Temperature Compensated Crystal Oscillator (TCXO)

· Package size (2.5 mm × 2.0 mm × 0.8 mm)
· High stability TCXO
· Output waveform : CMOS
· Reference weight Typ. 16 mg

[1] Product Number / Product Name

(1-1) Product Number / Ordering Code

X1G0051610013xx

last 2 digits code(xx) define Quantity.
The standard is "27", 10 000 pcs/Reel.

(1-2) Product Name / Model Name

TG2520CEN 48.000000 MHz KFGNNM

[2] Operating Conditions

Parameter	Symbol	Specifications			Unit	Conditions
		Min.	Typ.	Max.		
Supply voltage	Vcc	3	3.3	3.6	V	-
	GND	0	-	0	V	-
Operating temperature range	T_use	-40	-	+85	°C	-
Output load	Load_C	13.5	15	16.5	pF	-

[3] Frequency Characteristics

(Vcc = 3.3 V, GND = 0.0 V, Load = 15 pF, T_use = +25 °C)

Parameter	Symbol	Specifications			Unit	Conditions
		Min.	Typ.	Max.		
Output Frequency	fo	-	48	-	MHz	
Frequency tolerance *1	f_tol	-2.0	-	+2.0	$x10^{-6}$	T_use = +25 °C±2 °C After 2 reflows *2
Frequency / temperature characteristics	fo-Tc	-2.0	-	+2.0	$x10^{-6}$	T_use = -40 °C to +85 °C (Reference to +25 °C)
Frequency / load coefficient	fo-Load	-0.2	-	+0.2	$x10^{-6}$	15 pF±10 %
Frequency / voltage coefficient	fo-Vcc	-0.3	-	+0.3	$x10^{-6}$	Vcc ±5 % *3
Frequency aging *4	f_age	-1.5	-	+1.5	$x10^{-6}$	T_use = +25°C first year

*1 Include initial frequency tolerance and frequency deviation after reflow cycles.
*2 Measured in the elapse of 24 hours after reflow soldering.
*3 Vcc ± 5% must be in operating supply voltage range (3 V to 3.6 V)
*4 Aging stability is estimated from environmental reliability tests; expected amount of the frequency variation.

[4] Electrical Characteristics

(Vcc = 3.3 V, GND = 0.0 V, Load = 15 pF, T_use = +25 °C)

Parameter	Symbol	Specifications			Unit	Conditions
		Min.	Typ.	Max.		
Current consumption	Icc	-	-	6.5	mA	-
Output voltage	V_{OH}	90 % Vcc	-	-	V	-
	V_{OL}	-	-	10 % Vcc	V	-
Rise time	tr	-	-	8.0	ns	10 % Vcc to 90 % Vcc level
Fall time	tf	-	-	8.0	ns	90 % Vcc to 10 % Vcc level
Start up time	t_str	-	-	2.0	ms	Until frequency has been reached within ±1x10^{-6} of final frequency.
		-	-	2.0	ms	Until output signal has been reached min 90 % of final amp.
Symmetry	SYM	45	50	55	%	50 % Vcc Level

[For other general specifications, please refer to the attached Full Data Sheet below]

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.

►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]

This material is subject to change without notice.

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.: TG3225_2520CEN_AE_Ver. 1.00
Date: Nov. 20th 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
			2.66	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	V_C	V	GND	N.C.	-	V_C Terminal / TCXO
			0.4	1.4	2.4	V_C 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

(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	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 Vcc +/- 5% must be in operating supply voltage range.

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}	-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	-	-	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)

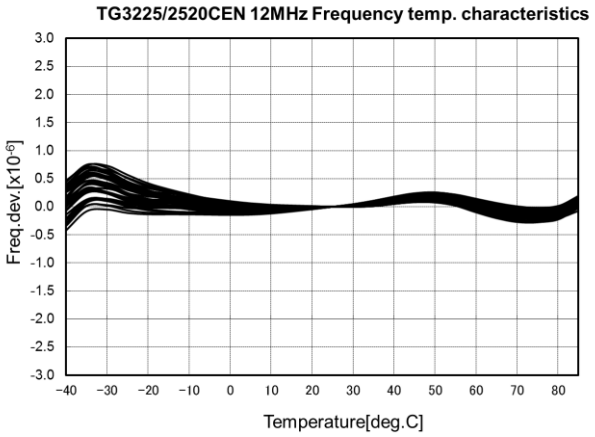
Parameter	Symbol	Unit	Min.	Typ.	Max	Notes
Current consumption	I_{CC}	mA	-	-	4.0	12 MHz ≤ f0 ≤ 26 MHz
			-	-	6.0	26 MHz <f0 ≤ 39 MHz
			-	-	6.5	39 MHz <f0 ≤ 52 MHz
Start up time	t_str	ms	-	-	2.0	Until output signal has been reached min 90% of final amp.
			-	-	2.0	Until frequency has been reached within +/-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%Vcc level
High output voltage	V_{OH}	V	90% V_{CC}	-	-	
Low output voltage	V_{OL}	V	-	-	10% Vcc	
Phase noise (12MHz)	L(f)	dBc/ Hz	-	-68	-54	1 Hz offset
			-	-98	-86	10 Hz offset
			-	-123	-113	100 Hz offset
			-	-144	-136	1 kHz offset
			-	-152	-146	10 kHz offset
			-	-152	-146	100 kHz offset
			-	-153	-147	1 MHz offset
Phase noise (27MHz)	L(f)	dBc/ Hz		-60	-46	1 Hz offset
				-91	-79	10 Hz offset
				-117	-107	100 Hz offset
			-	-139	-131	1 kHz offset
			-	-151	-145	10 kHz offset
			-	-153	-147	100 kHz offset
			-	-155	-149	1 MHz offset
Phase noise (39MHz)	L(f)	dBc/ Hz	-	-59	-45	1 Hz offset
			-	-89	-77	10 Hz offset
			-	-115	-105	100 Hz offset
			-	-136	-128	1 kHz offset
			-	-149	-143	10 kHz offset
			-	-151	-145	100 kHz offset
			-	-153	-147	1 MHz offset
Phase noise (52MHz)	L(f)	dBc/ Hz	-	-55	-41	1 Hz offset
			-	-85	-73	10 Hz offset
			-	-112	-102	100 Hz offset
			-	-133	-125	1 kHz offset
			-	-147	-142	10 kHz offset
			-	-150	-144	100 kHz offset
			-	-152	-146	1 MHz offset

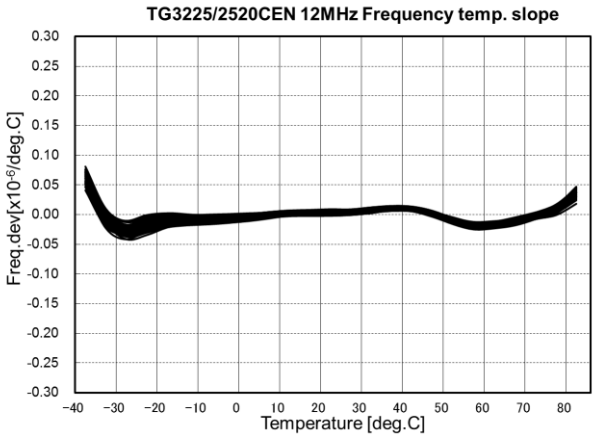
2. Characteristics

2-1) “Frequency / temperature characteristics”

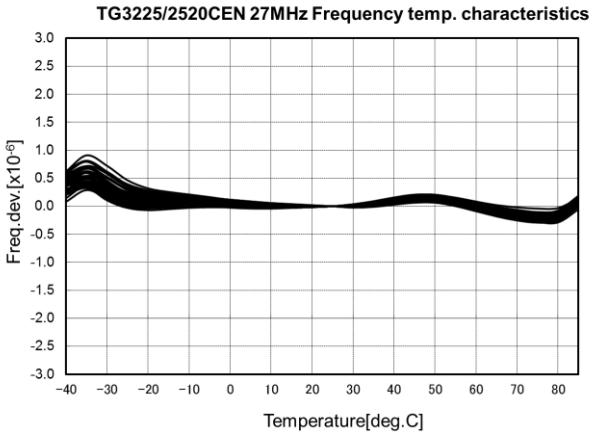
2-1-1) Standard spec : +/-2.0 × 10^{-6} Max. (T_use=-40°C to +85°C)

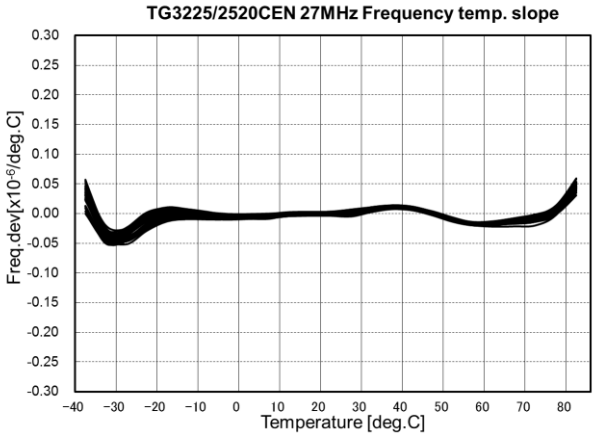
12MHz [N=40pcs]



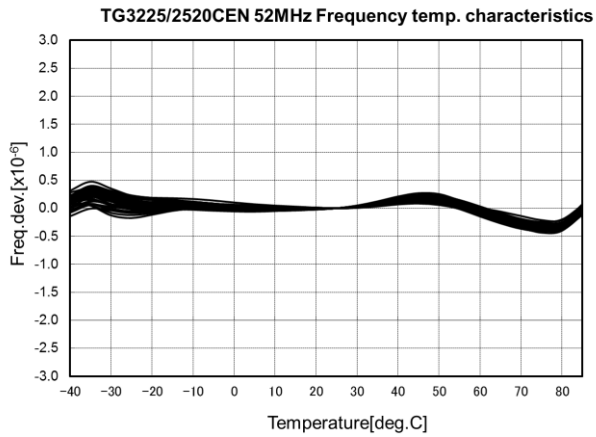


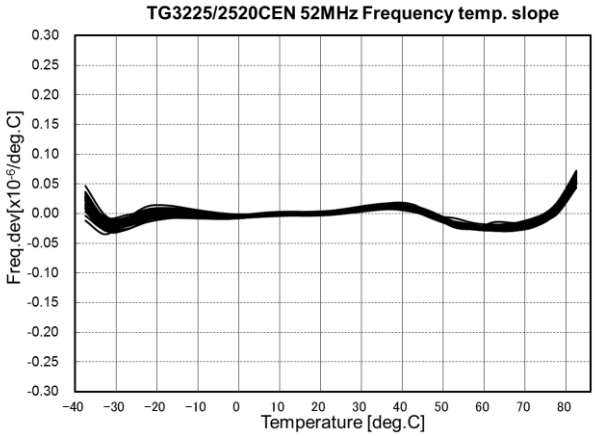
27MHz [N=40pcs]



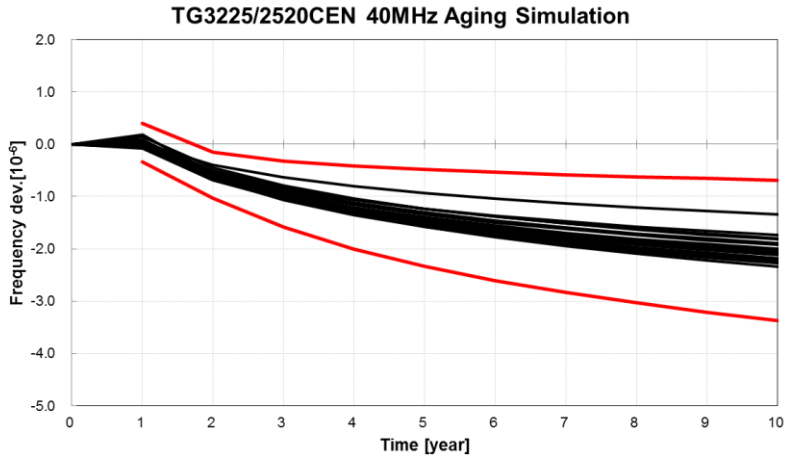


52MHz [N=40pcs]





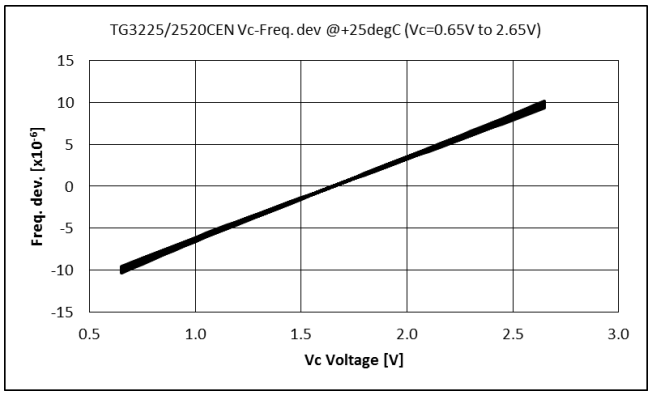
2-2) Frequency aging (40MHz) [N=22pcs]

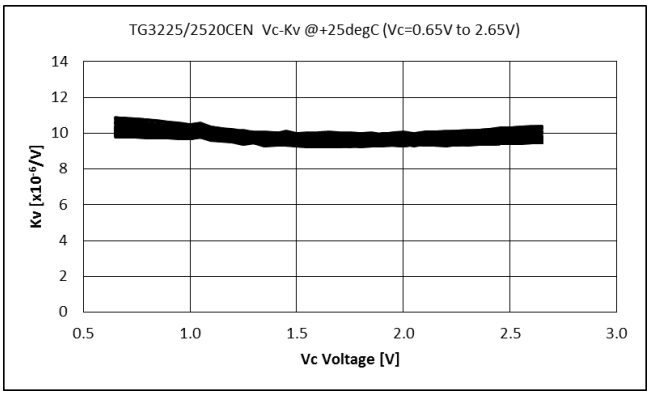


about 1year
Ave. : +0.03 x 10^{-6}
Max. : +0.19 x 10^{-6}
Min. : -0.08 x 10^{-6}

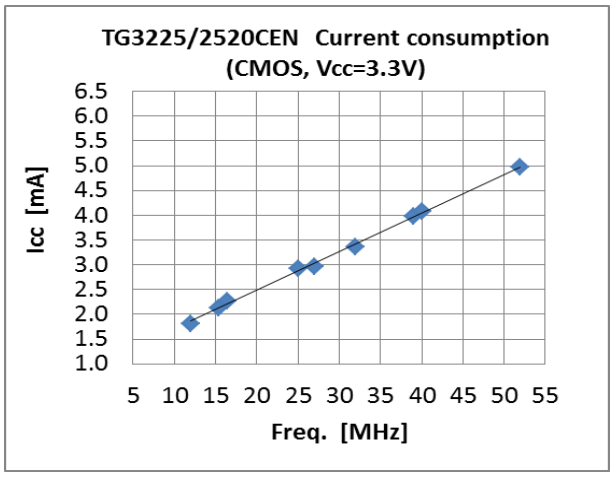
about 10years
Ave. : -2.03 x 10^{-6}
Max. : -1.34 x 10^{-6}
Min. : -2.34 x 10^{-6}

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

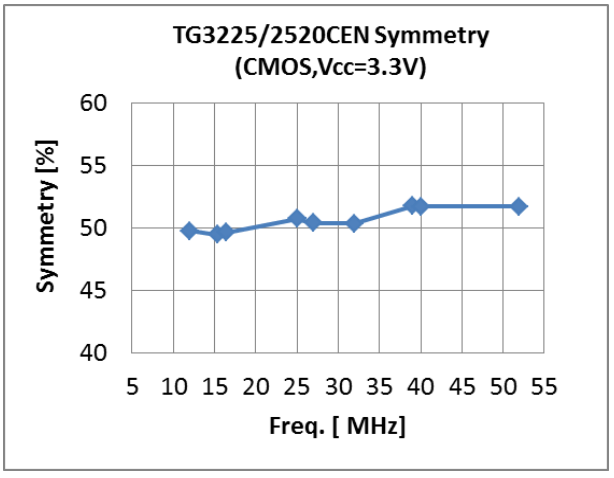




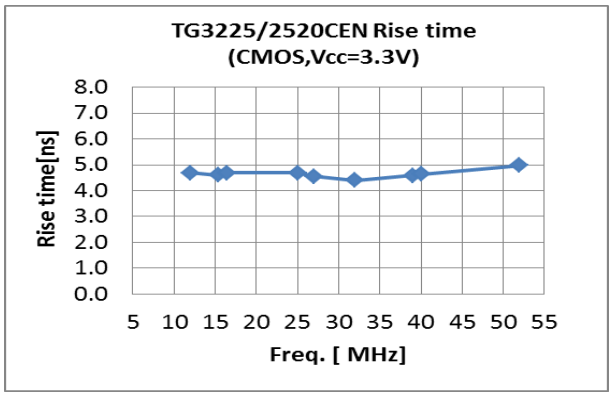
2-4) current consumption

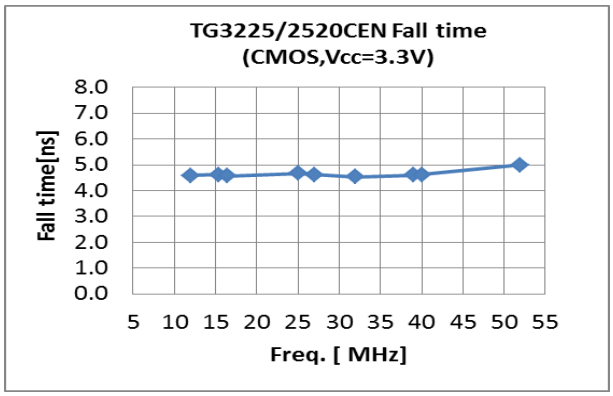


2-5) Symmetry

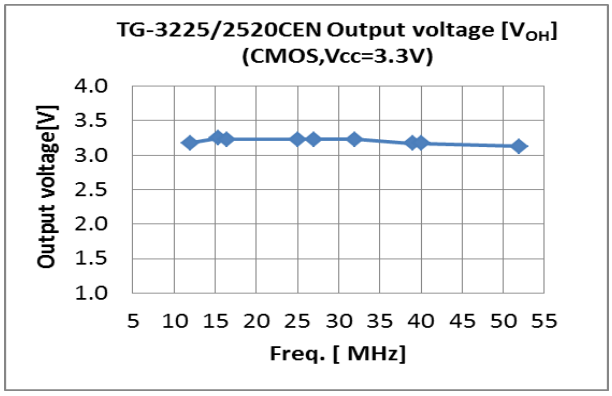


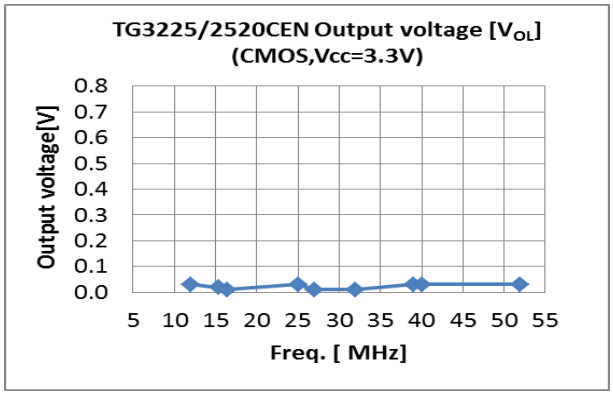
2-6) Rise time / Fall time





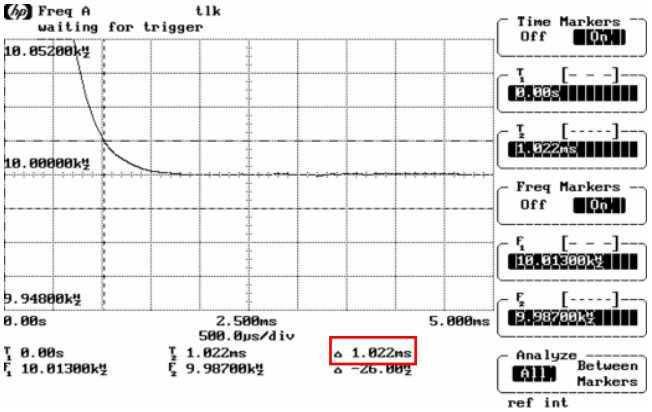
2-7) Output voltage [V_{OH}, V_{OL}]



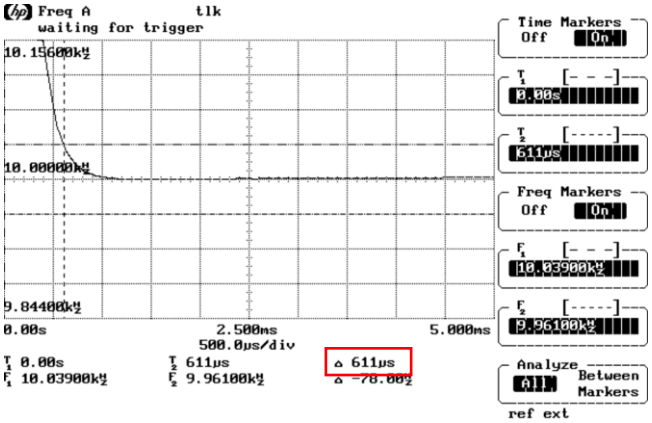


2-8) start up time(27MHz, 39MHz, 52MHz)

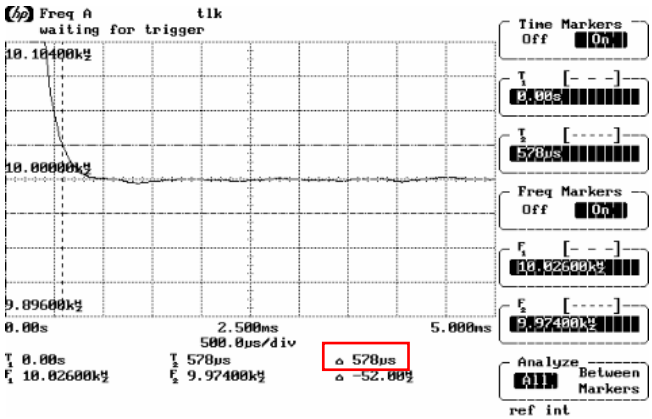
27MHz



39MHz

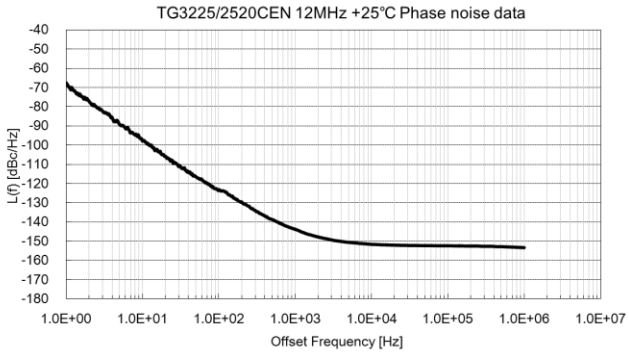


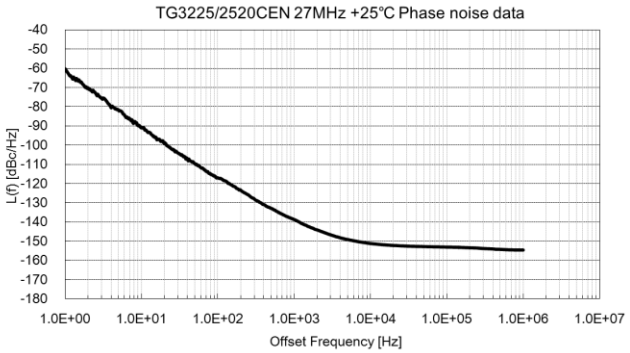
52MHz

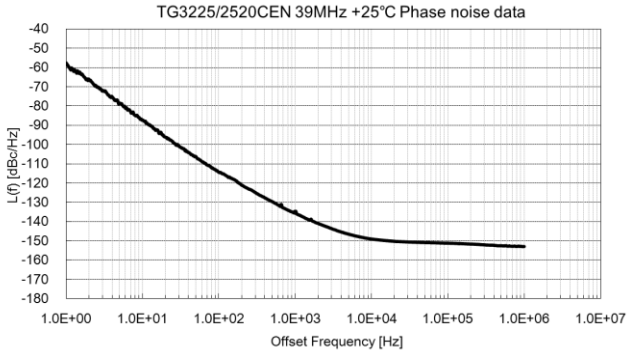


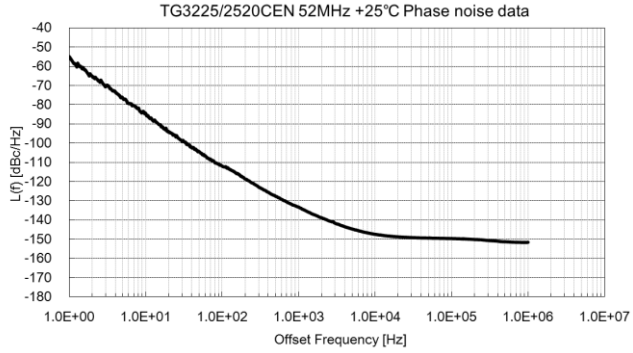
Seiko Epson Corporation
Document No.: TG3225_2520CEN_AE_Ver. 1.00
Date: Nov. 20th 2017

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

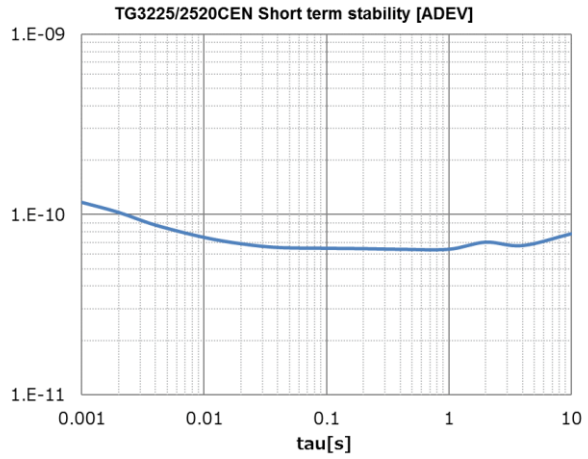








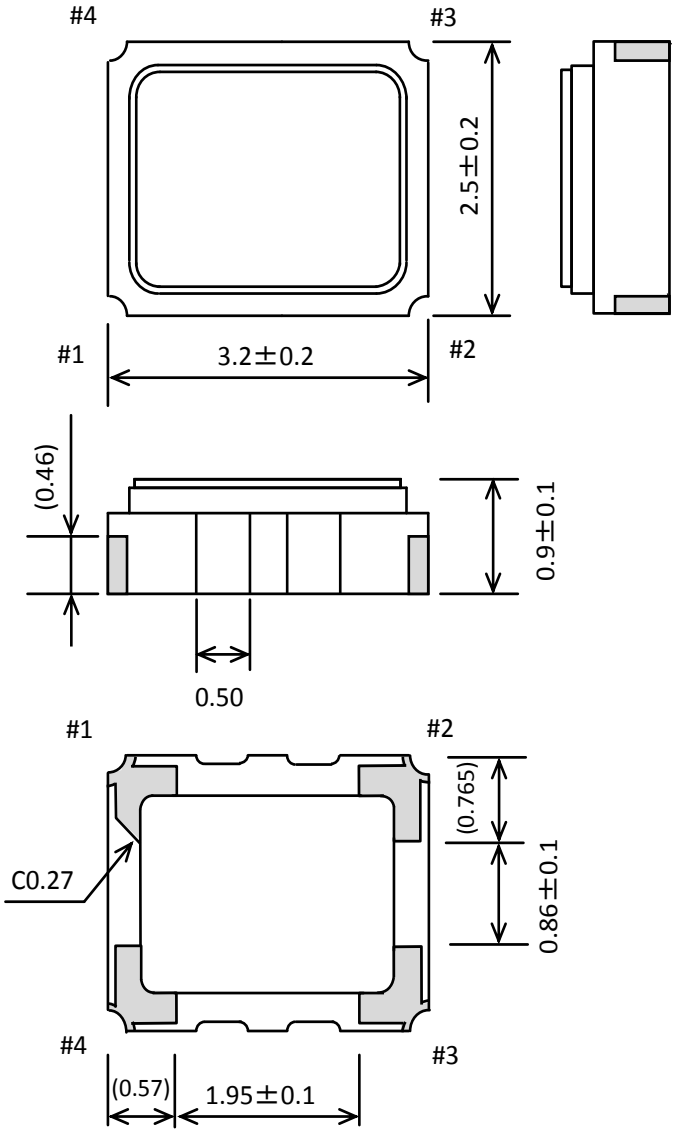
2-10) Short term stability [ADEV] (27MHz)



3. Outline

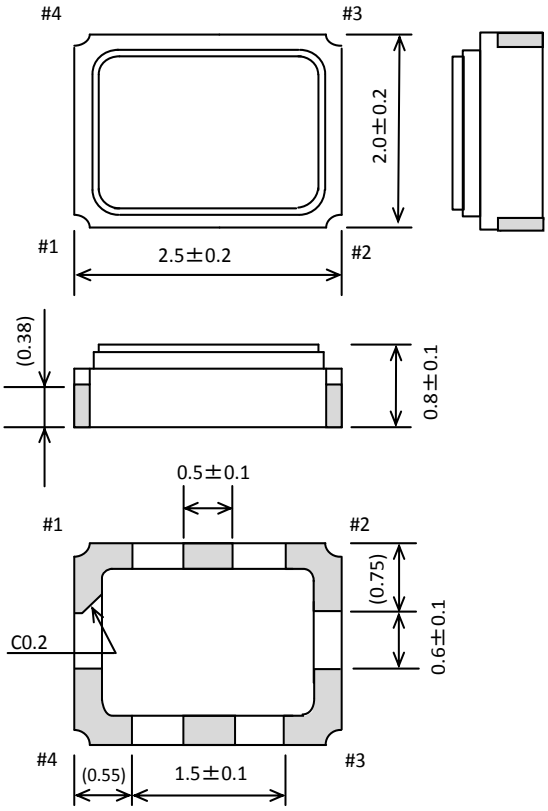
3-1) Outline dimensions and Pin information

3-1-1) TG3225CEN



3-1-2) TG2520CEN

Unit: mm



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

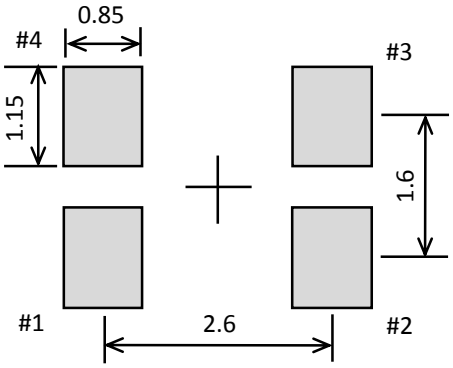
Do not connect “N.C.” pin with any other leads (also mutually)

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

3-2) Soldering pattern

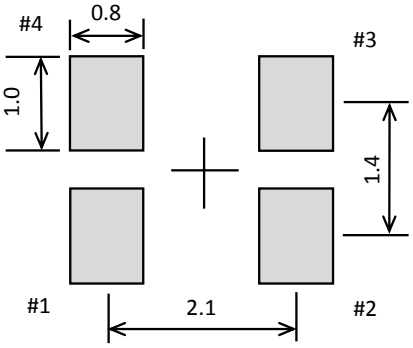
Example of patterning design indicated as follows. In an actual design, please consider mounting density, the reliability of soldering, etc. and check whether performance is optimal.

3-2-1) TG3225CEN



3-2-2) TG2520CEN

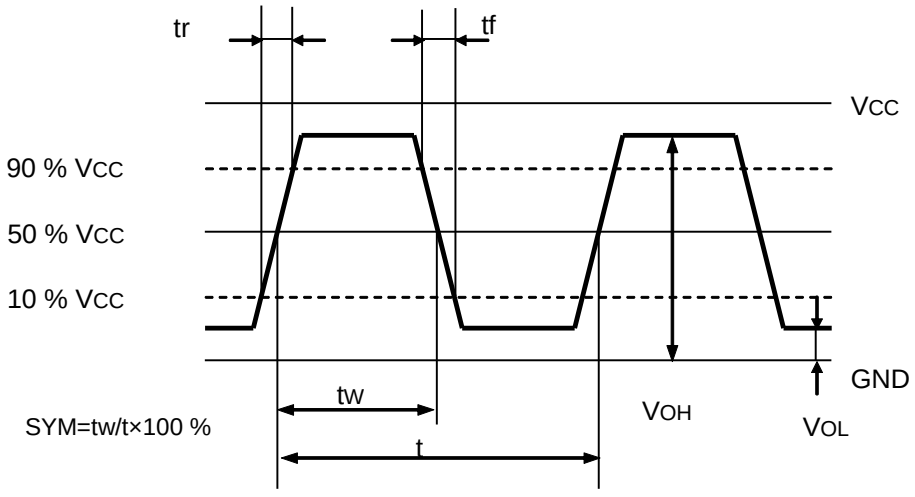
(unit : mm)



To maintain stable operation, provide a 0.01 to 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

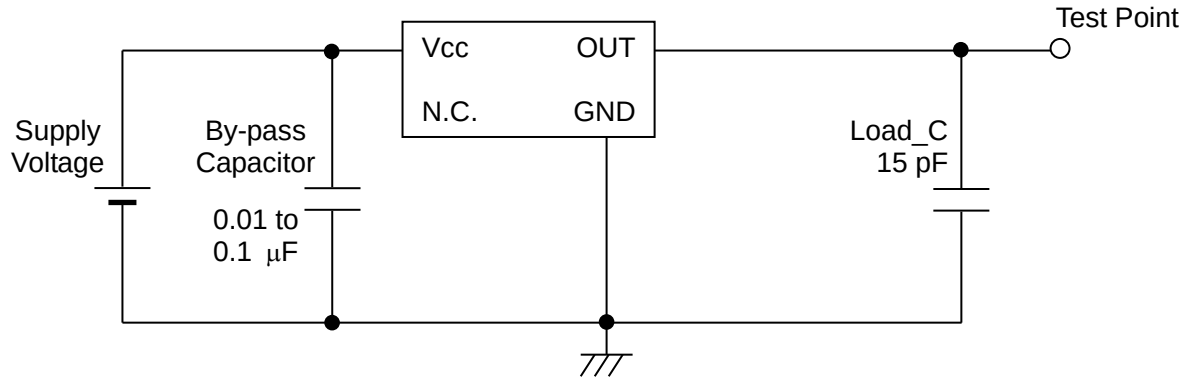
4-1) Output waveform (CMOS output)



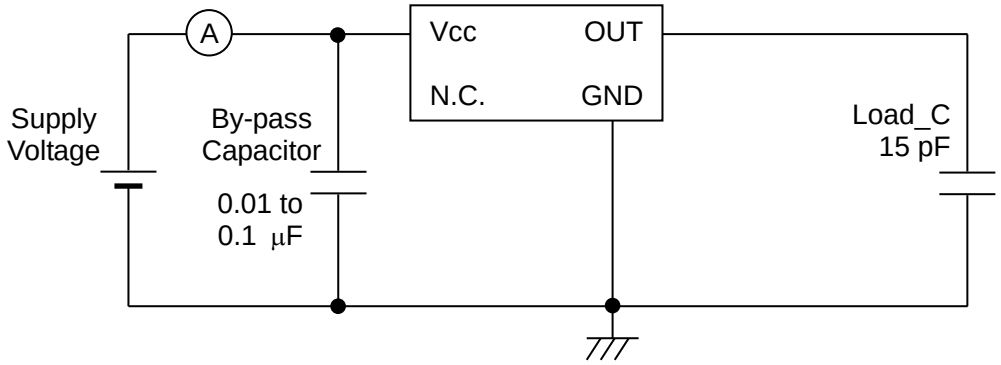
5. Test circuit

5-1) CMOS output for TCXO

1) Output Load : 15 pF



2) Current consumption



3) Conditions

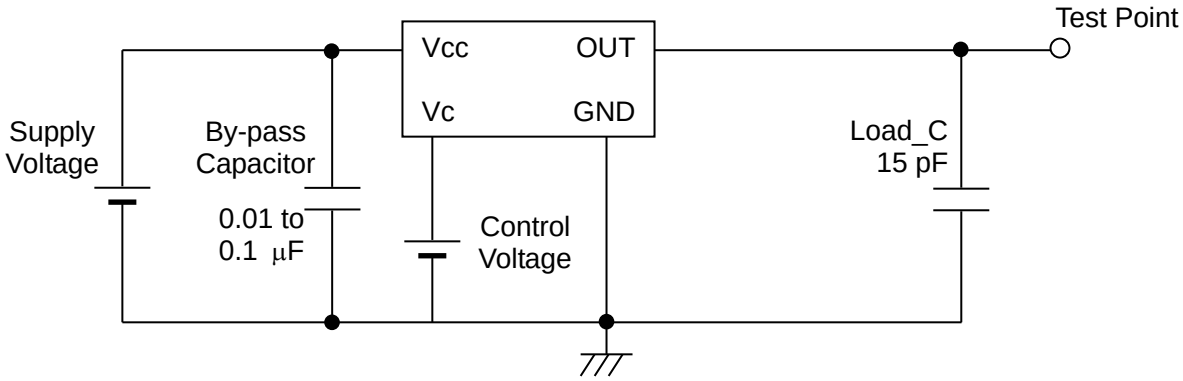
1. Oscilloscope: Impedance Min. 1 MΩ
   Input capacitance Max. 10 pF
   Band width Min. 300 MHz

   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: 0.01 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

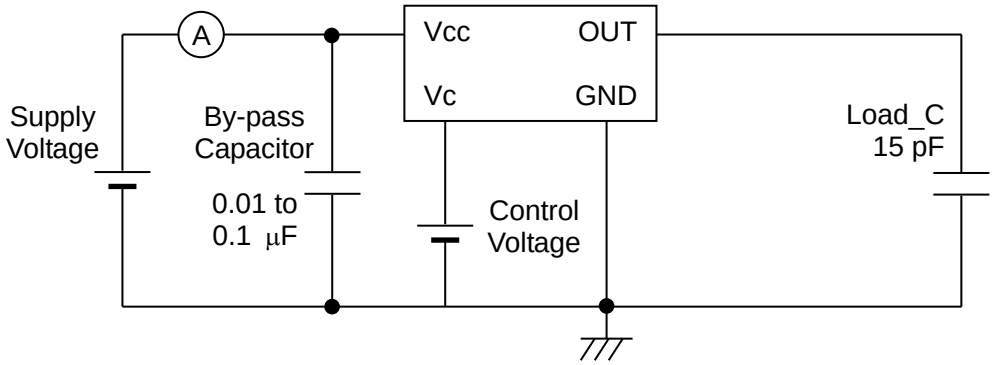
   Impedance of power supply should be as low as possible.
6. GND pin should be connected to low impedance GND.

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: 0.01 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 (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.
(10) This components used underfill material at the back side of package.
After mounting this components on the board, there’s possibility of IC damage happened by thermal expansion of adhesive, if adhesive will break into between TCXO and the board.
Please do not use adhesive, this will cause oscillation stop in case of IC damaged by adhesive.

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