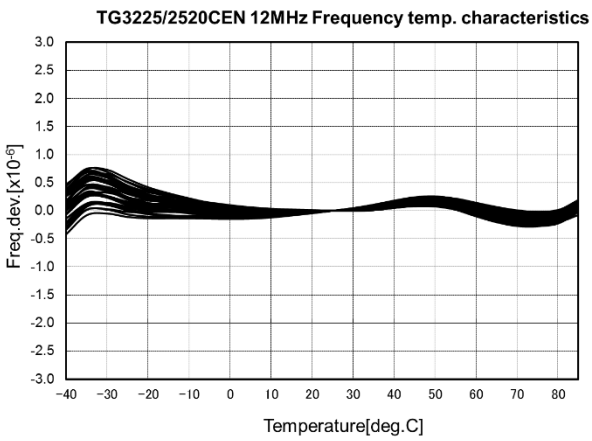
Parameter	Symbol	Unit	Min.	Typ.	Max	Notes
Current consumption	I_{CC}	mA	-	-	4.0	12 MHz ≤ f0 ≤ 26 MHz
			-	-	6.0	26 MHz <f0 ≤ 39 MHz
			-	-	6.5	39 MHz <f0 ≤ 52 MHz
Start up time	t_str	ms	-	-	2.0	Until output signal has been reached min 90% of final amp.
			-	-	2.0	Until frequency has been reached within +/-1x10^{-6} of final frequency.
Rise time	tr	ns	-	-	8.0	10%Vcc to 90%Vcc level (Standard)
			-	-	6.5	10%Vcc to 90%Vcc level (**Option**)
Fall time	tf	ns	-	-	8.0	90%Vcc to 10%Vcc level (Standard)
			-	-	6.5	90%Vcc to 10%Vcc level (**Option**)
Symmetry	SYM	%	45	50	55	50%V_{CC} level
High output voltage	V_{OH}	V	90% V_{CC}	-	-	
Low output voltage	V_{OL}	V	-	-	10% V_{CC}	
Phase noise (12 MHz)	L(f)	dBc/ Hz	-	-68	-	1 Hz offset
			-	-98	-	10 Hz offset
			-	-123	-	100 Hz offset
			-	-144	-	1 kHz offset
			-	-152	-	10 kHz offset
			-	-152	-	100 kHz offset
			-	-153	-	1 MHz offset
Phase noise (27 MHz)	L(f)	dBc/ Hz	-	-60	-	1 Hz offset
			-	-91	-	10 Hz offset
			-	-117	-	100 Hz offset
			-	-139	-	1 kHz offset
			-	-151	-	10 kHz offset
			-	-153	-	100 kHz offset
			-	-155	-	1 MHz offset
Phase noise (39 MHz)	L(f)	dBc/ Hz	-	-59	-	1 Hz offset
			-	-89	-	10 Hz offset
			-	-115	-	100 Hz offset
			-	-136	-	1 kHz offset
			-	-149	-	10 kHz offset
			-	-151	-	100 kHz offset
			-	-153	-	1 MHz offset
Phase noise (52 MHz)	L(f)	dBc/ Hz	-	-55	-	1 Hz offset
			-	-85	-	10 Hz offset
			-	-112	-	100 Hz offset
			-	-133	-	1 kHz offset
			-	-147	-	10 kHz offset
			-	-150	-	100 kHz offset
			-	-152	-	1 MHz offset

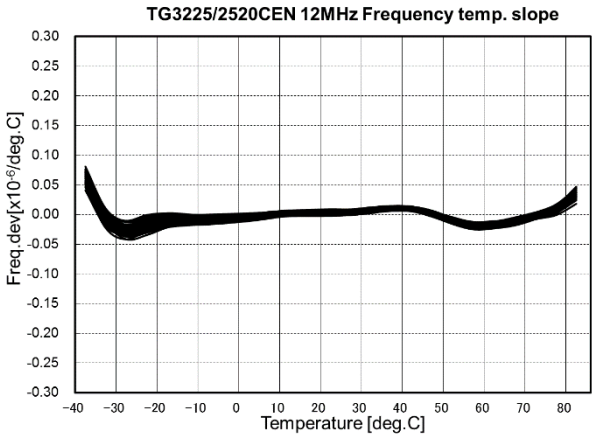
2. Characteristics

2-1) “Frequency / temperature characteristics”

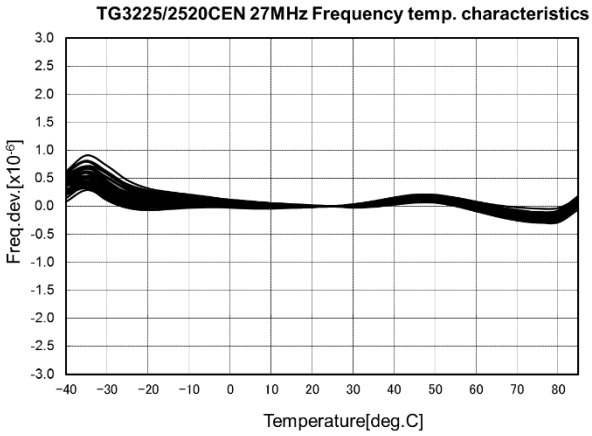
2-1-1) Standard spec : +/-2.0 × 10^{-6} Max. (T_use= -40 °C to +85 °C)

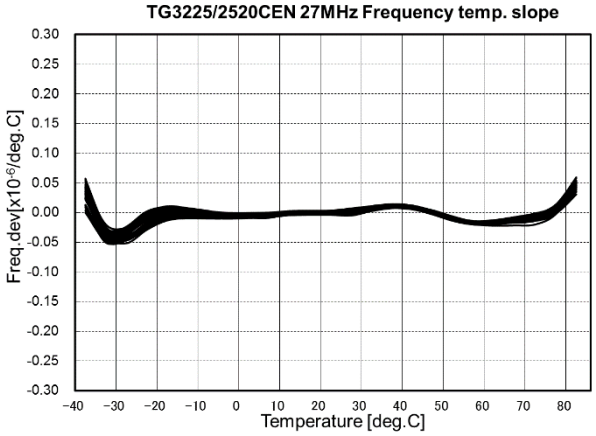
12 MHz [N= 40 pcs]



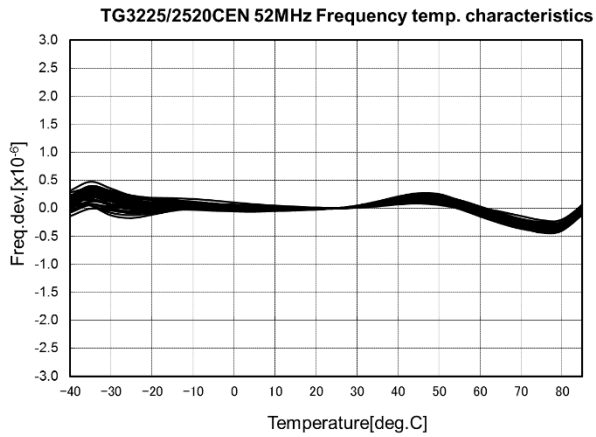


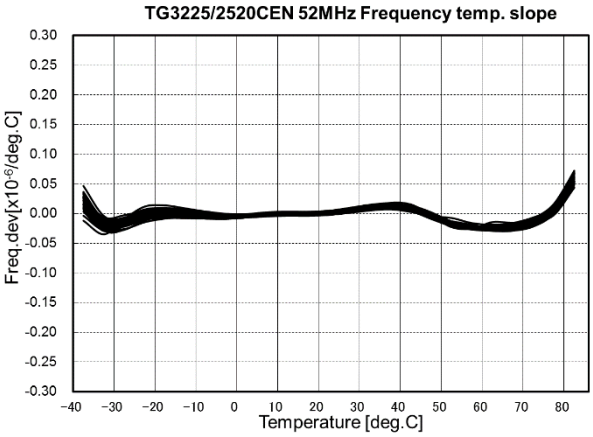
27 MHz [N= 40 pcs]



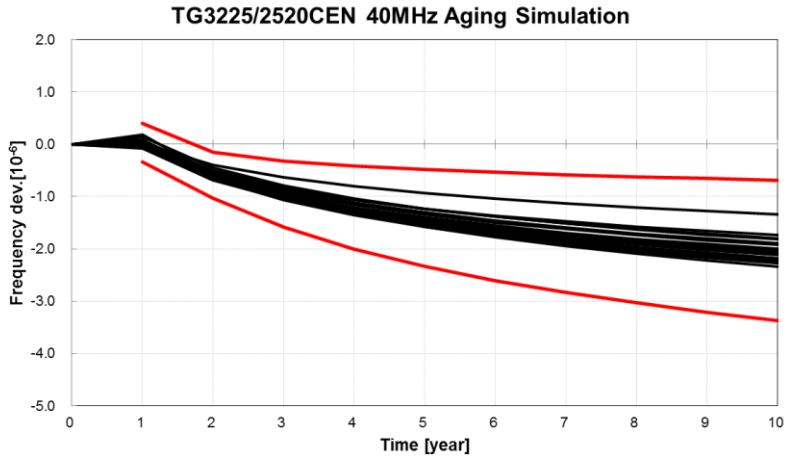


52 MHz [N= 40 pcs]





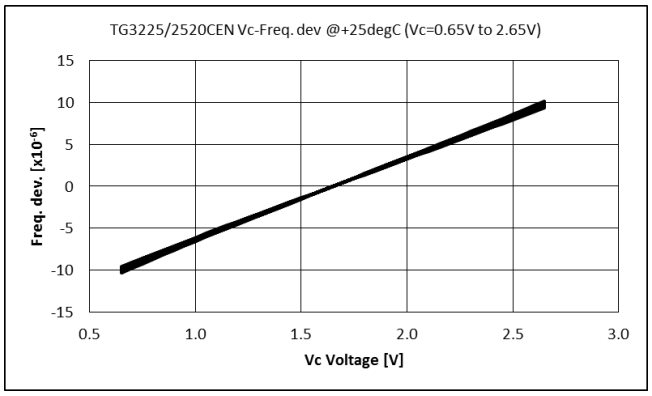
2-2) Frequency aging (40MHz) [N=22pcs]

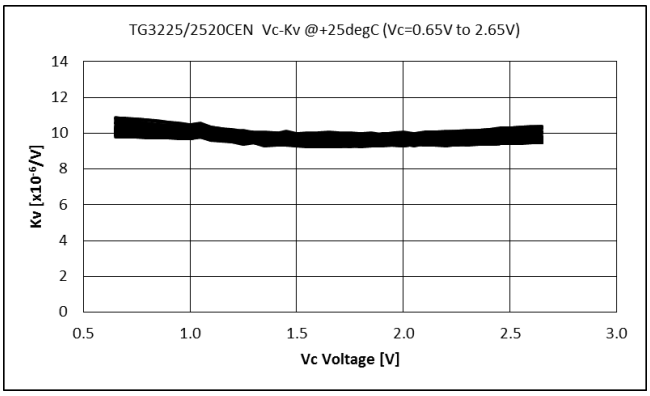


about 1year
Ave. : +0.03 x 10^{-6}
Max. : +0.19 x 10^{-6}
Min. : -0.08 x 10^{-6}

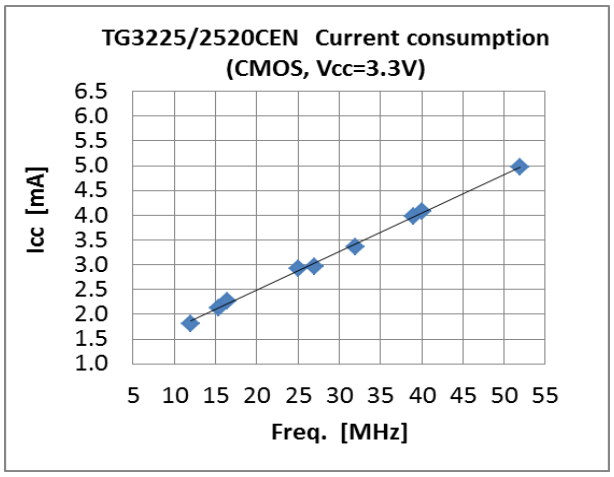
about 10years
Ave. : -2.03 x 10^{-6}
Max. : -1.34 x 10^{-6}
Min. : -2.34 x 10^{-6}

2-3) Frequency control characteristics [N = 40 pcs]

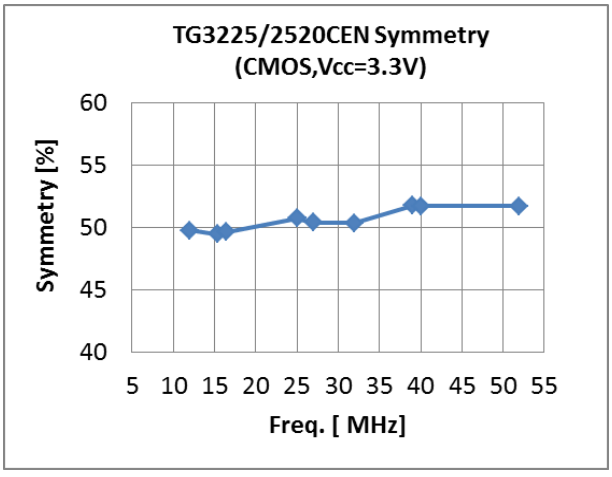




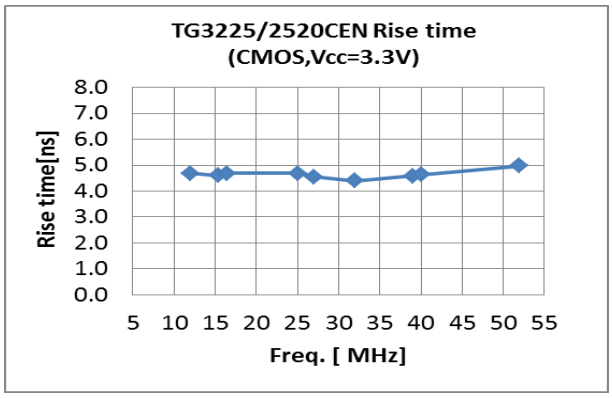
2-4) current consumption

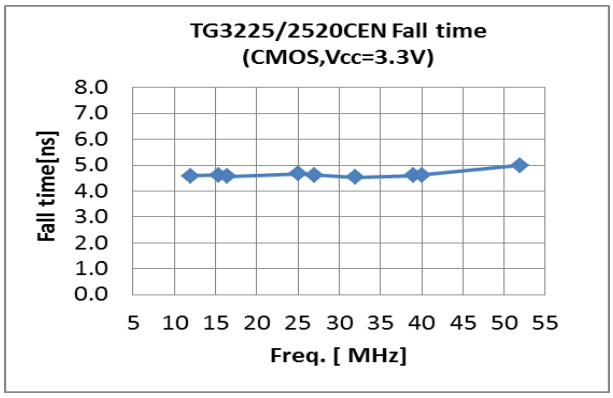


2-5) Symmetry

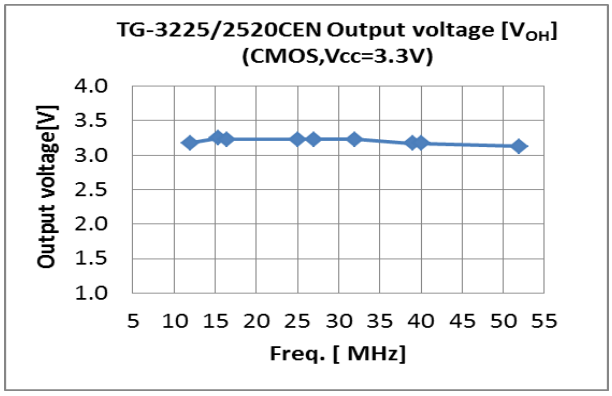


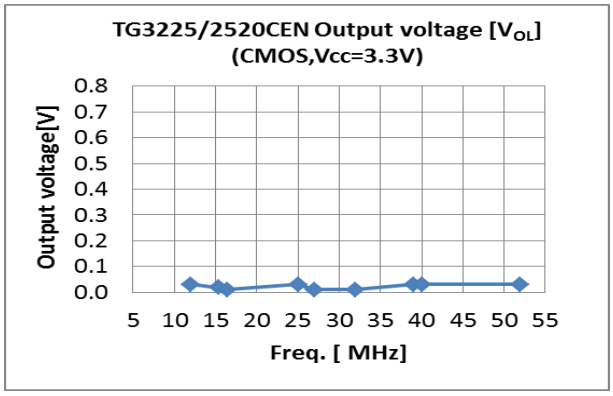
2-6) Rise time / Fall time





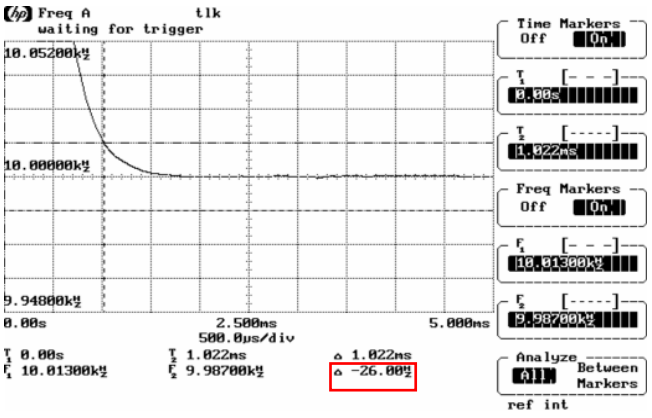
2-7) Output voltage [V_{OH}, V_{OL}]



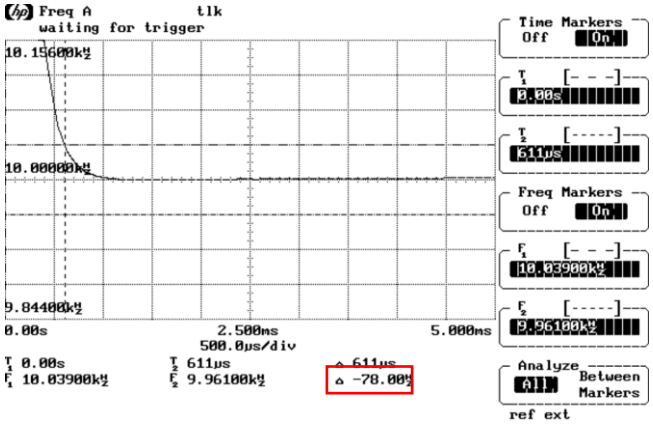


2-8) start up time(27 MHz, 39 MHz, 52 MHz)

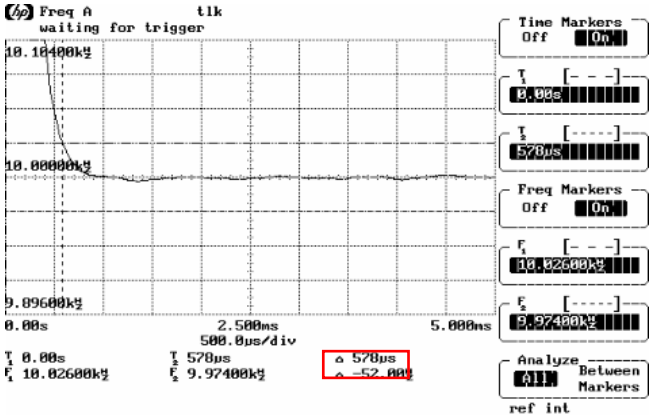
27 MHz



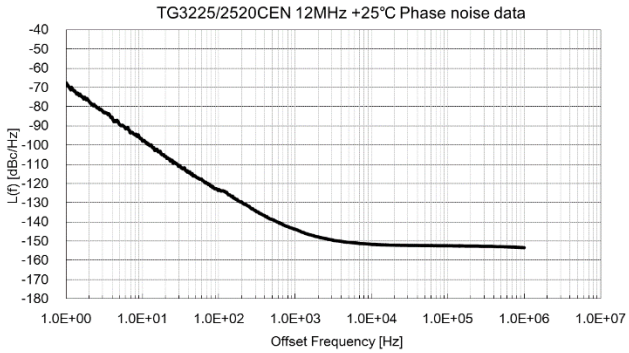
39 MHz

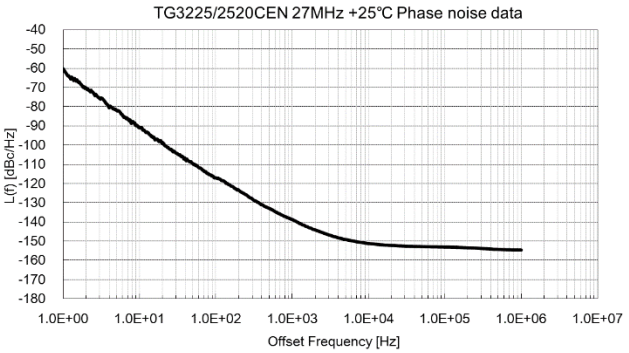


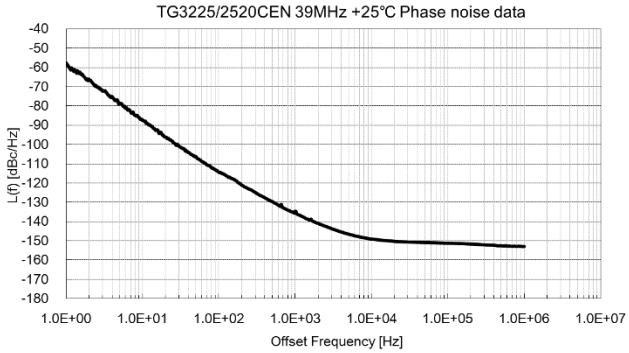
52 MHz

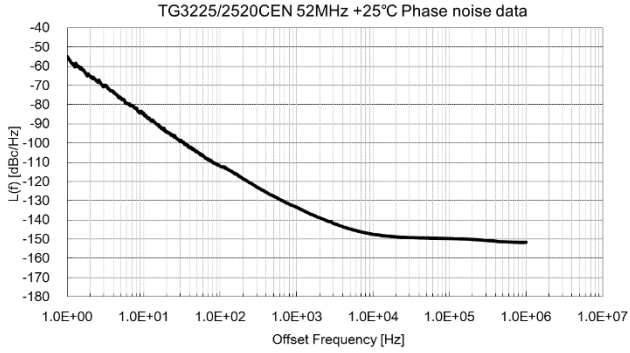


2-9) Phase noise (12 MHz, 27 MHz, 39 MHz, 52 MHz, refer to data of Page3.)

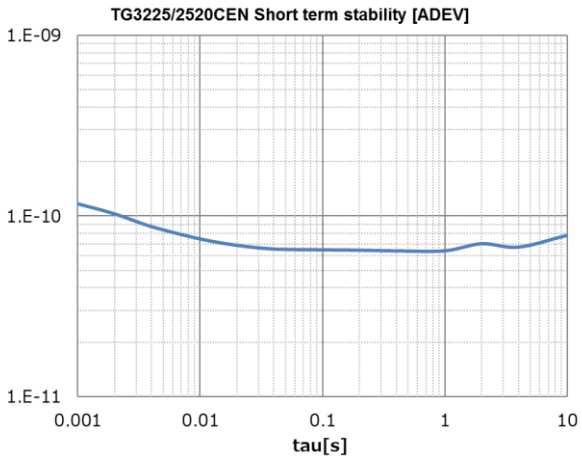








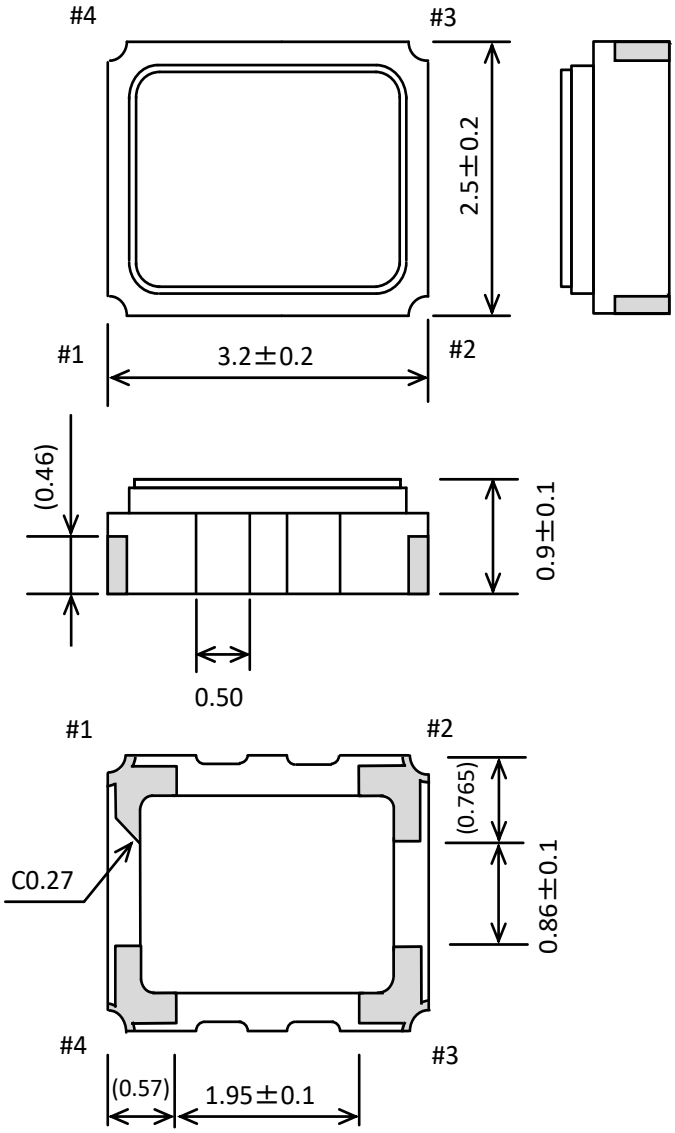
2-10) Short term stability [ADEV] (27MHz)



3. Outline

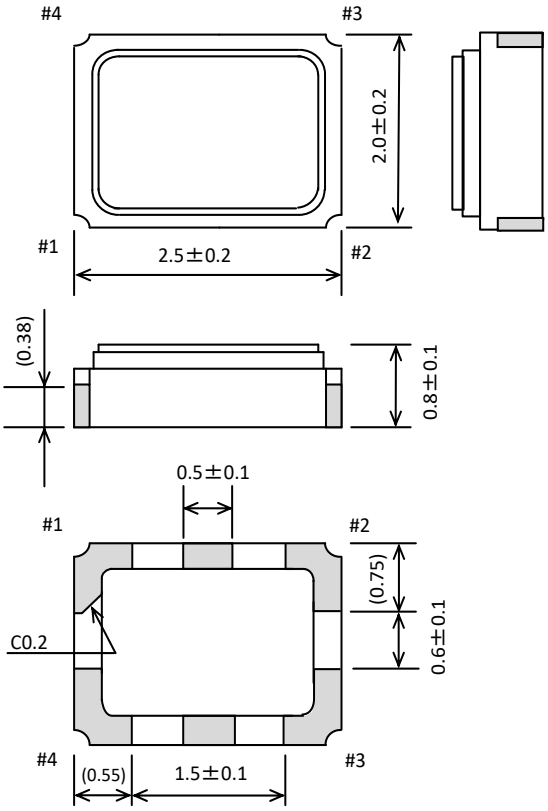
3-1) Outline dimensions and Pin information

3-1-1) TG3225CEN



3-1-2) TG2520CEN

Unit: mm



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

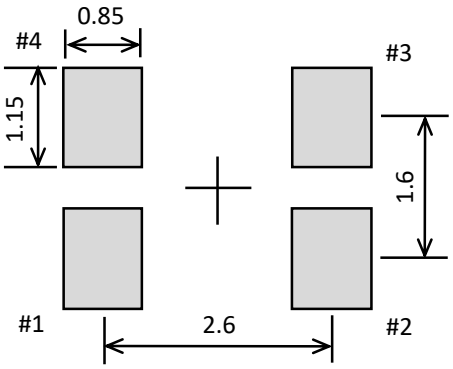
Do not connect “N.C.” pin with any other leads (also mutually)

Material
Ceramics(Cavity)
Au plated nickel(Electric terminal)
Fe-Ni-Co(Lid)

3-2) Soldering pattern

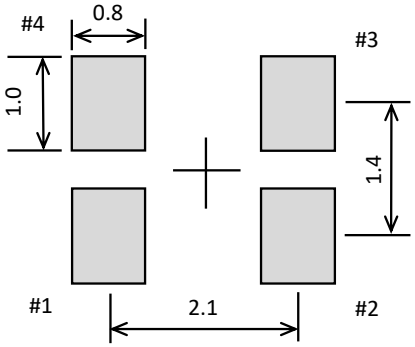
Example of patterning design indicated as follows. In an actual design, please consider mounting density, the reliability of soldering, etc. and check whether performance is optimal.

3-2-1) TG3225CEN



3-2-2) TG2520CEN

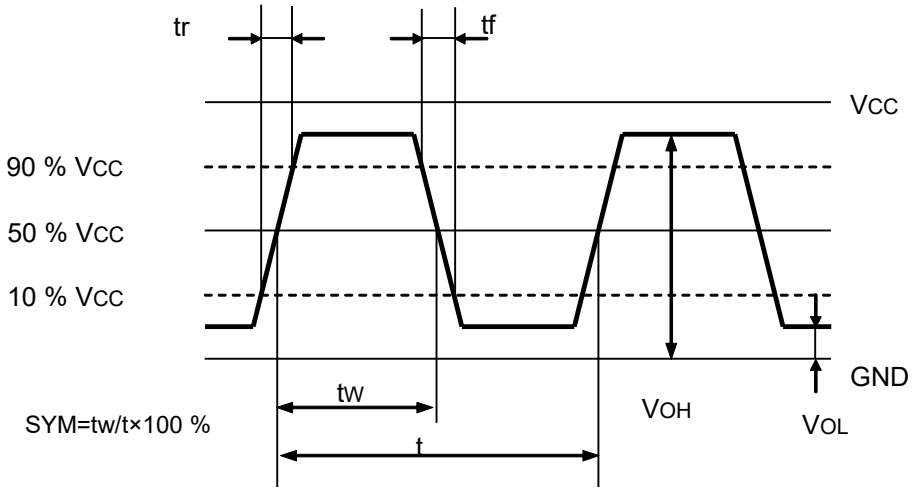
(unit : mm)



To maintain stable operation, provide a 0.01 uF to 0.1 uF by-pass capacitor at a location as near as possible to the power source terminal of the crystal product (between V_{CC} - GND).

4. Timing chart

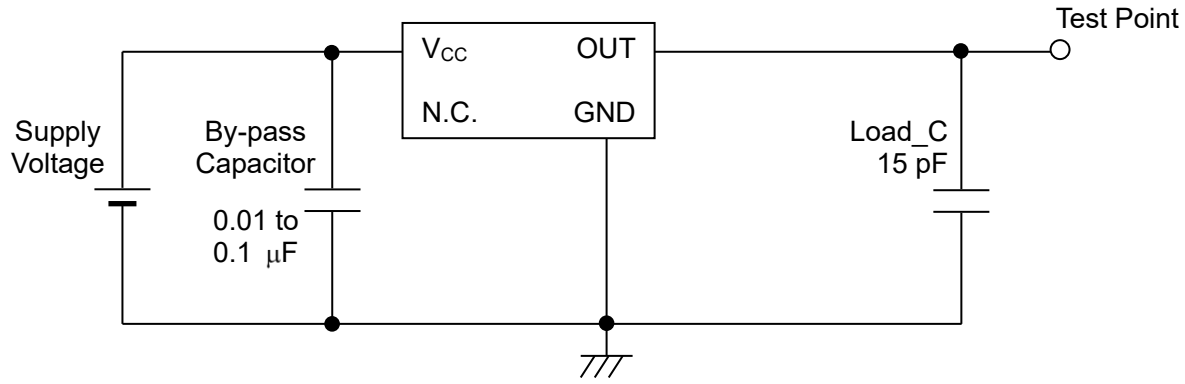
4-1) Output waveform (CMOS output)



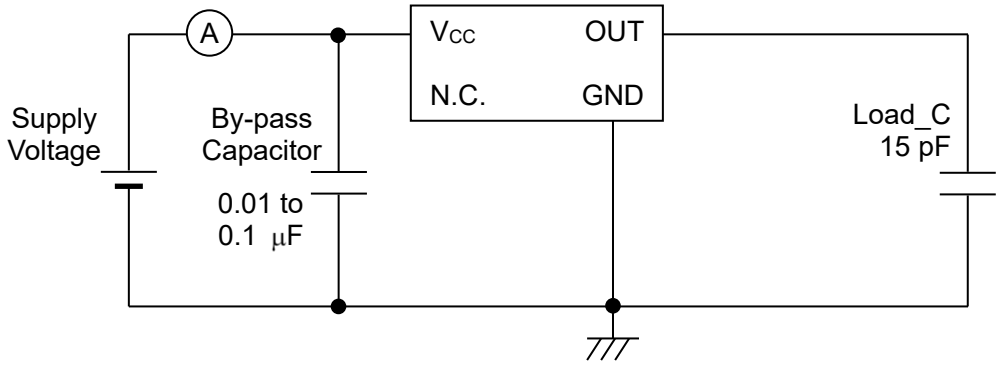
5. Test circuit

5-1) CMOS output for TCXO

1) Wave form Output Load : 15 pF



2) Current consumption



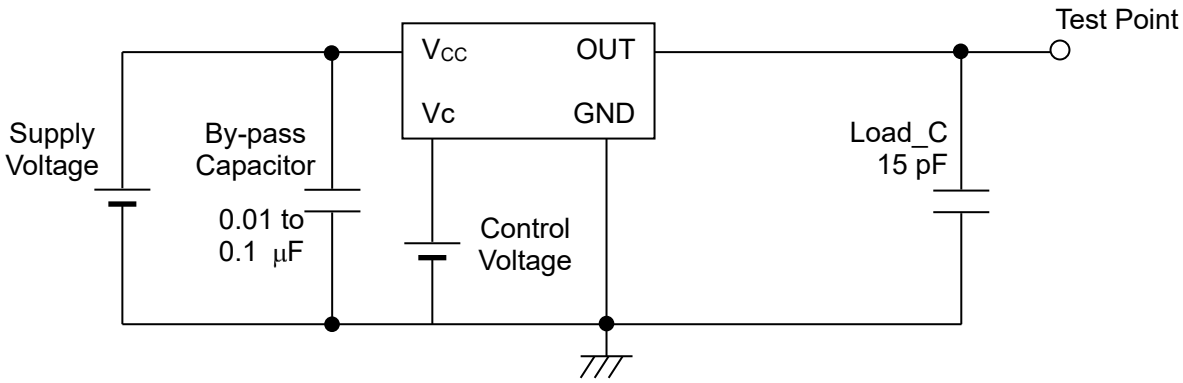
3) Conditions

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: 0.01 µF to 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.

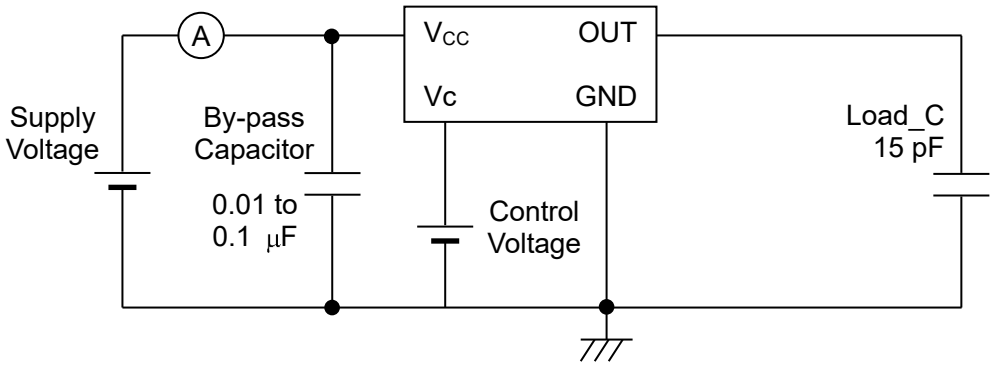
深圳市满度科技有限公司
Web:www.manduic.com
Tel:15612009940
Email:sales@manduic.com

5-2) CMOS output for VC-TCXO

1) Wave form 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: 0.01 µF to 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 (https://www5.epsondevice.com/en/information/#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 roduct 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) Do not expose this product to excessive mechanical shock or vibration.
(2) This product can be damaged by mechanical shock during the soldering process depending on the equipment used, process conditions, and any impact forces experienced. Always follow appropriate procedures, particularly when changing the assembly process in anyway and be sure to follow applicable process qualification standards before starting production.
(3) These devices are sensitive to ESD, please use appropriate precautions during handling, assembly, test, shipment, and installation.
(4) This product contains semiconductor content that should not be exposed to electromagnetic waves.
(5) The use of ultrasonic technology for cleaning, bonding, etc. can damage the Xtal unit inside this product.
Please carefully check for this consideration before using ultrasonic equipment for volume production with this product.
(6) Noise and ripple on the power supply may have undesirable affects on operation and cause degradation of phase noise characteristics. Evaluate the operation of this device with appropriate power supplies carefully before use.
(7) When applying power, ensure that the supply voltage increases monotonically for proper operation.
On power down, do not reapply power until the supplies, bypass capacitors, and any bulk capacitors are completely discharged since that may cause the unit to malfunction.
(8) Aging specifications are estimated from environmental reliability tests and expected frequency variation over time. They do not provide a guarantee of aging over the product lifecycle.
(9) The metal cap on top of the device is directly connected to the GND terminal (pin #2). Take necessary precautions to prevent any conductor not at ground potential from contacting the cap as that could cause a short circuit to GND.
(10) Do not route any signal lines, supply voltage lines, or GND lines underneath the area where the oscillators are mounted including any internal layers and on the opposite side of the PCB.
To avoid any issues due to interference of other signal lines, please take care not to place signal lines near the product as this may have an adverse affect on the performance of the product.
(11) A bypass capacitor of the recommended value(s) must be connected between the V_{CC} and GND terminals of the product. Whenever possible, mount the capacitor(s) on the same side of the PCB and as close to the product as possible to keep the routing traces short.
(12) Power supply connections to V_{CC} and GND pins should be routed as thick as possible while keeping the high frequency impedance low in order to get the best performance.
(13) The use of a filter or similar element in series with the power supply connections to protect from electromagnetic radiation noise may increase the high frequency impedance of the power supply line and may cause the oscillator to not operate properly. Please verify the design to ensure sufficient operational margin prior to use.
(14) Keep PCB routing from the output terminal(s) to the load as short as possible for best performance.
(15) Do not short the output to GND as that will damage the product. Always use with an appropriate load resistor connected.
(16) Product failures during the warranty period only apply when the product is used according to the recommended operating conditions described in the specifications. Products that have been opened for analysis or damaged will not be covered. It is recommended to store and use in normal temperature and humidity environments described in the specifications to ensure frequency accuracy and prevent moisture condensation. If the product is stored for more than one year, please confirm the pin solderability prior to use.
(17) If the oscillation circuit is exposed to condensation, the frequency may change or oscillation may stop.
Do not use in any conditions where condensation occurs.
(18) Do not store or use the product in an environment where it can be exposed to chemical substances that are corrosive to metal or plastics such as salt water, organic solvents, chemical gasses, etc..
Do not use the product when it is exposed to sunlight, dust, corrosive gasses, or other materials for long periods of time.
(19) When using water-soluble solder flux make sure to completely remove the flux residue after soldering.
Pay particular attention when the residues contain active halogens which will negatively affect the product and its performance.
(20) Do not touch the surface of the IC with tweezers or other hard tools.
(21) Do not use adhesives with this product as this will cause the oscillation to stop if the IC is damaged by adhesive. This product uses an underfill material on the bottom side of package where adhesive near the bottom side may cause the TCXO to be damaged by thermal expansion.

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