Epson Timing Device

FY2025

Epson Europe Electronics Munich

Industry

Epson IMU positioning test with Novatel (2023)

Seiko Astron, World's First Quartz Wristwatch (1969)

home

Agenda

EPSON

Seiko Epson Corporation

- Company & Epson Timing Devices
- Epson Core Technology

Key Products

- kHz and MHz Crystal
- Real Time Clock Module
- SPXO / TCXO
- High end SPXO / TCXO / VCXO for Networking
- Clock Buffers 

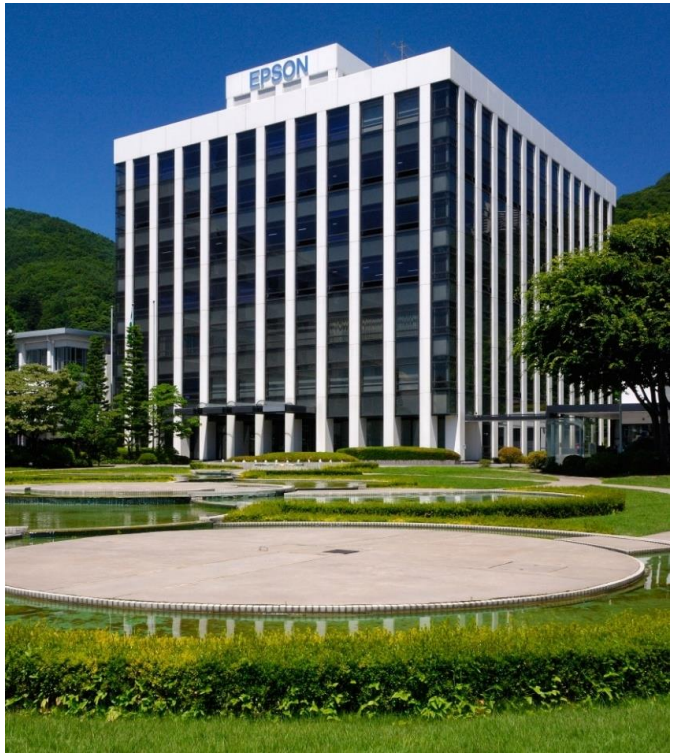
- Automotive Grade for Industry

Appendix

- Useful links

home

Seiko Epson Corporation



SEIKO EPSON HQ, Suwa, Nagano, Japan

Yasunori Ogawa
President

79,944
Employees

83 Group
Companies

Founded 1942

Microdevices
Revenue

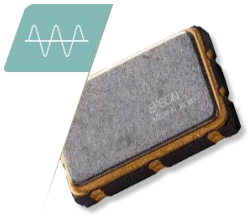
$ 717 M (FY2023)

Revenue (consolidated)
$9.17 B (FY2023)

Business Profit (consolidated)
$ 517 M (FY2023)

home

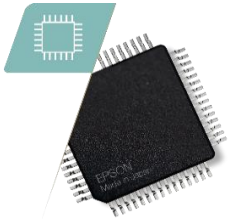
Epson Micro Devices (MD)



“TD” Timing Devices

Quartz Crystals, Oscillators, RTCs, Gyros

Used in Seiko watches and all Epson products



“IC” Semiconductor Products

Microcontrollers, LCD controllers, PMICs, etc

Used in Epson printers and projectors

“IMU” Inertial Sensors

Gyros & IMUs

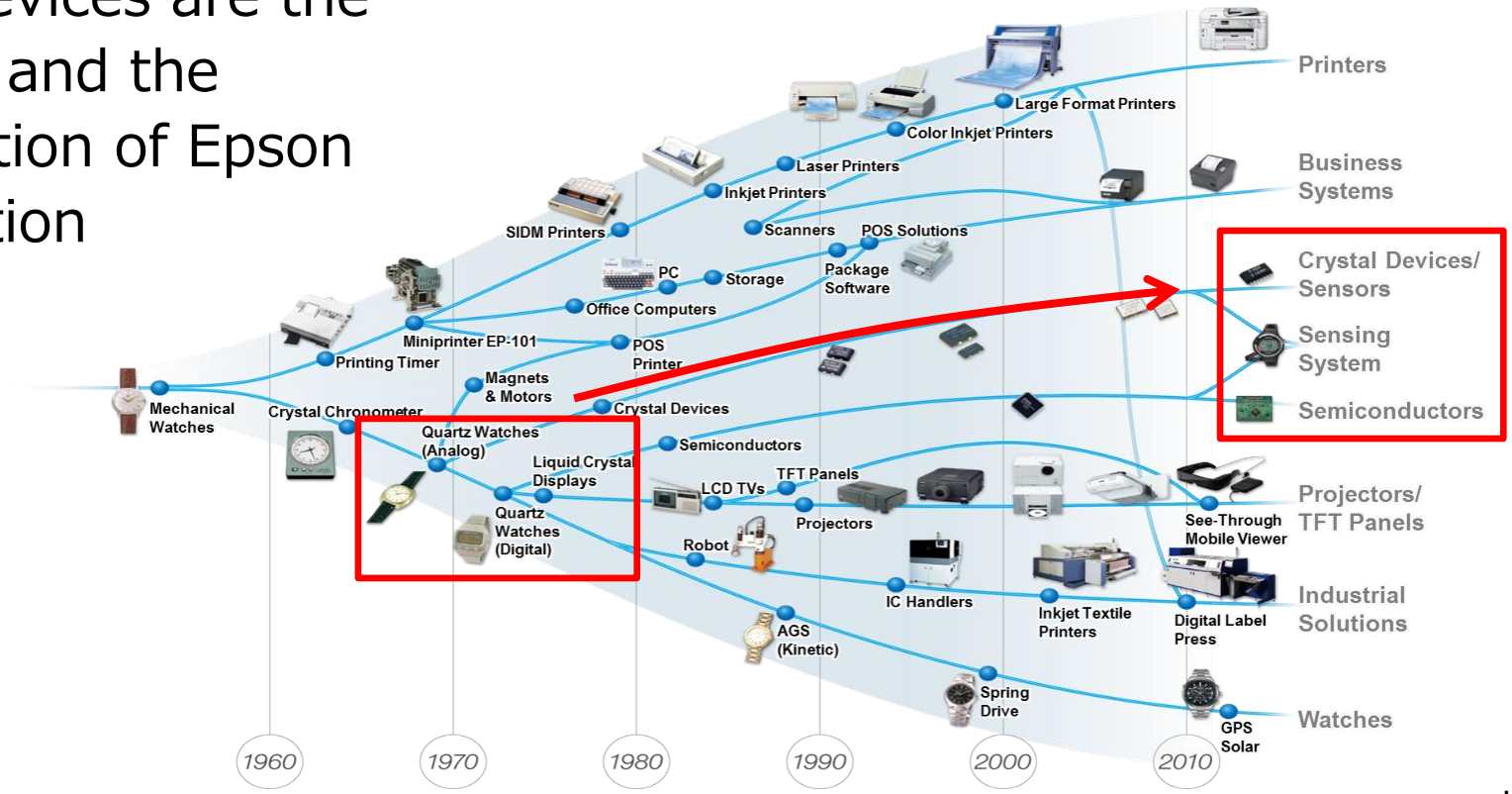
Used in Epson robots

home

Epson Microdevice History

EPSON

Microdevices are the history and the foundation of Epson innovation



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Seiko Epson Corp. Revenue Split

EPSON

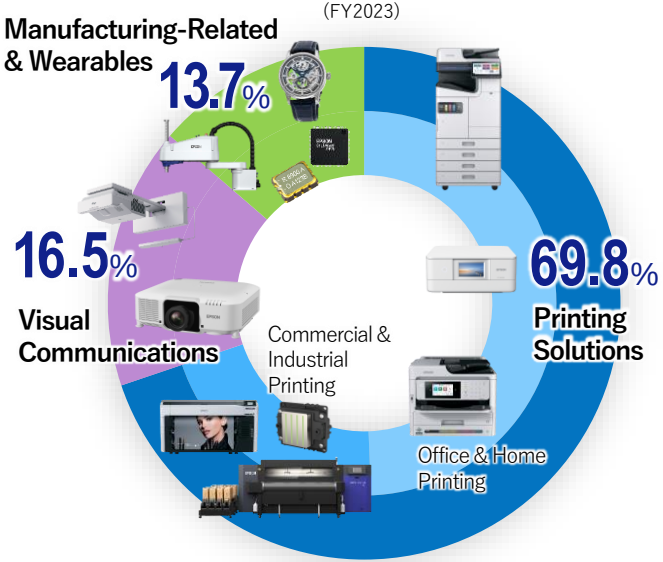
Revenue (Consolidated)
FY2023
¥1,313.9billion

Business Profit (Consolidated)
FY2023
¥64.7billion

* Business profit is very similar to operating income under Japanese accounting standards, both conceptually and numerically. It is calculated by deducting the cost of sales and selling, general and administrative expenses from revenue.

Segment Revenue as a Percentage of Total Revenue

(FY2023)

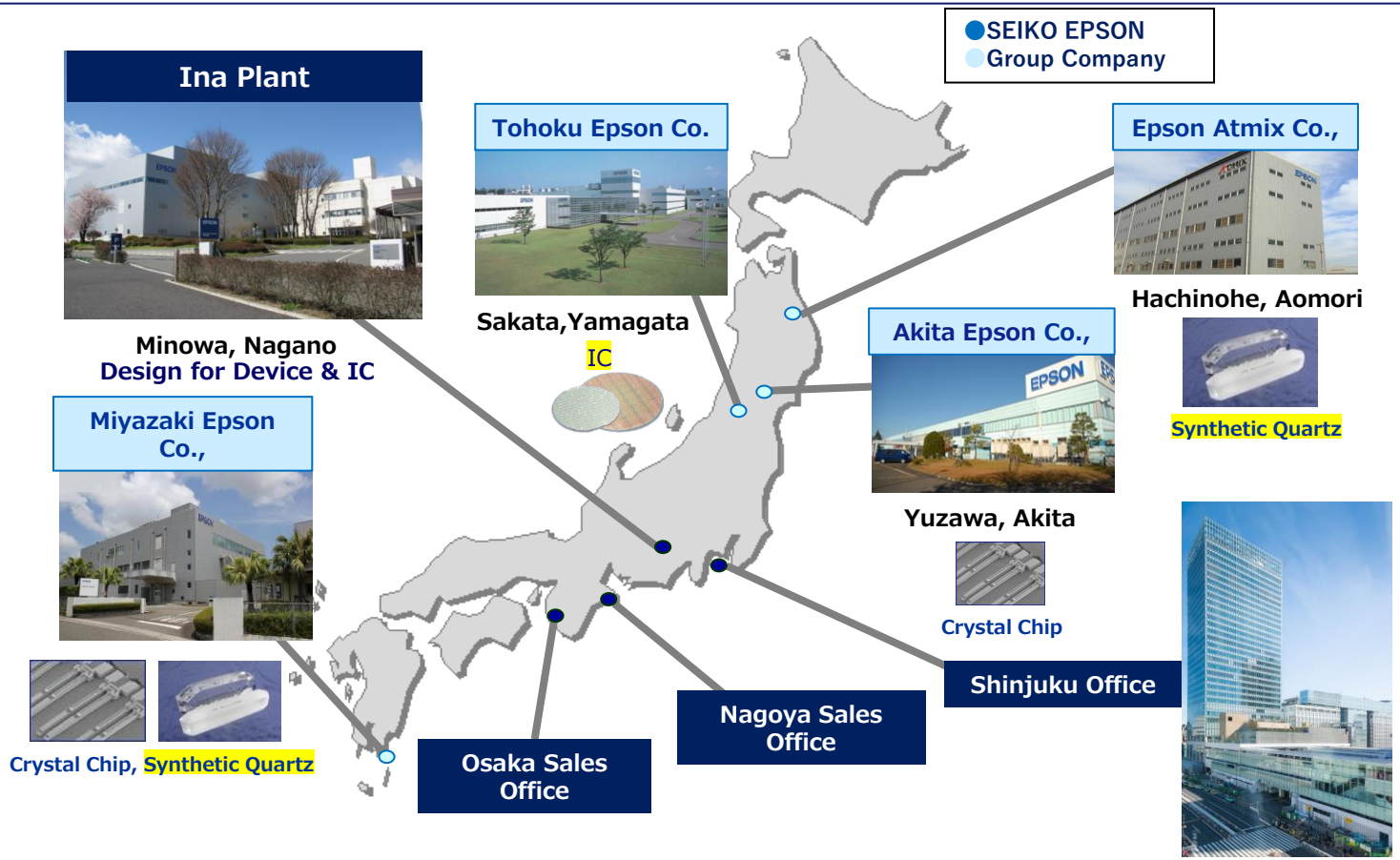


Innovation	Office & Home Printing Innovation	Commercial & Industrial Printing Innovation	Visual Innovation	Manufacturing Innovation	Lifestyle Innovation	
Segment	Printing solutions business		Visual communications business	Manufacturing-related & wearables business		
Operation	Office & home printing business	Commercial & industrial printing business	Visual communications business	Manufacturing solutions business	Wearable products business	Microdevices business / PC business
Main Technology	Micro Piezo inkjet technology Dry Fiber Technology		Microdisplay technology Projection technology	Precision mechatronic technology High-precision sensing technology Software technology Ultra-precision & micromachining technology High-density board assembly technology Low power consumption technology		
Main Operations	Office & home inkjet printers, serial impact dot matrix(SIDM) printers, page printers, color image scanners, dry process office papermaking systems, and related consumables	Commercial & industrial inkjet printers, inkjet printheads, printers for use in POS systems, label printers, and consumables	Projectors and smart glasses	Industrial robots, micro injection molding machines	Wristwatches, watch movements	Crystal devices (crystal units, oscillators, sensors) Semiconductors (CMOS, LSI), Superfine alloy powder Surface finishing / PCs & other
Global Market Share	**Inkjet printers** (unit volume)[1] No.2 32%	**Printer market** (including laser printers, unit volume)[2] No.3 20%	**Projectors** (>500 lumens, unit volume)[3] No.1 51%	**SCARA robots** (unit volume)[4] No.1 21%	**Crystal oscillators** (sales revenue)[5] 24%	

1 Source: IDC's Worldwide Quarterly Hardcopy Peripherals Tracker 2024Q1 Share by Brand 2 Source: IDC's Worldwide Quarterly Hardcopy Peripherals Tracker 2024Q1 Share by Brand. Laser printers = up to 90 ppm monochrome laser printers. Color laser = up to 69 ppm 3 Unit volume share for projectors with 500 lumens or more, excluding screenless TV products. Source: Futuresource Consulting Ltd., FY2023 4 Source: Epson documents based on Fuji Keizai's "Current status and future outlook of worldwide robot-related markets 2024" 5 Source: QYRESEARCH Inc. Global Timing Device Market Report, published 2023

Domestic Plants and Offices (Japan)

EPSON



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Global Manufacturing Plants

Epson Precision Suzhou CO.,LTD.

Suzhou, China

Epson Precision Malaysia Sdn.Bhd.

Kuala Lumpur, Malaysia

Epson Precision (Thailand) LTD.

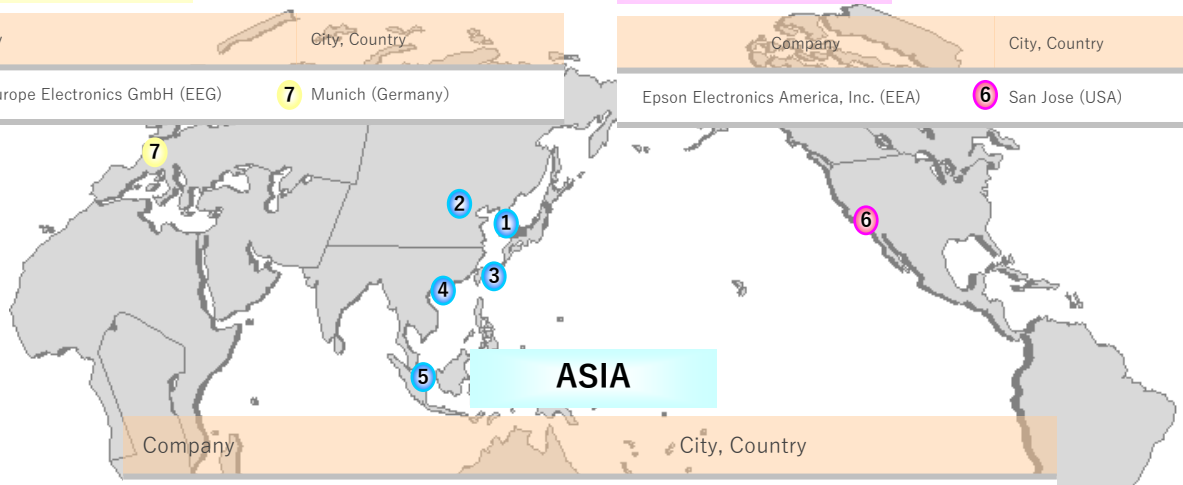
Chachensao, Thailand

- flexible sites and production lines
- maximum of supply security and capacity

home

Overseas Sales offices

EPSON



Company	City, Country
Epson Europe Electronics GmbH (EEG)	7 Munich (Germany)

Company	City, Country
Epson Electronics America, Inc. (EEA)	6 San Jose (USA)

Company	City, Country
Seiko Epson Corporation Korea Office (EKO)	1 Seoul (Korea)
Epson (China) Co., Ltd. (ECC)	2 Beijing, Shanghai, Shenzhen (China)
Epson Taiwan Technology & Trading Ltd. (ETT)	3 Taipei (Taiwan)
Epson Hong Kong Ltd. (EHK)	4 Hong Kong (China)
Epson Singapore Pte., Ltd. (ESP)	5 Singapore

home

Environmental Vision 2050

EPSON

See more
Environmental Vision 2050
https://global.epson.com/SR/environment/vision/

Epson will become carbon negative and underground resource*1 free by 2050 to achieve sustainability and enrich communities

*1 Non-renewable resources such as oil and metals

Goals

- 2030: Reduce total emissions in line with the 1.5° C scenario*2
- 2050: Carbon negative and underground resource*1 free

Actions

- Reduce the environmental impacts of products and services and in supply chains
- Achieve sustainability in a circular economy and advance the frontiers of industry through creative, open innovation
- Contribute to international environmental initiatives

*1 Non-renewable resources such as oil and metals
*2 Target for reducing greenhouse gas emissions aligned with the criteria under the Science Based Targets initiative (SBTi)

home

Environmental Friendly Production

EPSON

1) Utilization of renewable energy (Installation of solar power generation equipment))

Installations in Ina, Thailand, China crystal business bases.
Installations & expansions at two domestic bases by the end of FY2022
Installation at Malaysian crystal business base by the end of FY2023

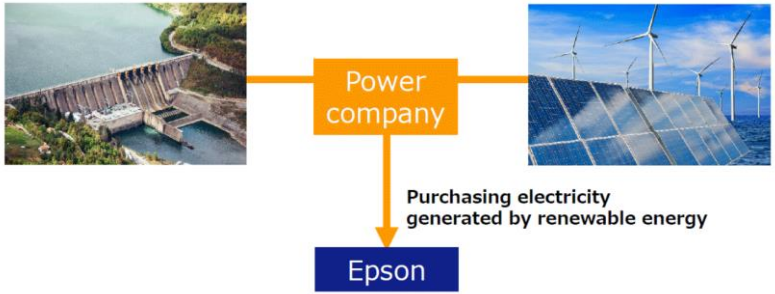
Left: Thailand, Right: China

2) Environmental investment in line with maintenance and renewal of basic equipment

High-efficiency HVAC system improvements at Overseas base of crystal business by the end of FY2023
- Aged air conditioning system, piping renewal
- Optimization of piping and wiring layout

3) Purchase of Carbon-free electricity (Renewable energy)

Crystal Business at our domestic bases uses electricity which converted into 100% renewable energy.
We plan to convert the electricity used at all crystal business bases to renewable energy by the end of 2023
*Some rental properties such as sales bases are excluded.



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Evaluation by External Parties (Apr-2022)

EPSON

https://global.epson.com/SR/evaluation/?fwlink=sr_top

In green: After Jan. 2022

ESG Indices and Ratings Inclusion

- FTSE4Good Index Series: 18th consecutive year
- FTSE Blossom Japan Index (GPIF adopted index): 5th consecutive year
- **FTSE Blossom Japan Sector Relative Index (GPIF adopted index): first time**
- Empowering Women Index (WIN) (GPIF adopted index): 5th consecutive year
- S&P/JPX Carbon Efficient Index (GPIF adopted index): 4th consecutive year
- Sompo Sustainability Index: 10th consecutive year
- CDP A Lists (climate change and water security): 2nd Consecutive Year
- **CDP Supplier Engagement Rating Leaderboard: 3rd Consecutive Year**
- EcoVadis Platinum Rating for Overall Sustainability: 2nd Consecutive Year
- **DBJ (Development Bank of Japan) Environmentally Rated Loan Program Rank A: first time**

ESG awards / Index Adoption

- Forbes JAPAN Ranked No.1 in “The 100 Most Sustainable Companies”: Sep. 2021
- 3rd Annual SDGs Management Survey top-rated level: Nov. 2021
- Environmental Value Award at the 3rd Annual Nikkei SDGs Management Grand Prix: Nov. 2021
- **Silver Award in the Environmentally Sustainable Company category of the third ESG Finance Awards Japan: Feb. 2022**
- **2022 Health & Productivity Stock Selection (No.1 in electrical equipment) *: March 2022**
- Nikkei 225: from 2017

*Health Management Objectives and Organization
https://global.epson.com/SR/our_people/health_and_productivity.html#h2_02

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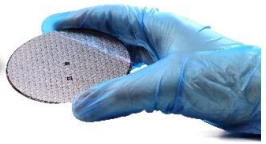
Core Technology - Vertical Integration

EPSON

IC Design

Epson is 1 of very few who design their own ICs



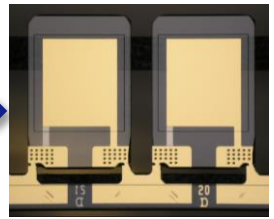
IC Fabrication

Epson is the only supplier with our own IC foundry

Epson is the only supplier who makes their own robots

Synthetic Quartz

Epson is 1 of few suppliers who grow their own Quartz

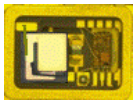


Crystal Fabrication

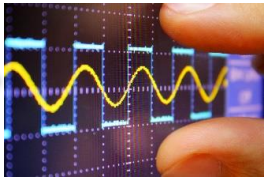
Epson was the 1st to develop Photolithographic Quartz crystals

QMEMS

Module Assembly



Crystal and IC inside ceramic package



Final Test

100% tested

home

EXPLAINER VIDEO

Epson timing products - manufacturing process

Core Technology - Synthetic Quartz Production

EPSON

2-6
months

Natural Quartz

Better Purity

Lower Defects

Synthetic Quartz

World's Largest Autoclaves

16 Autoclaves in 2 locations

- Hachinohe, Aomori, Japan
- Miyazaki, Japan
- Longmont, WA

Assurance of Supply

Lower Defect Density

Enhanced Stability

Improved Phase Noise

home

EXPLAINER VIDEO

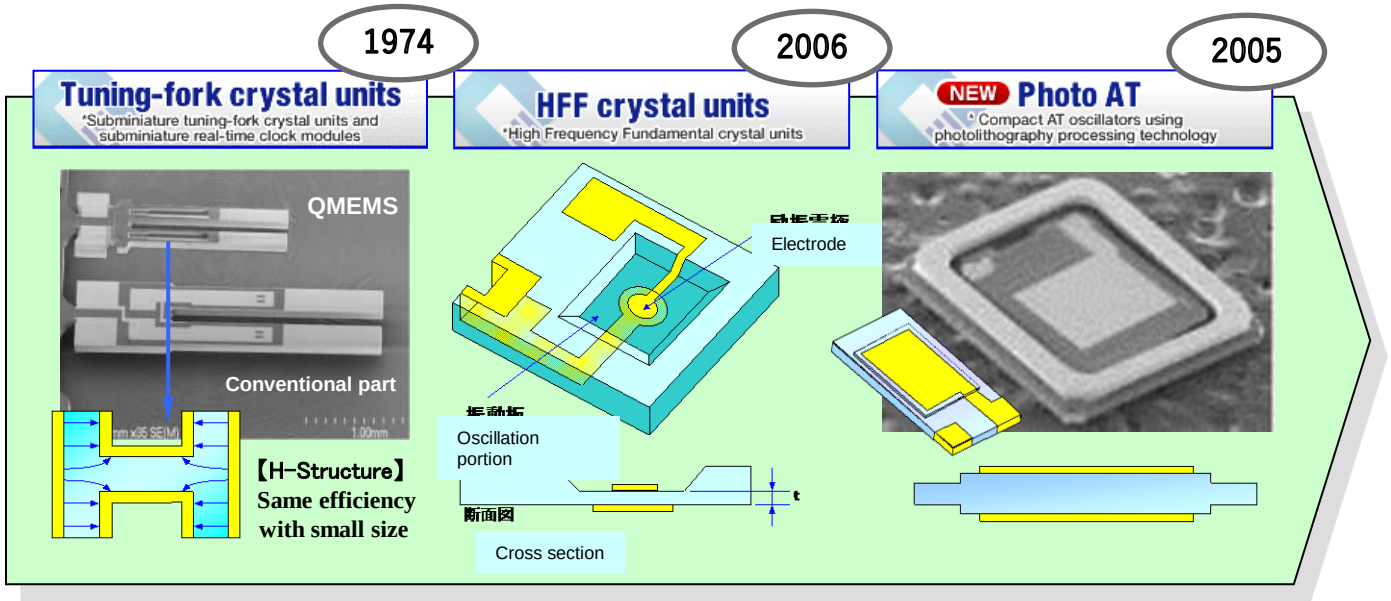
Manufacturing Synthetic Quartz

Core Technology - QMEMS Technology - 1st in market

EPSON

QUARTZ+MEMS
high accuracy and high stability
Micro Electro Mechanical Systems

QMEMS



Smallest Packages
Low ESR

Direct oscillation
w/o PLL up to
500MHz

High FTC control
High Yield

home

Core Technology – QMEMS Potolitographic Process

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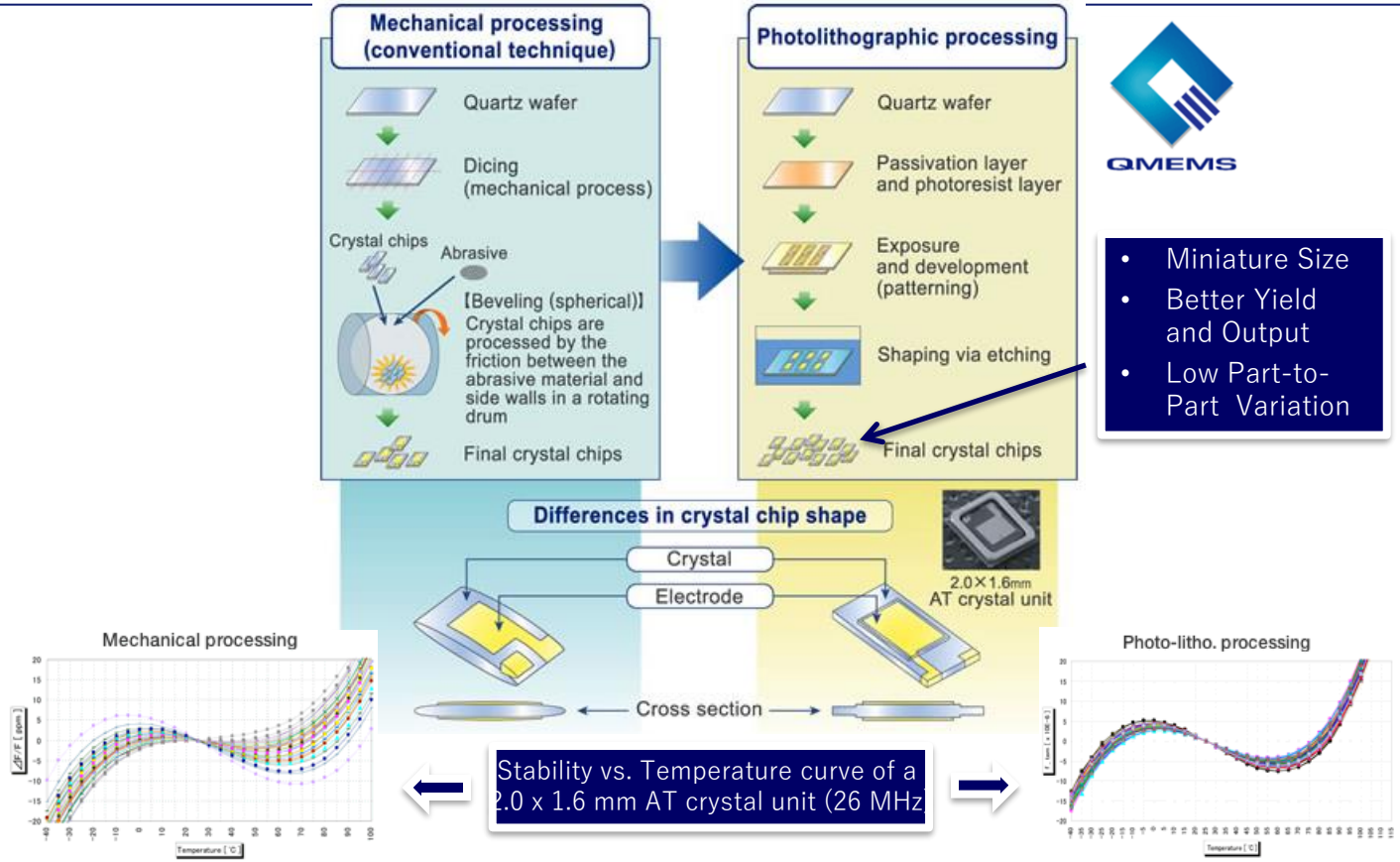

Find out more here: http://www5.epsondevice.com/en/quartz/aboutus/qmems/

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Core Technology - IC Design & Production In-House

EPSON

Production: Sakata
R&D: Fujimi

Advantages:
- Custom designs for timing – performance & features
- Cost
- Assurance of supply

Epson Timing IC IP:
- Oscillators
- Temperature compensation
- Integer and fractional PLLs
- AFEs for sensing

Epson ICs used in
- RTCs
- SPXOs, SPSOs, & MOSOs
- VCXOs & VCSOs
- P-SPXOs & P-VCXOs
- TCXOs
- Gyros & IMUs

home

Reference Designs & Board Evaluation Service

EPSON

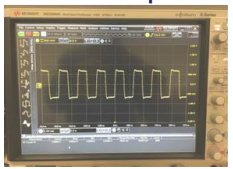
Altera Corporation Circuit design IC partners	ANALOG DEVICES Circuit design IC partners	Atmel Circuit design IC partners	Greenvity IC partners
Inphi Corporation IC partners	IDT IC partners	ROHM GROUP LAPIS SEMICONDUCTOR Circuit design IC partners	Marvell Technology Group Ltd. IC partners
Microchip Technology Inc. IC partners	Microsemi Corporation IC partners	NORDIC SEMICONDUCTOR Circuit design IC partners	NTT Electronics IC partners
nuvoTon IC partners	NXP Semiconductors Circuit design IC partners	QLogic Corp. IC partners	RENESAS Circuit design IC partners
ROHM Circuit design IC partners	SEMTECH IC partners	SILICON LABS IC partners	ST life.augmented Circuit design IC partners
Texas Instruments Circuit design IC partners	u-blox IC partners	Xilinx Inc. Circuit design IC partners	

- Epson as leading manufacturer first choice at IC maker
- to approve 32KHz / MHz / TCXO for Wireless ICs
- to approve SPXO for FPGA and Networking

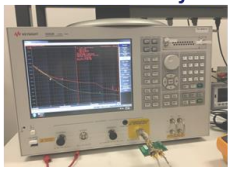
-> safe design of oscillation circuit
-> quick definition of part number
-> high probability of sampling ex stock

-> Epson saves your time in the design phase !

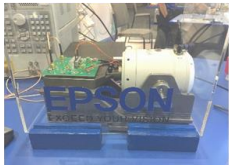
Oscilloscopes



Phase Noise Analyzer



Vibration Tester



GPS Time Reference

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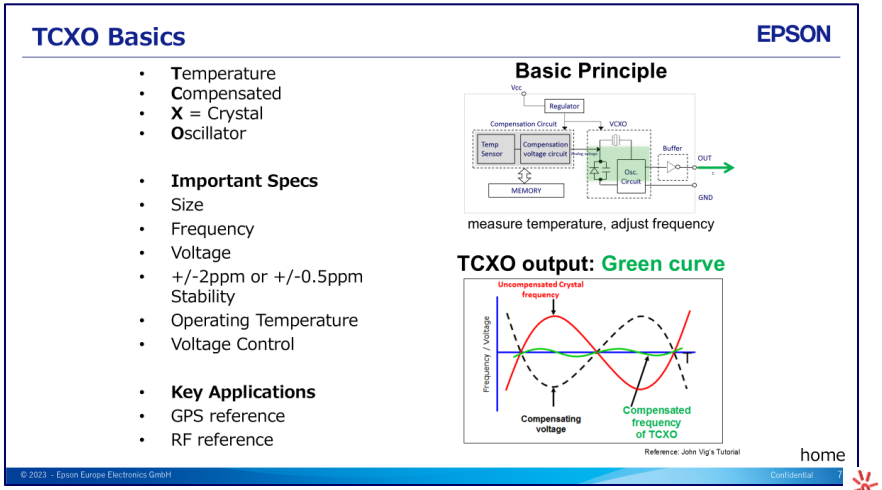
How to use the Index slide

EPSON

Jump to any product family you wish by clicking on any hyperlink

Click on home to return to the Product Line-up home page any time you like

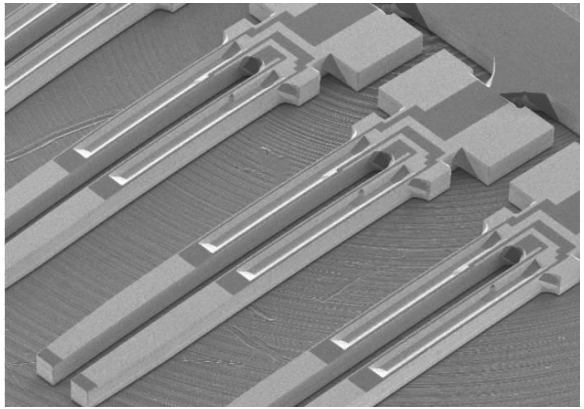


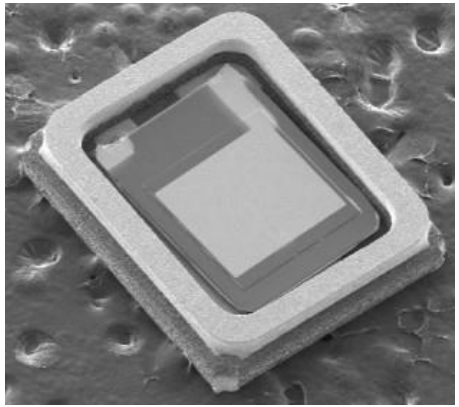
Timing Product Line-Up

- kHz Crystal
- Real Time Clock Module
- MHz Crystal
- SPXO
- TCXO
- High-end clocks for Networking
- Clock Buffer NEW
- Automotive Grade 

kHz and MHz Crystal

basic crystal elements for every application





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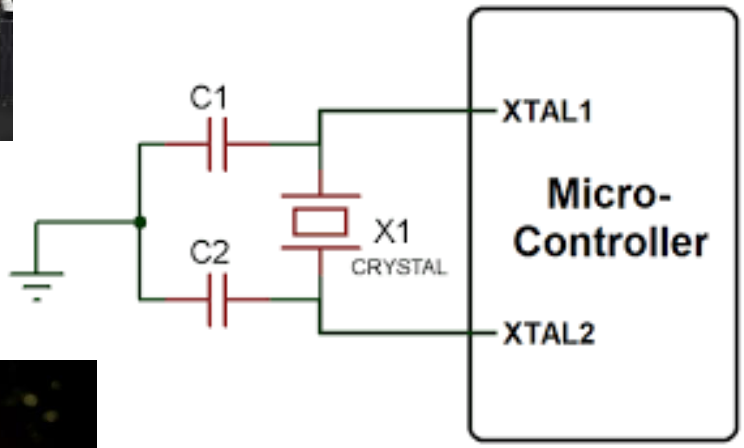
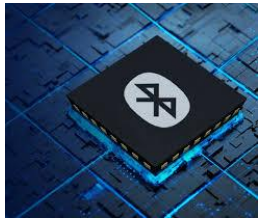
Applications for Crystal

EPSON





LoRa™ NB-IoT

LTE-M sigfox

home

kHz Crystal Basics

Known As…

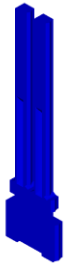
- Tuning Fork Crystal
- Clock Crystal

Important Specs

- Size
- Height
- Frequency Tolerance
- Load capacitance
- Equivalent Series Resistance (ESR)

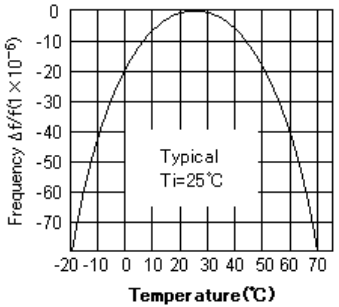
Key Applications

- MCU clocking
- Real Time Clock clocking



Flexural Vibration mode

kHz Frequency Deviation Temperature Curve



$\Delta f/f = B(Ti-\theta X)^2$

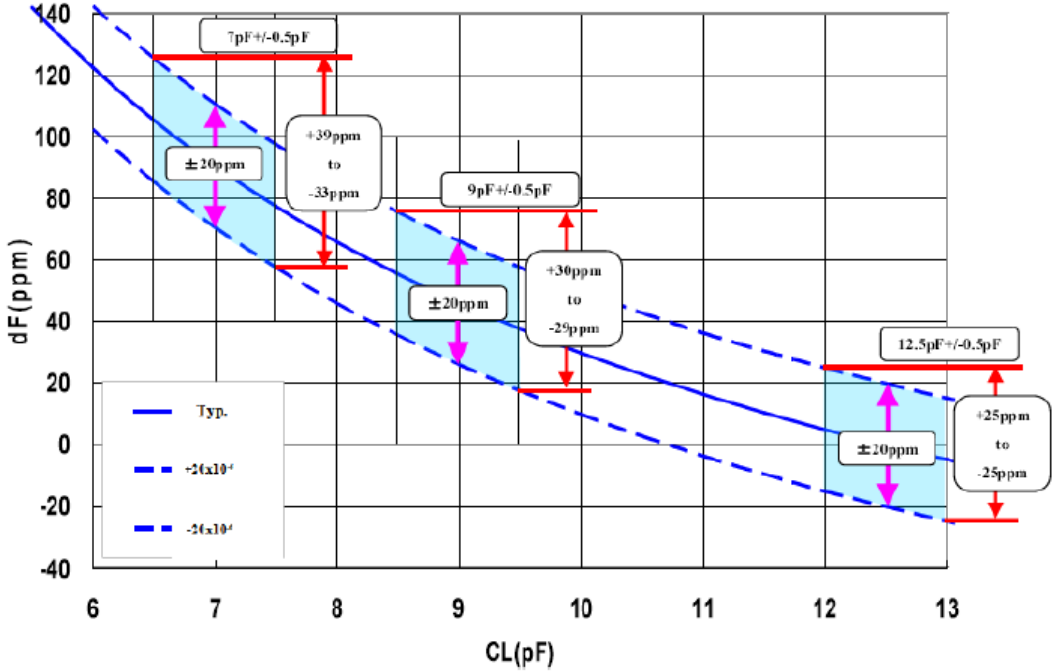
θX: specified temperature, B: Parabolic coefficient

home

Load Capacitance – the right choice

EPSON

- Smaller Load Cap has the advantage of lower the current consumption at the oscillation circuit.
- On the others hand, smaller Load Cap makes the oscillation frequency unstable, design it difficult to improve time accuracy.



	CL value	Smaller	Larger
Oscillation circuit	|-R|:Negative resistance	Larger	Smaller
	Oscillation allowance	Larger	Smaller
	Power consumption	Smaller	Larger
	Drive level	Smaller	Larger
	Frequency stability	Worse	Better
	Oscillation start-up time	Shorter	Longer

$$CL \fallingdotseq \frac{CG \times CD}{CG + CD} + CS \quad \text{(Stray capacity)}$$

home

kHz Products | Crystal Unit

EPSON

Low ESR for Low Power

In MP | ▼ES In Design | ▽ES Planned | Considering

Current Products

Crystal Unit

FC-135 / FC-135R
3.2 x 1.5 x 0.8t,
70 / 50 (R) kΩ,
Glass lid

FC-12M
2.0 x 1.2 x 0.6t, 90 kΩ, Metal lid

FC2012SN
2.0 x 1.2 x 0.6t, 90 kΩ,
Metal lid

FC3215/2012AN
3.2 x 1.5 x 0.8t, 50 kΩ,
2.0 x 1.2 x 0.6t, 50 kΩ, Metal lid

FC1610AN
1.6 x 1.0 x 0.5t
90 kΩ,
Metal lid

FC1610BN
1.6 x 1.0 x 0.5t
60 kΩ,
Metal lid

CY25				CY26		CY27		CY28~
1Q	2Q	3Q	4Q	1H	2H	1H	2H	

FC3215BN
3.2 x 1.5 x 0.8t
Same sensitivity as
FC-135R with PB-Free
Metal lid
ES: 3Q/'25, MP: 4Q/'25

Low ESR and Miniature Size 32kHz XTAL

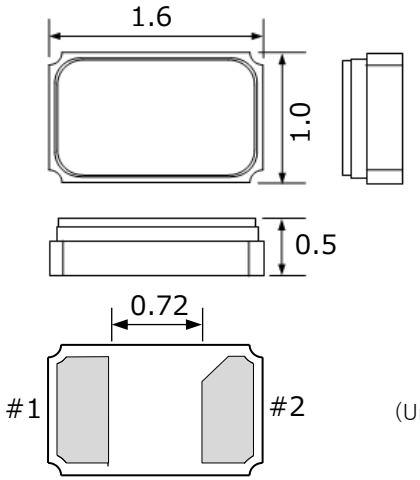
■ Feature

- Frequency range : 32.768 kHz
- Low ESR : 45 kΩ typ. at +25 °C
- Size : 1.65 x 1.05 x 0.5 t mm

■ Overview

Item	Symbol	Specifications	Conditions / Remarks
Nominal frequency range	f_nom	32.768 kHz	
Storage temperature	T_stg	-55 °C to +125 °C	Storage as single product.
Operating temperature	T_use	-40 °C to +105 °C	
Level of drive	DL	0.1 µW (0.5 µW Max.)	
Frequency tolerance	f_tol	±20 × 10^{-6}	+25 °C, DL=0.1 µW
Turnover temperature	Ti	+25 °C ±5 °C	
Parabolic coefficient	B	-0.04 × 10^{-6} / °C^2 Max.	
Load capacitance	CL	9 pF, 12.5 pF	Please specify
Motional resistance (ESR)	R1	45 kΩ typ. at +25°C 60 kΩ Max. at -40 to +85 °C 70 kΩ Max. at -40 to +105 °C	
Motional capacitance	C1	7.5 fF typ.	
Shunt capacitance	C0	1.5 pF typ.	
Frequency aging	f_age	±3 × 10^{-6} / year Max.	+25 °C, First year

■ External dimensions



(Unit : mm)

■ Schedule

ES : Done

MP : 2Q/2024

home

Same Sensitivity as FC-135R with Pb Free

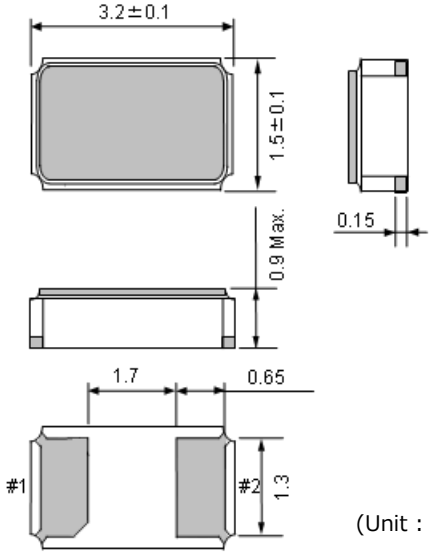
■ Feature

- Frequency range : 32.768 kHz
- Low ESR : 50 kΩ Max
- Size : 3.2 x 1.5 x 0.9 t mm
- Applications ; IoT devices, Modules, etc

■ Overview

Item	Symbol	Specifications	Conditions / Remarks
Nominal frequency range	f_nom	32.768 kHz	
Storage temperature	T_stg	-55 °C to +125 °C	Storage as single product.
Operating temperature	T_use	-40 °C to +105 °C	
Level of drive	DL	0.5 µW (1.0 µW Max.)	
Frequency tolerance	f_tol	±20 × 10^{-6}	+25 °C, DL=0.1 µW
Turnover temperature	Ti	+25 °C ±5 °C	
Parabolic coefficient	B	-0.04 × 10^{-6} / °C^2 Max.	
Load capacitance	CL	7 pF, 9 pF, 12.5 pF	Please specify
Motional resistance (ESR)	R1	50 kΩ Max.	
Motional capacitance	C1	3.4 fF typ.	
Shunt capacitance	C0	1.0 pF typ.	
Frequency aging	f_age	±3 × 10^{-6} / year Max.	+25 °C, First year

■ External dimensions



(Unit : mm)

■ Schedule

ES : 2H/2024
MP : 1H/2025

home

High Stability Miniature Size 32k SPXO

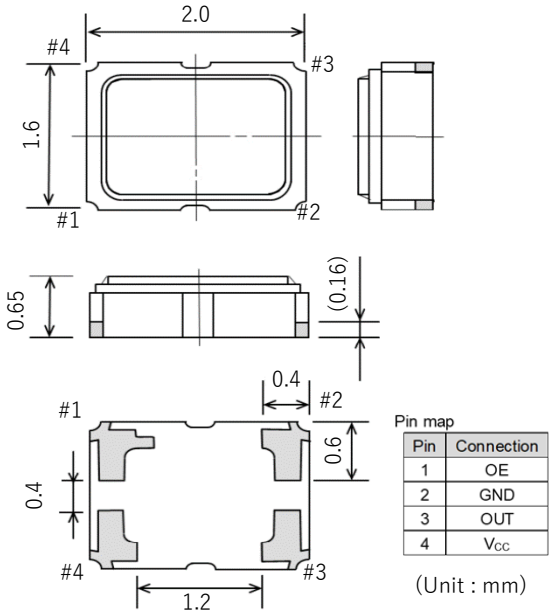
■ Features

- Output Frequency : 32.768kHz, CMOS output
- Low Current consumption : 0.4µA typ.
- Frequency Tolerance : ±8.0 x 10^{-6} (+25 °C)
- Size : 2.0 x 1.6 x 0.65t mm or 1.6 x 1.0 x 0.65t mm

■ Specifications

Item	Symbol	Specifications	Conditions / Remarks
Output frequency	fo	32.768 kHz	
Supply voltage	V_{CC}	1.4 to 5.5 V	
Storage temperature	T_stg	-55 °C to +125 °C	Storage as single product.
Operating temperature	T_use	-40 °C to +105 °C	
Frequency / Temperature characteristics	F_T_C	±8.0 x 10^{-6}	Ta = 25 °C
Current consumption	I_{CC}	0.4µA typ.	No Load condition, V_{CC} = 1.8V
Symmetry	SYM	45 % to 55 %	50 % V_{CC} level
Output load condition (CMOS)	L_CMOS	30 pF Max.	
Start-up time	T_str	1 s Max.	Ta = +25 °C, V_{CC} = 1.5 V to 5.5 V
Cycle Jitter	tC-C	5 ns Typ.	Please specify
Frequency aging	f_age	±3 x 10^{-6} / year Max.	+25 °C, First year

■ External dimensions



■ Schedule

ES : TBD

MP: TBD

home

High Stability Miniature Size 32k TCXO

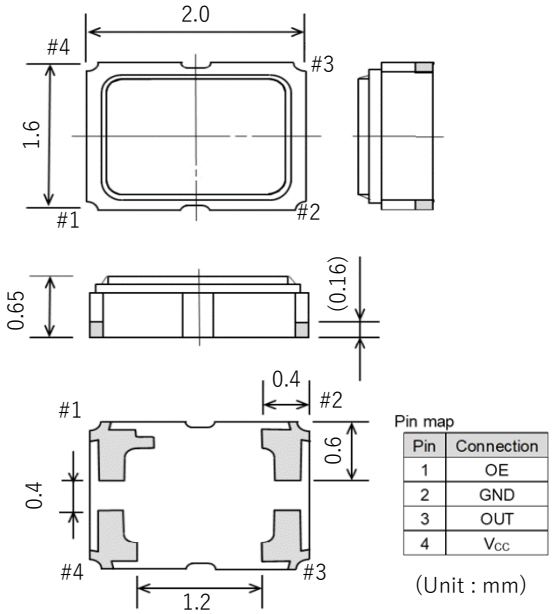
■ Features

- Output Frequency : 32.768kHz, CMOS output
- Low Current consumption : 0.5µA typ.
- Frequency Tolerance : ±8.0 x 10^{-6} (-40 °C to +105 °C)
- Size : 2.0 x 1.6 x 0.65t mm or 1.6 x 1.0 x 0.65t mm

■ Specifications

Item	Symbol	Specifications	Conditions / Remarks
Output frequency	fo	32.768 kHz	
Supply voltage	V_{CC}	1.4 to 5.5 V	
Storage temperature	T_stg	-55 °C to +125 °C	Storage as single product.
Operating temperature	T_use	-40 °C to +105 °C	
Frequency / Temperature characteristics	F_T_C	±8.0 x 10^{-6}	Ta = -40 °C to +105 °C
Current consumption	I_{CC}	0.5µA typ.	No Load condition, V_{CC} = 1.8V
Symmetry	SYM	45 % to 55 %	50 % V_{CC} level
Output load condition (CMOS)	L_CMOS	30 pF Max.	
Start-up time	T_str	1 s Max.	Ta = +25 °C, V_{CC} = 1.5 V to 5.5 V
Cycle Jitter	tC-C	5 ns Typ.	Please specify
Frequency aging	f_age	±3 x 10^{-6} / year Max.	+25 °C, First year

■ External dimensions



■ Schedule

ES : TBD
MP: TBD

MHz Crystal Basics

EPSON

Known As…

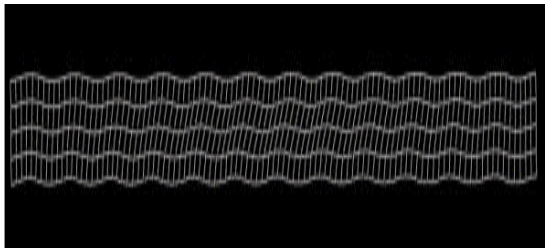
- AT Crystal
- RF Crystal

Important Specs

- Size
- Frequency
- Frequency Tolerance and Stability
- Operating Temperature
- Load Capacitance
- Equivalent Series Resistance (ESR)

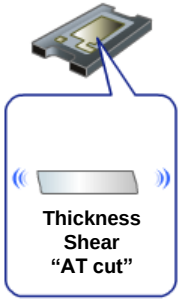
Key Applications

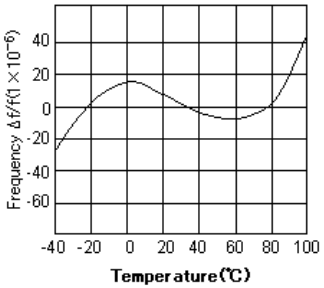
- Connectivity (WiFi, BT, Lora etc)
- RF Clocking
- MCU Clocking



Thickness Shear Vibration mode

MHz Frequency Deviation Temperature Curve





$\Delta f/f = \alpha (\theta X-25)^3 + \beta (\theta X-25)^2 + \gamma (\theta X-25)$

θX: specified temperature

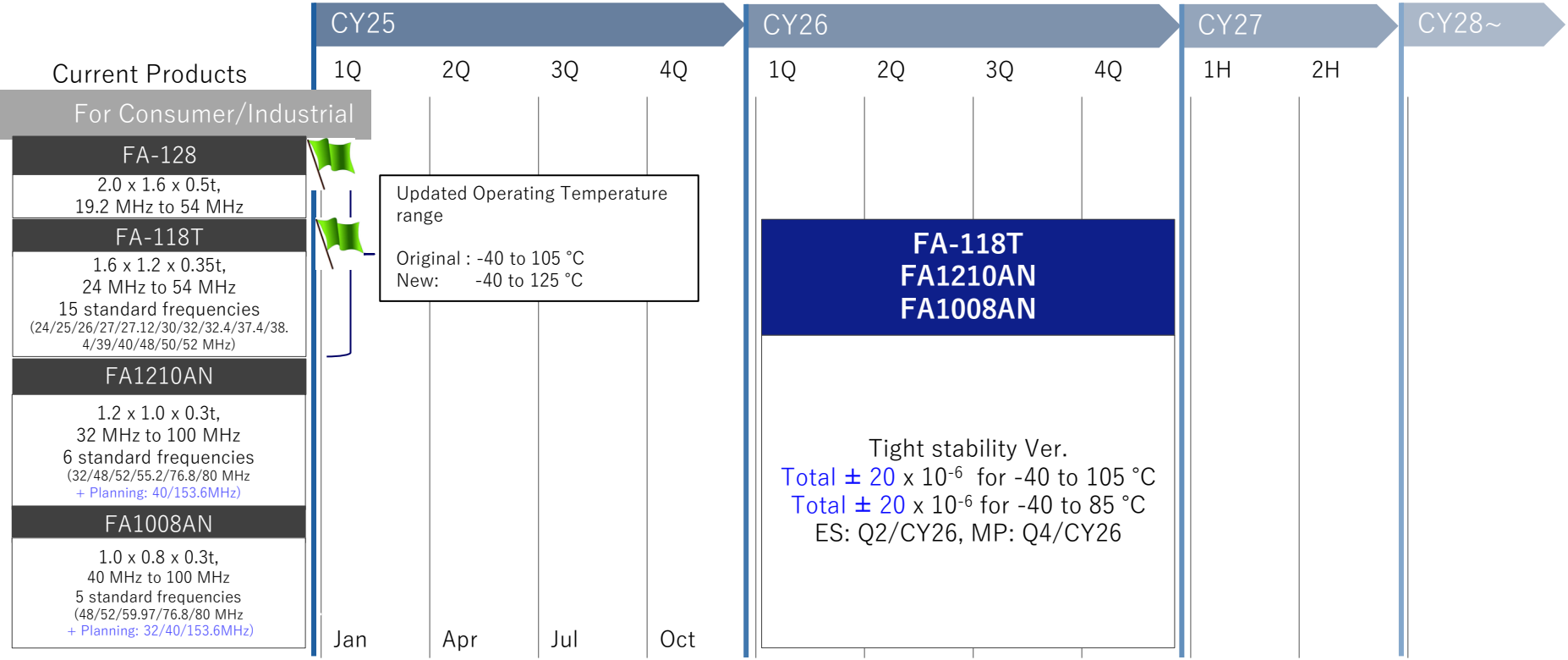
home

MHz Products | Crystal Unit

EPSON

Miniaturization
High Frequency/Tight Stability

In MP | ▼ES In Design | ▽ES Planned | Considering



FA-118T tight stability

EPSON

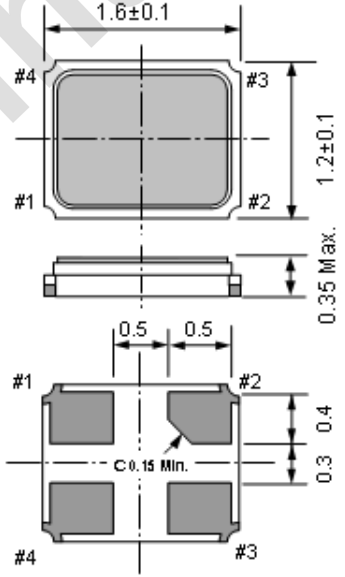
■ **Features**

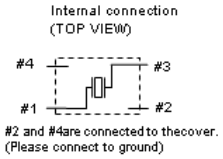
- Ultra Small size with low height package crystal unit.
  1.6 × 1.2 mm, t = 0.35 mm Max.
- Best for small size application such as...
  Small wireless device, Small wireless module, and Wearable device, etc

■ Specifications

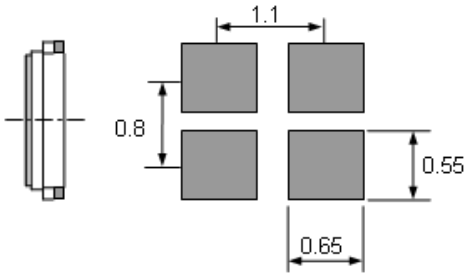
Item	Specifications
Nominal frequency range	52 to 80 MHz
Storage temperature range	-40 °C to +125 °C
Operating temperature range	-40 °C to +105 °C
Level of drive	200 μW Max.
Frequency tolerance	±7 x 10^{-6}
Load capacitance	6 pF to ∞
Motional resistance (ESR)	60 Ω Max.
Frequency versus temperature characteristics.	±10 x 10^{-6} / -30 °C to +85 °C
Frequency Aging (5 years at +25 °C) Reflow shift (After 2 reflows)	±3 x 10^{-6}

■ External dimension





■ Footprint



■ Schedule

ES : 4Q/‘25
MP : 2Q/‘26

home

FA1008AN tight stability

EPSON

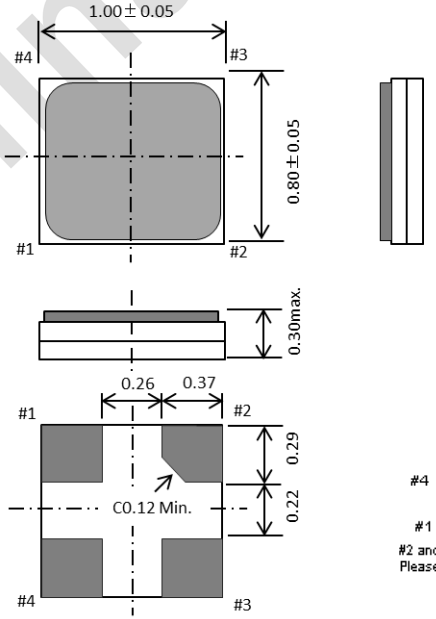
■ **Features**

- Ultra Small size with low height package crystal unit.
  1.0 × 0.8 mm, t = 0.3 mm Max.
- Best for small size application such as...
  Small wireless device, Small wireless module, and Wearable device, etc

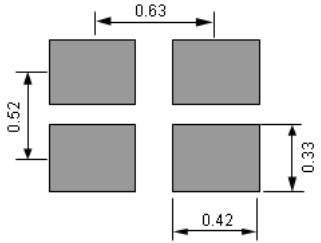
■ Specifications

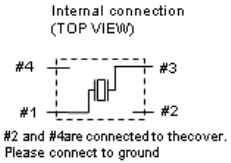
Item	Specifications
Nominal frequency range	52 to 80 MHz
Storage temperature range	-40 °C to +125 °C
Operating temperature range	-40 °C to +105 °C
Level of drive	200 μW Max.
Frequency tolerance	±7 x 10^{-6}
Load capacitance	6 pF to ∞
Motional resistance (ESR)	60 Ω Max.
Frequency versus temperature characteristics.	±10 x 10^{-6} / -30 °C to +85 °C
Frequency Aging (5 years at +25 °C) Reflow shift (After 2 reflows)	±3 x 10^{-6}

■ External dimension



■ Footprint





■ Schedule

ES : 4Q/‘25
MP : 2Q/‘26

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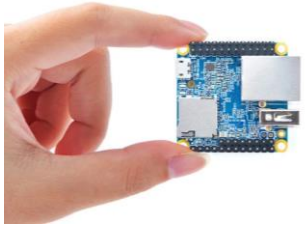
RTC Module

Integrated Module with 32KHz crystal & Epson IC

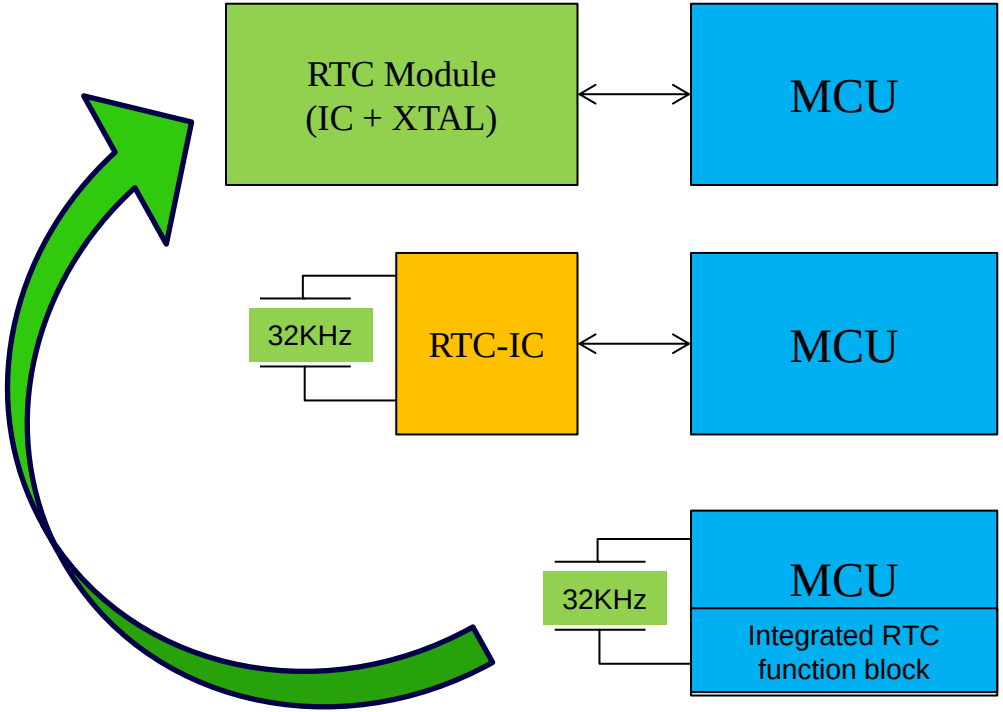
home

Applications for RTC Modules



home

Options to realize RTC function



low power
high accuracy
optional power switch
battery charge control
event detection
one package: reliable & tiny
overall cost

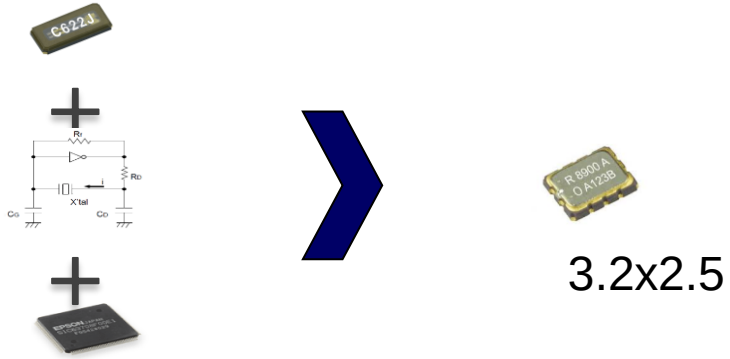
low power
optional power switch
battery charge control

lowest *component* cost
power consumption ?
stability / calibration ?
oscillator circuit design ?
additional functions ?
reliability ?
overall cost inc production ?

up-grade your application !

home

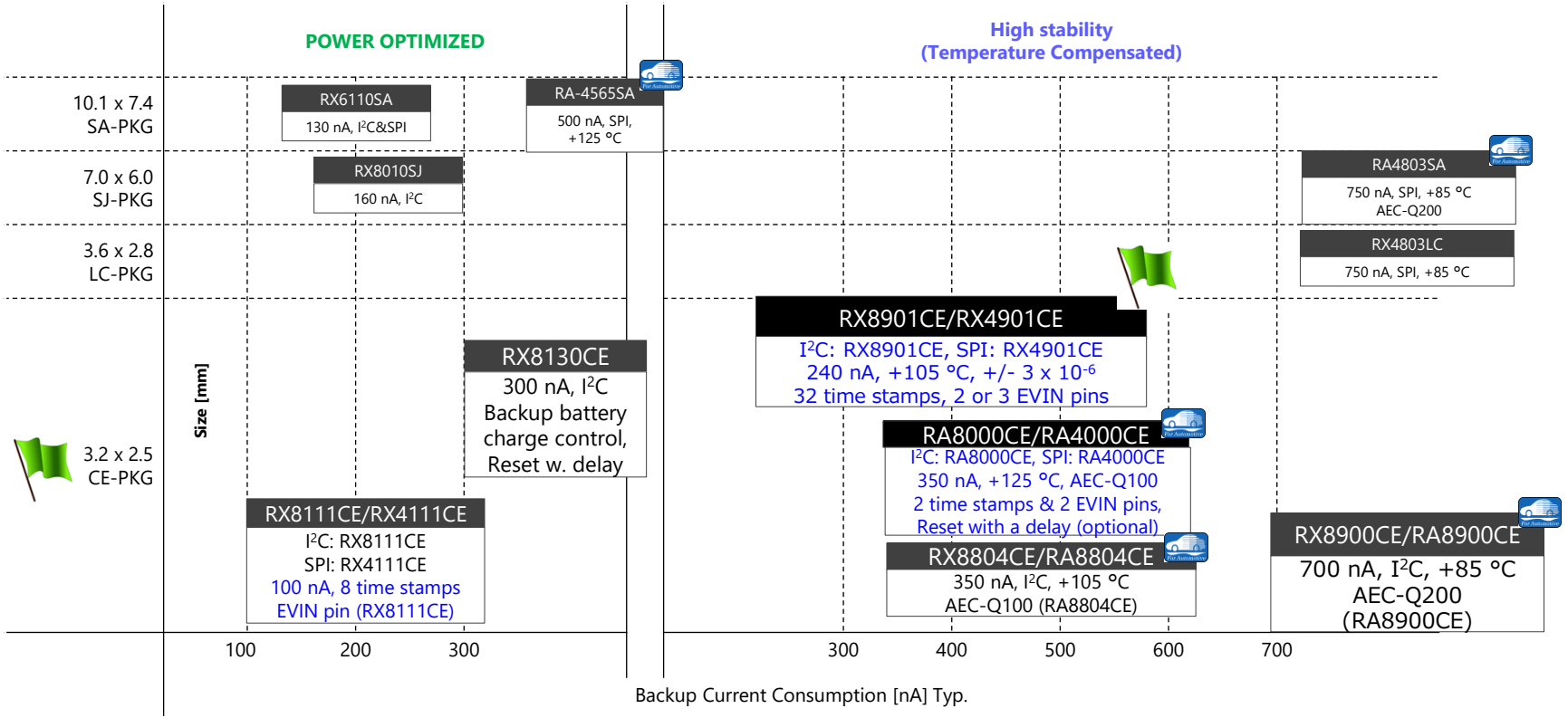
An Overall Cost Calculation



KHz + MCU	RTC Module
32KHz discrete needed	32KHz integrated
proper 32KHz osc design	included
calibration needed	included and optimized
power switch needed	included and optimized
battery size & service time	optimized power consumption
time stamps	included and optimized

home

Real Time Clock module



home

Comparison 3.2x2.5 size

	RX8111CE	RX4111CE	RX8130CE	RX8804CE	RX8900CE	RX8901CE
DTCXO				Built-in	Built-in	**Built-in**
Interface	I²C	SPI	I²C	I²C	I²C	I²C
Up to +105 °C				Yes		Yes
Backup current Typ. / 3 V	**100 nA**	**100 nA**	**300 nA**	350 nA	700 nA	**250 nA**
Time stamp	Yes, 8 times	Yes, 8 times		Yes, 1 time		**Yes, 32 times**
EVIN pin	Yes			Yes		Yes, 3
Power switching	Yes	Yes *Need external Diode for V_{BAT}	Yes, Built-in backup battery charge control function		Yes *Need external Diode for V_{BAT}	Yes
Reset output			Yes			
Pricing	$$	$$	$	$$$	$$$	$$$

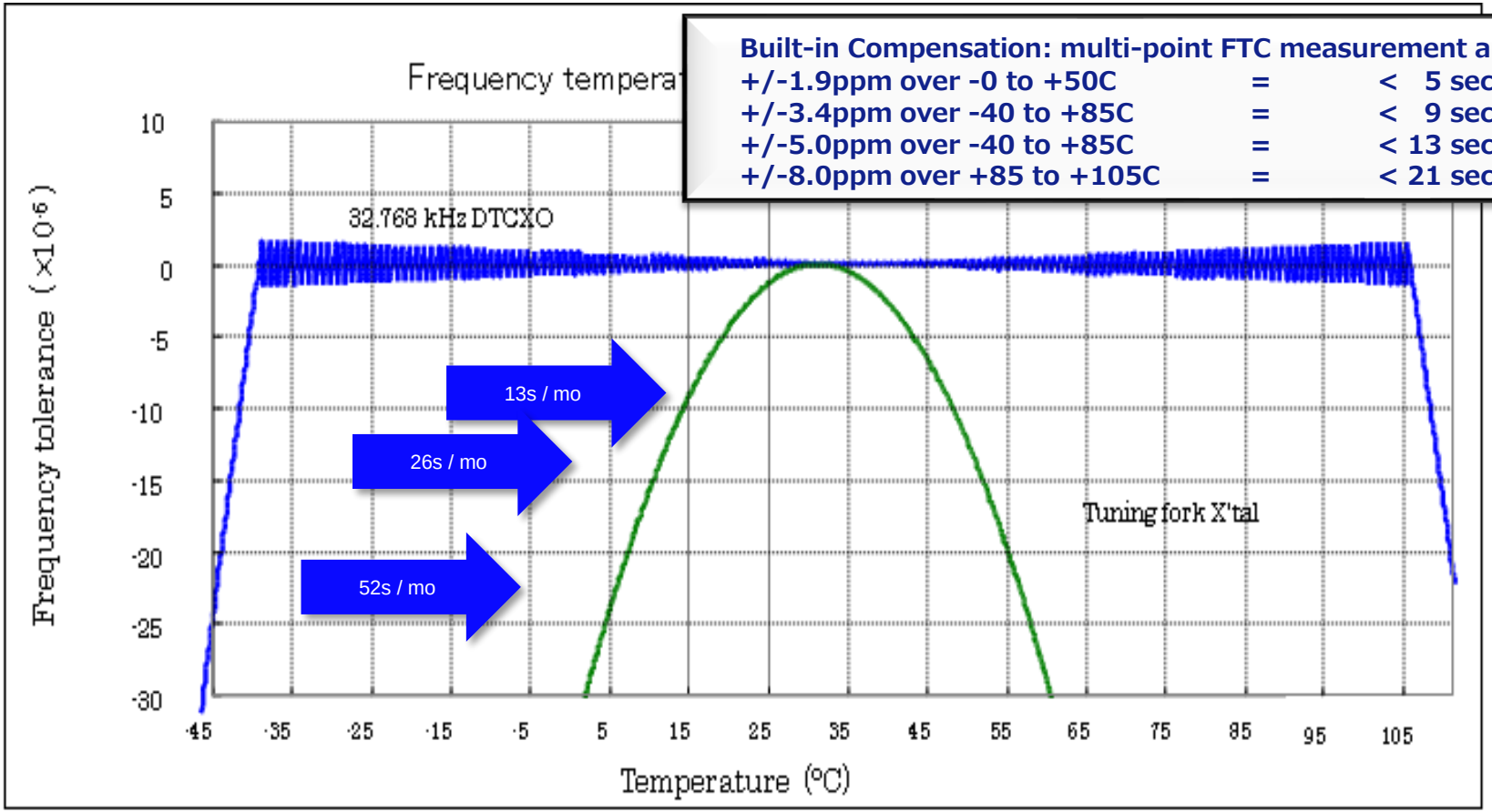
home

High Stability over Temperature Range

EPSON

Built-in Compensation: multi-point FTC measurement and D-TCXO

+/-1.9ppm over -0 to +50C	=	< 5 sec/mth
+/-3.4ppm over -40 to +85C	=	< 9 sec/mth
+/-5.0ppm over -40 to +85C	=	< 13 sec/mth
+/-8.0ppm over +85 to +105C	=	< 21 sec/mth



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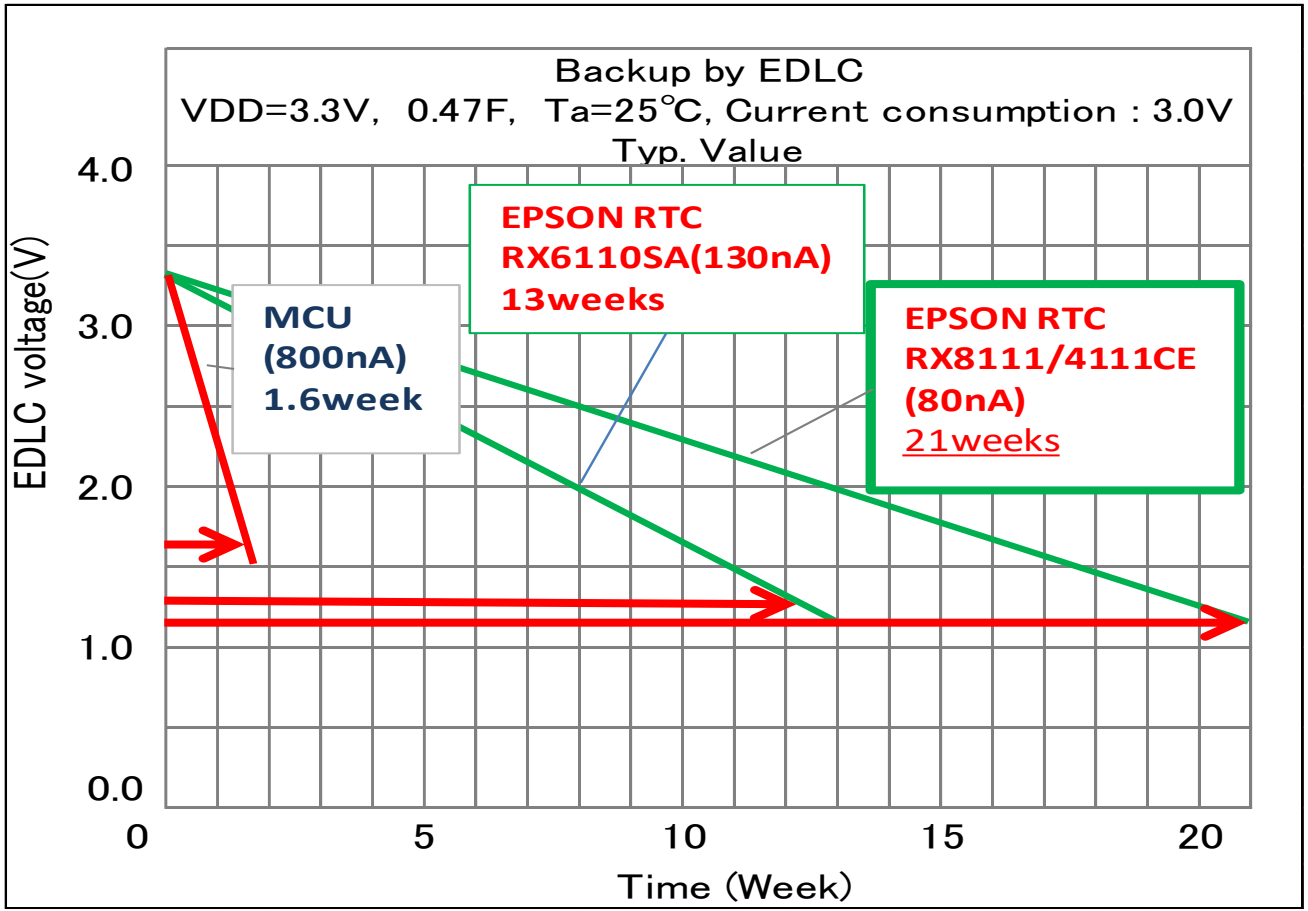
Ultra Low Power Consumption

EPSON

Minimum clock Voltage



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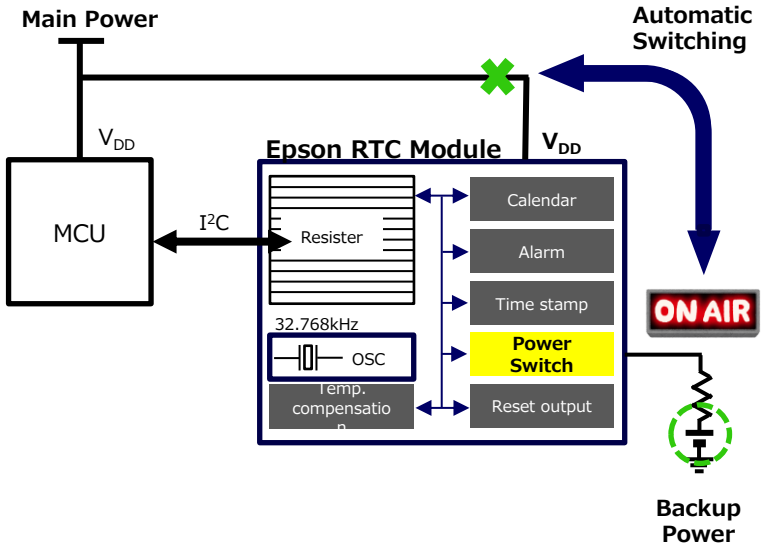
Power Switch

This monitors the main power condition, and this will automatically change the power source to backup mode when the voltage on the main power drops.



Advantages vs Diode-OR circuit

- Reduce a leak current

By using MOS switch in RTC module, user doesn't care about VF/IR specification of Diode.

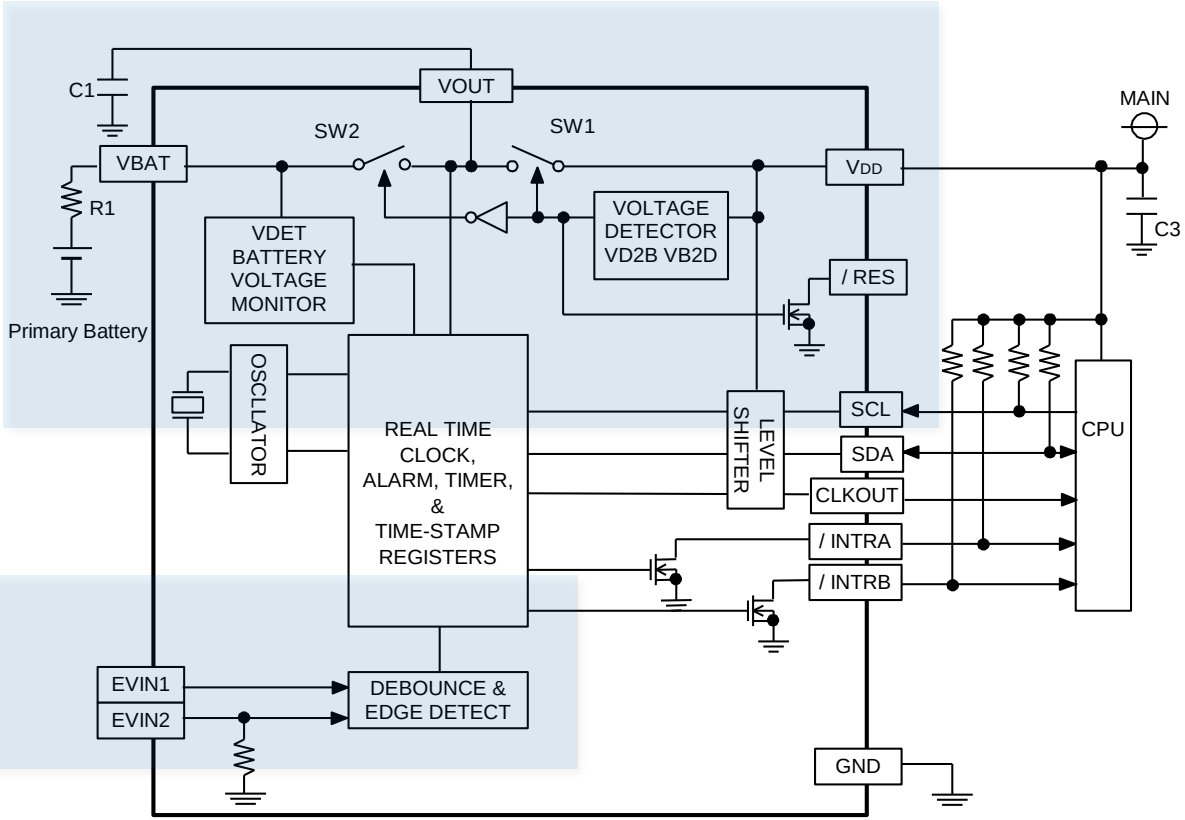
*Depends on backup battery type

home

Typical RTC module insight

Battery Switch

Event Detection



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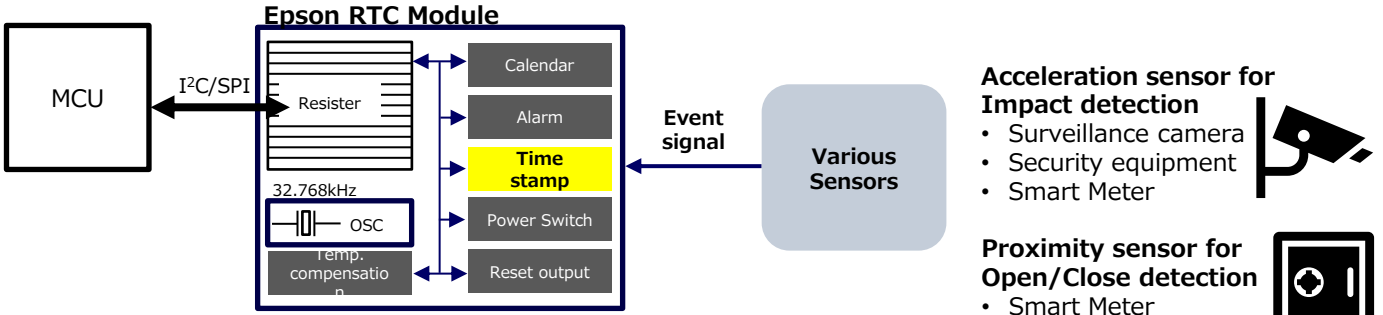
Time Stamp / Even Recording

This function records the time data when an event (signal) is detected.

- RX8111CE and RX8804CE can receive event signals directly from the event input pin (EVIN), enabling RTC operation even when the MCU is in standby mode.
- RX8111CE and RX4111CE can record 8 times clock time data. (User can select first/last 8times)

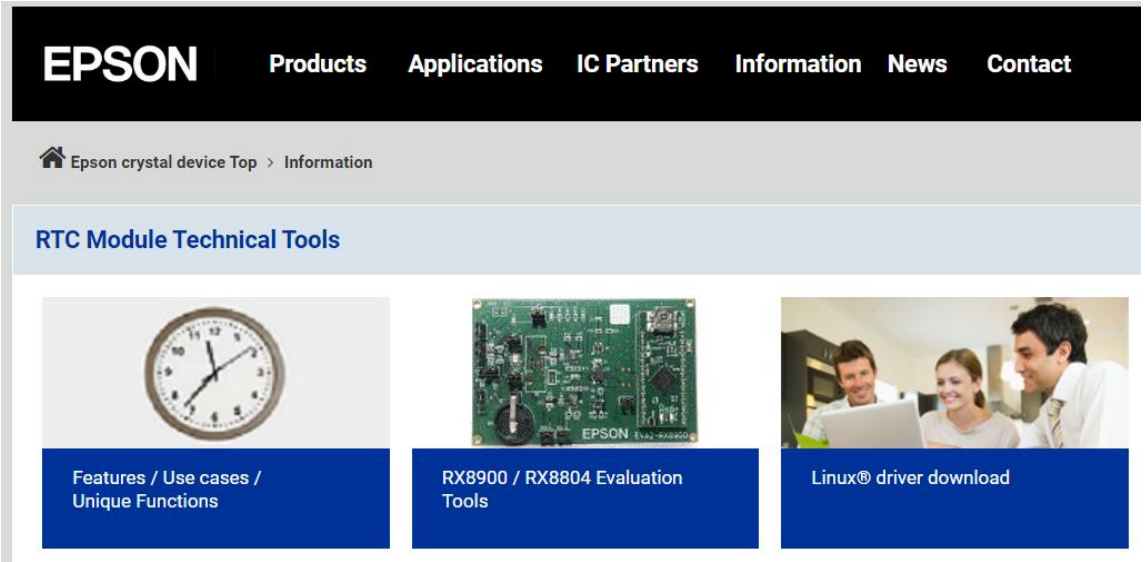


Event trigger

- EVIN pin input (RX8111CE, RX8804CE)
- Interlock with RTC's internal operation
- Bus access

home

Epson RTC module design-in support



https://www5.epsondevice.com/en/information/

Extensive information on the RTC portfolio including application manuals and Linux drivers

Possibility to offer RTC Adapter-boards for evaluation purposes.

! Get in direct contact with Epson for online support

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SPXO

CMOS Standard Oscillators with Epson IC inside

home

Applications for SPXO

home

Oscillator (SPXO) Basics

EPSON

Basic Principle

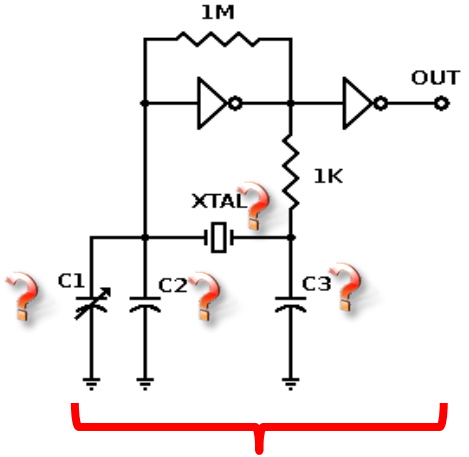
- Crystal + amplifier IC Packaged Together
- No need for circuit evaluation

Important Specs

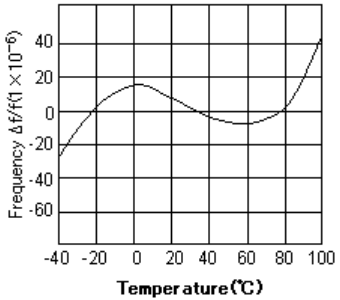
- Phase Noise / Jitter
- Package Size
- Stability

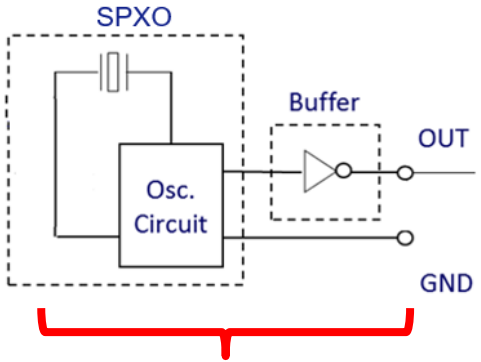
Key Applications

- Medical
- Networking
- Test and Measurement
- Industrial Automation



Frequency Tolerance “S” curve





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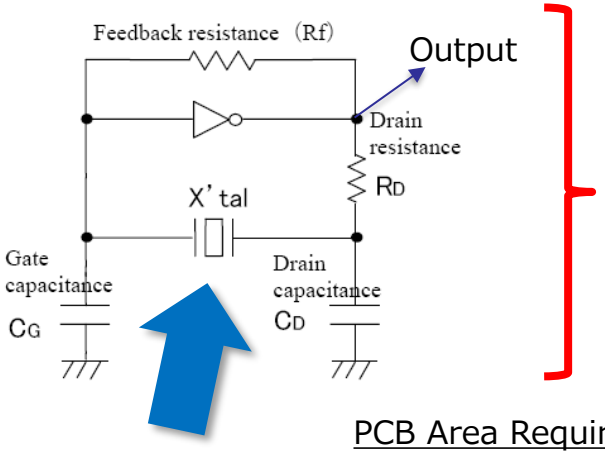
Crystal vs. Oscillator

EPSON

Crystal

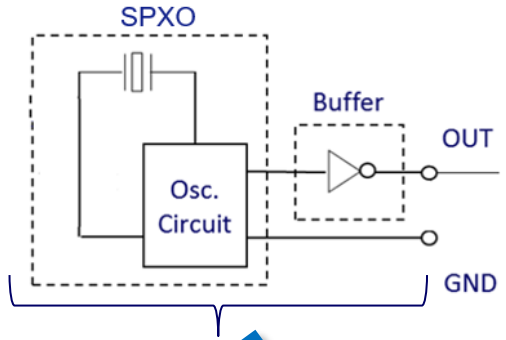
Typical Pierce Oscillator Circuit



PCB Area Required

Small Crystal 1.6x1.2mm + External Components Load Caps & Resistors

Oscillator



PCB Area Required

Small SPXO 2.0x1.6mm

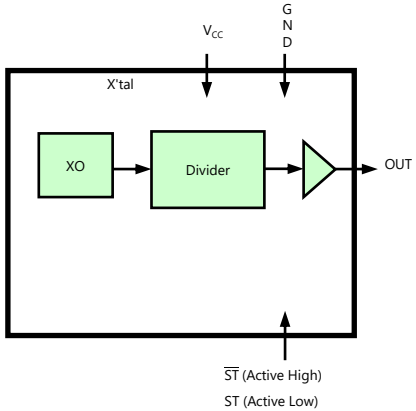
home

Direct „fixed frequency“ SPXO

20 standard frequencies

4/8/10/12/12.288/14.7456/16/20/24/24.675/25/26/27
/32/33.33/33.3333/40/48/50/72MHz

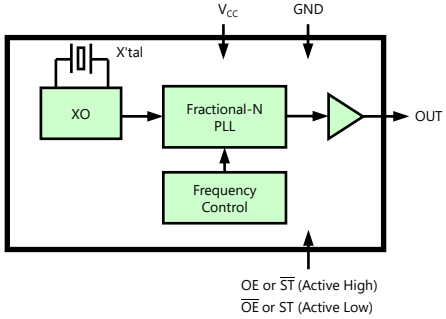
SG7050/5032/3225/2016
SG-210STF



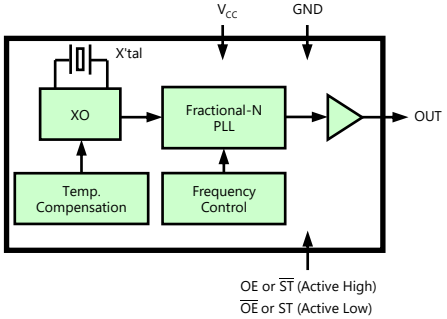
PLL „programmable" SPXO

All non-standard frequencies

SG8018xx/SG8200xx



SG8101xx/ SG8201xx

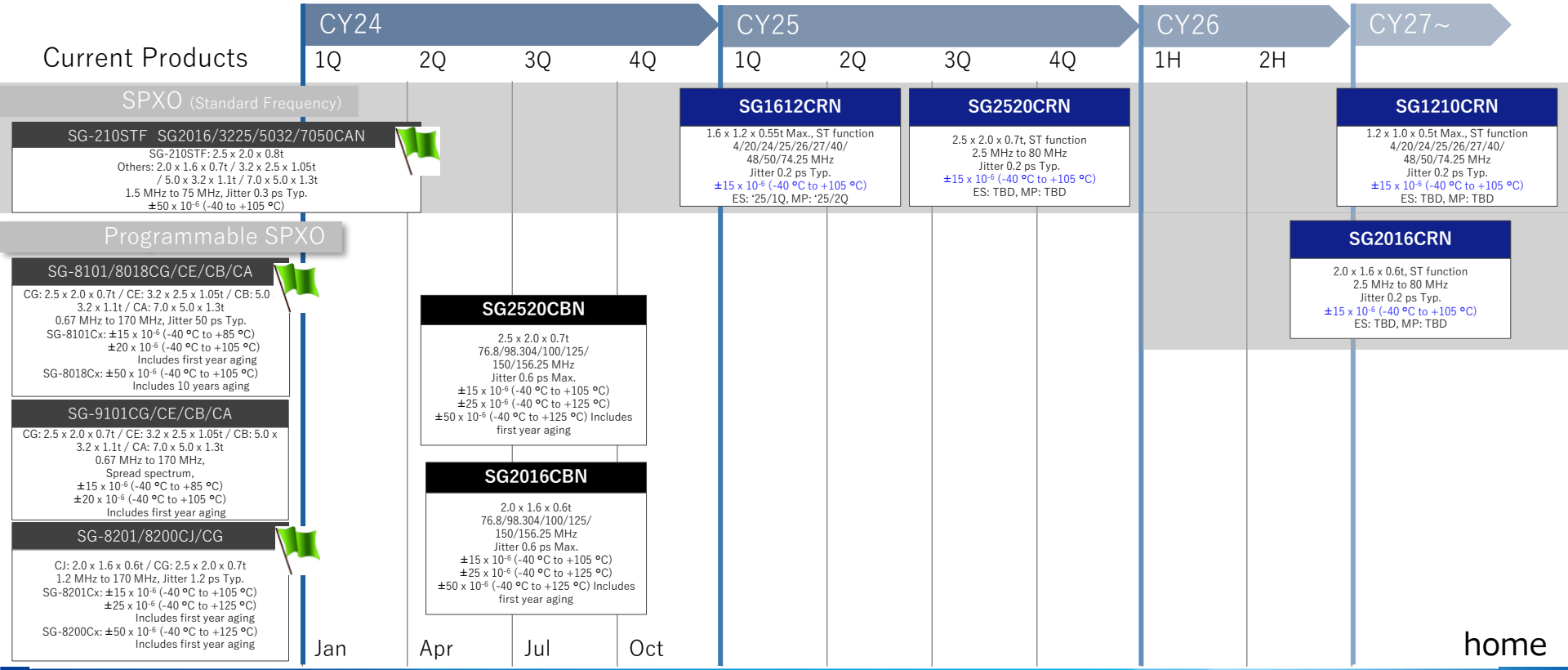


home

SPXO – CMOS output

EPSON

In MP | In Design (ES) | Planned (ES) | Considering



home

SG2016CBN, SG2520CBN

EPSON

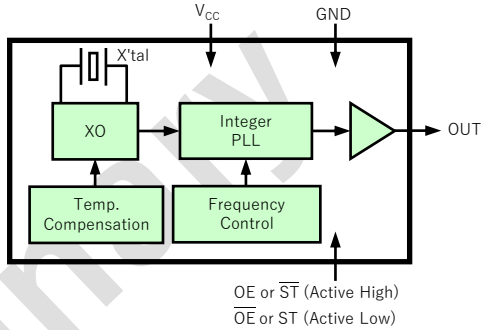
■ Feature

- **Low noise Integer PLL technology support**
- Jitter characteristics **0.6 ps Max.** at fo = 125 MHz
- **±15 x 10^{-6} (up to +105 ° C) / ±25 x 10^{-6} (up to +125 ° C)** with **Temperature compensation function**

■ Specifications

Item	Specifications
Standard frequency (fo)	76.8 MHz / 98.304 MHz / 100 MHz 125 MHz / 150 MHz / 156.25 MHz
Output	CMOS
Supply voltage (V_{CC})	1.62 V to 3.63 V
Frequency tolerance / Operating temperature	±15 x 10^{-6} / -40 ° C to +105 ° C ±25 x 10^{-6} / -40 ° C to +125 ° C ±50 x 10^{-6} / -40 ° C to +125 ° C * Including includes Initial frequency tolerance, Frequency / temperature characteristics, Frequency / voltage coefficient, Frequency / load coefficient and Aging (+25 ° C, First year)
Current consumption (No load)	11.6 mA Max. (fo ≦ 100 MHz) 13.2 mA Max. (100 MHz < fo ≦ 125 MHz) 16.6 mA Max. (fo > 125 MHz)
Symmetry	45 % to 55 %
Rise/Fall time	2.5 ns Max. (fo ≦ 125 MHz) 2.0 ns Max. (fo > 125 MHz)
Phase jitter (@125 MHz)	0.6 ps Max. / 12 kHz to 20 MHz
Function	Output enable or Stand-by

■ Block diagram

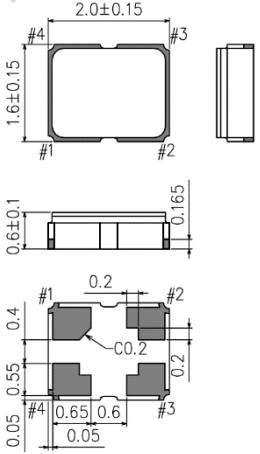


■ Schedule

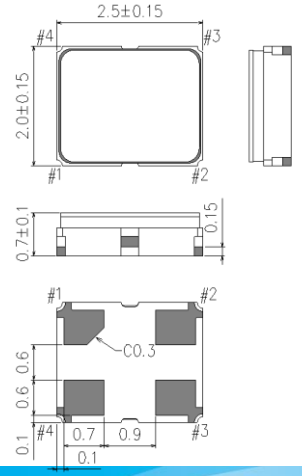
SG2016CBN: ES: Done
MP: 7/CY24
SG2520CBN: ES: Done
MP: 7/CY24

■ External dimension (unit in mm)

< SG2016CBN >



< SG2520CBN >



■ Pin map

#1	OE or ST (Active High) ST or OE (Active Low)
#2	GND
#3	OUT
#4	Vcc

home

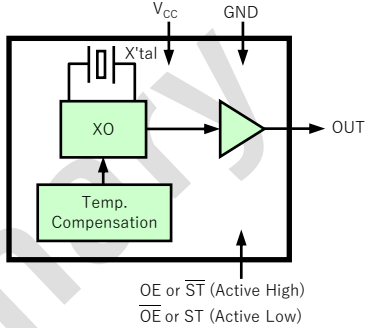
SG2016CRN, SG2520CRN

EPSON

■ Feature

- High frequency stability in up to +105 ° C
- Tight symmetry
- Precise and Low phase noise

■ Block diagram



■ Schedule

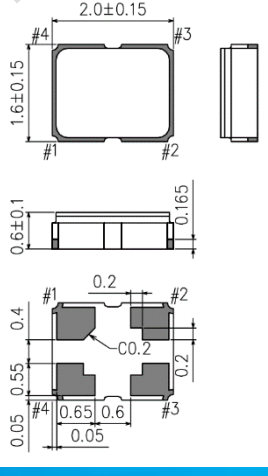
SG2016CRN: ES: TBD
MP: TBD
SG2520CRN: ES: TBD
MP: TBD

■ Specifications

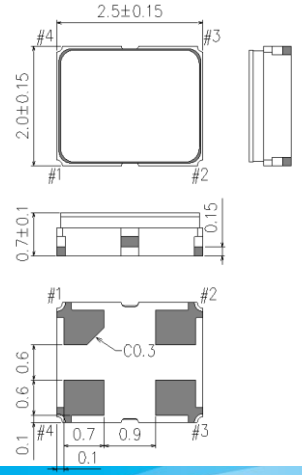
Item	Specifications
Frequency (fo)	10 MHz to 80 MHz
Output	CMOS
Supply voltage (V_{CC})	1.8 V ± 5 % / 2.5 V ± 10 % / 3.3 V ± 10 %
Frequency tolerance / Operating temperature	±15 x 10^{-6} / -40 ° C to +105 ° C * Including includes Initial frequency tolerance, Frequency / temperature characteristics, Frequency / voltage coefficient, Frequency / load coefficient. and Aging (+25 ° C, First year)
Current consumption (@26 MHz, No load)	3.5 mA Max.
Symmetry	45 % to 55 % (opt. 49 % to 51 %)
Phase noise (@26 MHz)	-148 dBc/Hz Typ. at 1 kHz -169 dBc/Hz Typ. at 100 kHz
Phase jitter (@26 MHz)	0.2 ps Typ. / 12 kHz to 20 MHz
Function	Output enable or Stand-by

■ External dimension (unit in mm)

< SG2016CRN >



< SG2520CRN >



■ Pin map

#1	OE or ST (Active High) ST or OE (Active Low)
#2	GND
#3	OUT
#4	Vcc

home

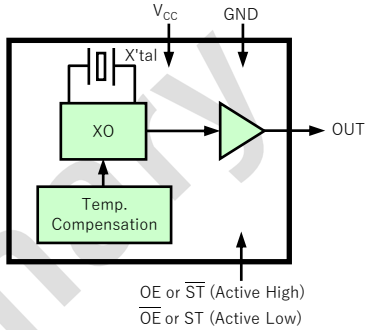
SG1612CRN

EPSON

■ Feature

- **High frequency stability in up to +105 ° C**
- Tight symmetry
- Precise and Low phase noise

■ Block diagram



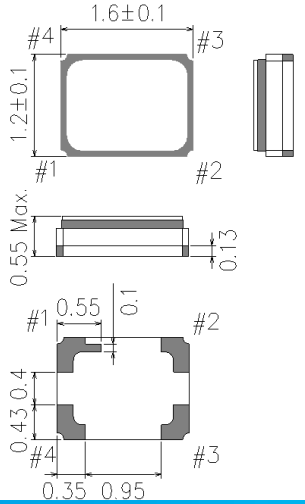
■ Schedule

ES: 1Q/CY25
MP: 2Q/CY25

■ Specifications

Item	Specifications
Frequency (fo)	10 MHz to 80 MHz
Output	CMOS
Supply voltage (V_{CC})	1.8 V ± 5 % / 2.5 V ± 10 % / 3.3 V ± 10 %
Frequency tolerance / Operating temperature	±15 x 10^{-6} / -40 ° C to +105 ° C * Including includes Initial frequency tolerance, Frequency / temperature characteristics, Frequency / voltage coefficient, Frequency / load coefficient. and Aging (+25 ° C, First year)
Current consumption (@26 MHz, No load)	3.5 mA Max.
Symmetry	45 % to 55 % (opt. 49 % to 51 %)
Phase noise (@26 MHz)	-145 dBc/Hz Typ. at 1 kHz -159 dBc/Hz Typ. at 100 kHz
Phase jitter (@26 MHz)	0.2 ps Typ. / 12 kHz to 20 MHz
Function	Output enable or Stand-by

■ External dimension (unit in mm)



■ Pin map

#1	OE or ST (Active High) ST or OE (Active Low)
#2	GND
#3	OUT
#4	Vcc

home

SG1210CRN

EPSON

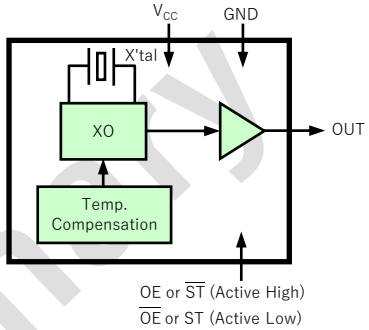
■ Feature

- **High frequency stability in up to +105 ° C**
- Tight symmetry
- Precise and Low phase noise

■ Specifications

Item	Specifications
Frequency (fo)	10 MHz to 80 MHz
Output	CMOS
Supply voltage (V_{CC})	1.8 V ± 5 % / 2.5 V ± 10 % / 3.3 V ± 10 %
Frequency tolerance / Operating temperature	±15 x 10^{-6} / -40 ° C to +105 ° C * Including includes Initial frequency tolerance, Frequency / temperature characteristics, Frequency / voltage coefficient, Frequency / load coefficient. and Aging (+25 ° C, First year)
Current consumption (@26 MHz, No load)	3.5 mA Max.
Symmetry	45 % to 55 % (opt. 49 % to 51 %)
Phase noise (@26 MHz)	-145 dBc/Hz Typ. at 1 kHz -159 dBc/Hz Typ. at 100 kHz
Phase jitter (@26 MHz)	0.2 ps Typ. / 12 kHz to 20 MHz
Function	Output enable or Stand-by

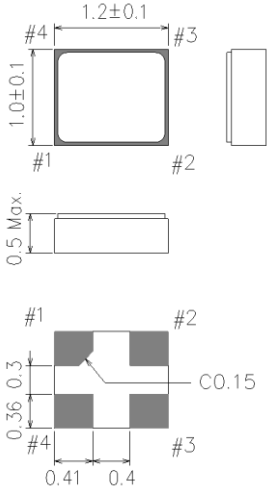
■ Block diagram



■ Schedule

ES: TBD
MP: TBD

■ External dimension (unit in mm)



■ Pin map

#1	OE or ST (Active High) ST or OE (Active Low)
#2	GND
#3	OUT
#4	Vcc

home

PLL - SPXO Basics

Programmable
Simple
Packaged
X = Crystal
Oscillator

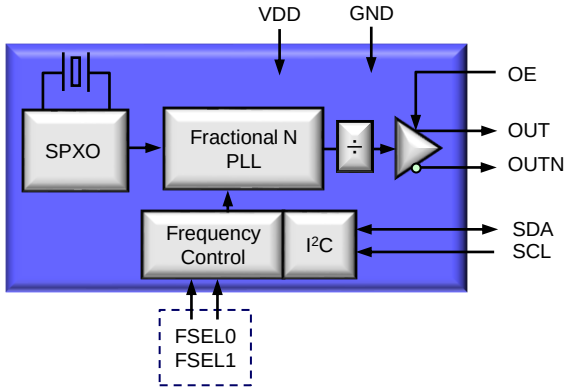
Important Specs

- Frequency
- Tolerance
- Operating Temperature
- Phase Noise/Jitter

Key Applications

- Medical
- Networking
- Test & Measurements
- Industrial Automation

Programmable oscillator using Fractional-N PLL to synthesis any frequency.



Basic Building Blocks:

1. Oscillator: SPXO
2. Fractional-N PLL
3. Output Buffer & Divider: CMOS or LVPECL
4. Control Block
   1.Select Pins
   2.I2C Interface1

home

Programmable SPXOs (PLL)

	SG-8018	SG-8101	SG-82xx
Frequency Range (MHz)	**0.67 to 170**	**0.67 to 170**	**1.2 to 170**
Frequency Options	1 Frequency (Fractional-N PLL)	1 Frequency (Fractional-N PLL)	1 Frequency (Fractional-N PLL)
Phase Jitter	<50ps RMS	<50ps RMS	**1.1ps typ.**
Supply Voltage	1.6V to 3.6V	1.6V to 3.6V	1.6V to 3.6V
Temperature Range	**-40C to 105C**	-40C to 85C **-40C to 105C**	-40C to 105C **-40C to 125C**
Frequency Tolerance	**50 ppm TTL inc. 10years aging**	**15/20/50 ppm**	**15/20/50 ppm TTL inc. 1year aging**
Current Consumption	2.7mA to 6.8mA	2.7mA to 6.8mA	7.5mA – 12.4mA
Output Type	LVCMOS	LVCMOS	LVCMS
Packages	CG/CE/CB/CA	CG/CE/CB/CA	CG/CJ

Any non-standard frequency with 6 digits behind the comma

Phase Jitter in the range of direct oscillators

High Stability over wide temperature range

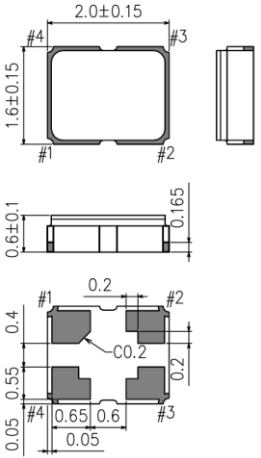
Most common footprints
Smallest = cheapest !

home

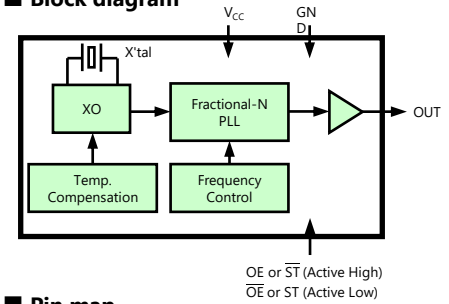
SG-8200CJ/SG-8201CJ - New Low Jitter PLL SPXO

Item	Specifications
Frequency (fo)	1.2 MHz to 170 MHz
Output	CMOS
Supply voltage (V_{CC})	1.62 V to 3.63 V
Frequency tolerance / Operating temperature	SG-8200CJ: ±50 x 10^{-6} / -40 °C to +125 °C SG-8201CJ: ±15 x 10^{-6} / -40 °C to +105 °C ±25 x 10^{-6} / -40 °C to +125 °C Including Initial frequency tolerance Frequency / temperature characteristics, Frequency / voltage coefficient, Frequency / load Coefficient and Aging (+25 °C, First year)
Current consumption	7.5 mA Max. (fo = 25 MHz) 12.4 mA Max. (fo = 125 MHz)
Symmetry	45 % to 55 %
Rise/Fall time	2.0 ns Max. (fo > 125 MHz) 2.5 ns Max. (75 MHz < fo ≤ 125 MHz) 4.0 ns Max. (50 MHz < fo ≤ 75 MHz) 6.0 ns Max. (fo ≤ 50 MHz)
Phase jitter (12 kHz to 20 MHz)	1.1 ps Typ. (fo = 125 MHz)
Function	Output enable or Stand-by

■ **External dimension**



■ **Block diagram**



■ **Pin map**

#1	OE or $\overline{ST}$ (Active High) ST or $\overline{OE}$ (Active Low)
#2	GND
#3	OUT
#4	Vcc

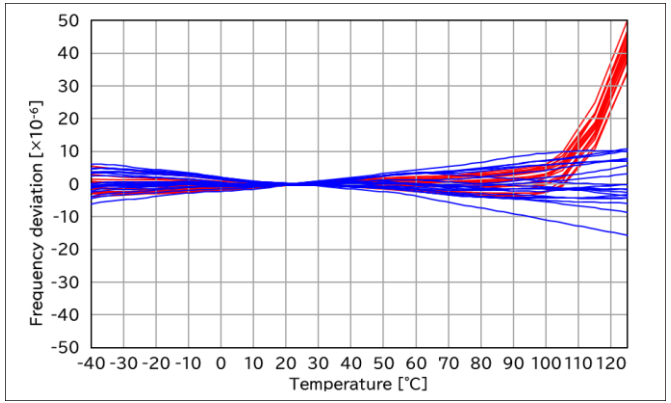
home

SG-8200CJ/SG-8201CJ features

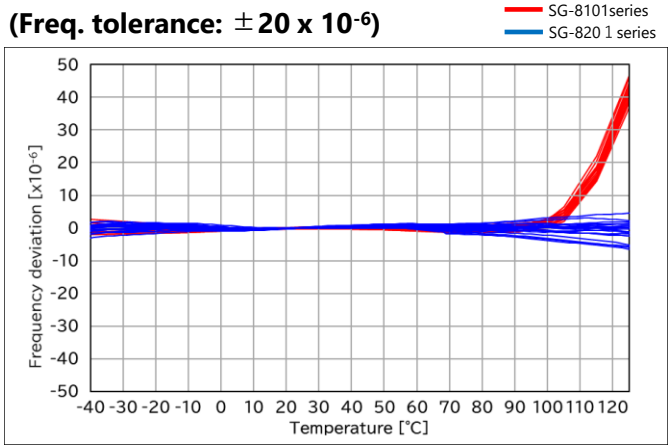
High Stability & Wide Temperature Range

Compared with existing programmable SPXO SG-8101series, this product can adjust the temperature variation up to +125 ° C and has high stability characteristics over a wide temperature range.

SG-8200CJ vs SG-8101series
(Freq. tolerance: ±50 x 10^{-6})



SG-8201CJ vs SG-8101series
(Freq. tolerance: ±20 x 10^{-6})

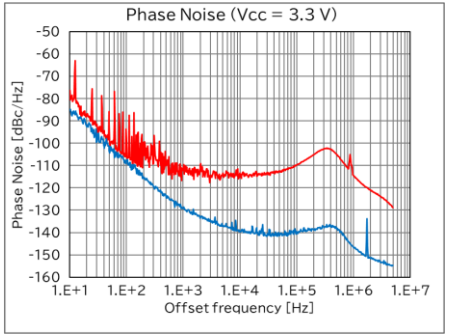


home

Low Phase Noise/Low Jitter Characteristics

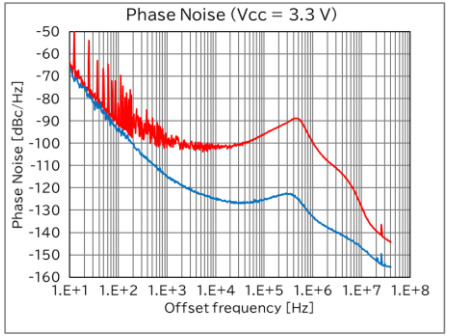
Compared with existing programmable SPXO SG-8101series, phase noise is improved about 30 dBc/Hz at offset frequency from 100 kHz to 1 MHz, and phase jitter is reduced to about 1/40.

fo = 25.0 MHz



	Phase jitter (12 kHz to 5 MHz)
SG-8101series	45.8 ps
SG-8201series	1.2 ps

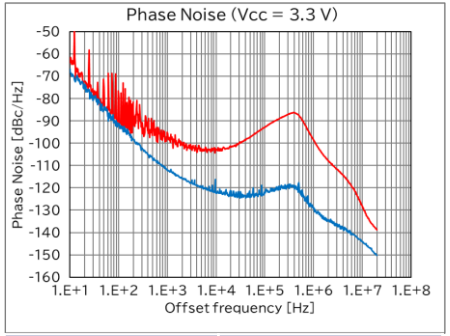
fo = 125.0 MHz



	Phase jitter (12 kHz to 20 MHz)
SG-8101series	43.7 ps
SG-8201series	1.1 ps

fo = 170.0 MHz

SG-8101series
SG-8201series



	Phase jitter (12 kHz to 20 MHz)
SG-8101series	42.3 ps
SG-8201series	1.5 ps

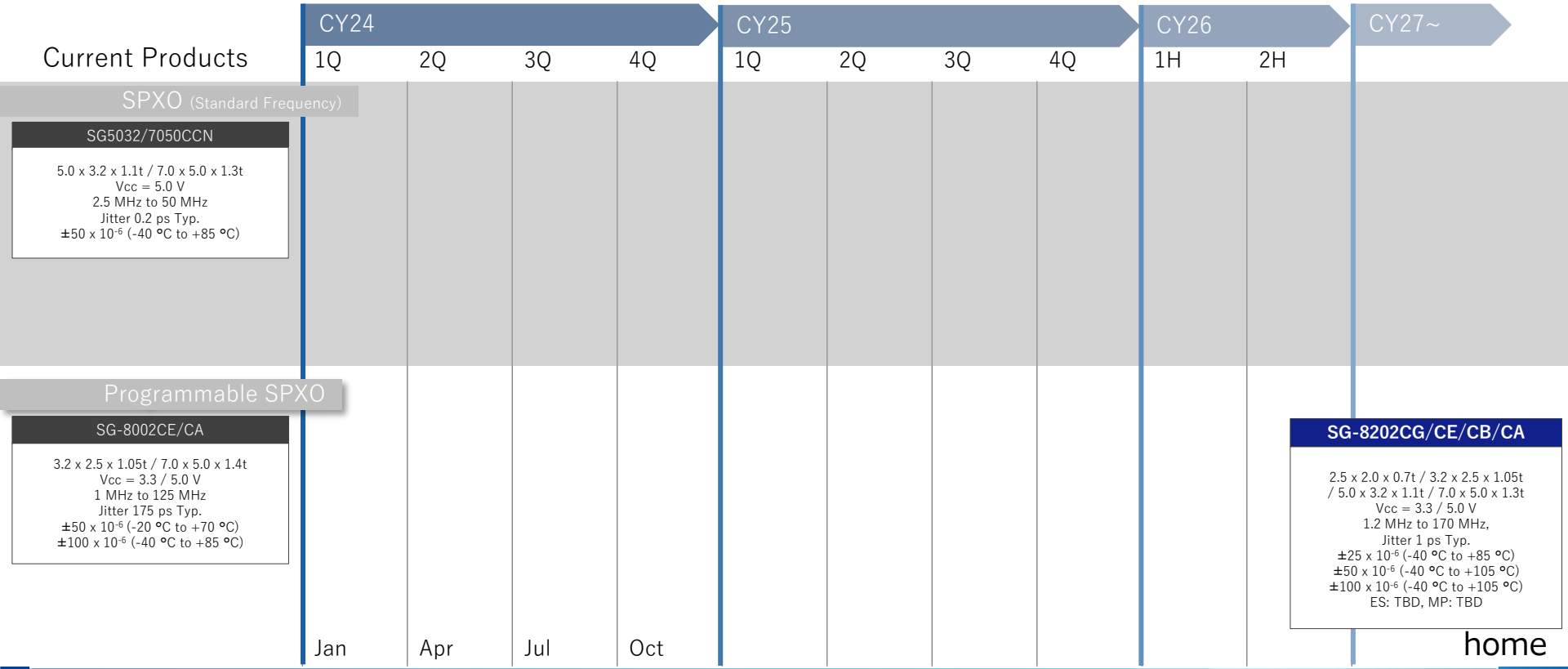
home

SPXO – CMOS with 5V operating voltage

EPSON

Long lifetime with Epson's In-house IC

In MP | ▼ES In Design | ▽ES Planned | Considering



SG-8202CG/CE/CB/CA

EPSON

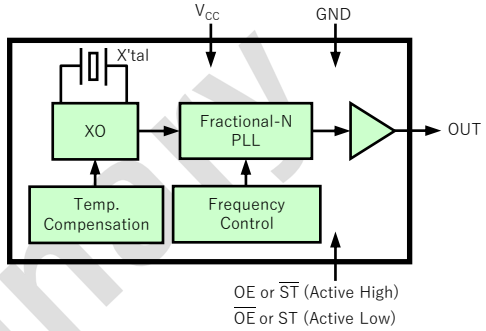
■ Feature

- **Low noise Fractional PLL technology** support **any frequency** between 1.2 MHz and 170 MHz with quick turn-around time
- **±15 x 10^{-6} (up to +105 °C) / ±25 x 10^{-6} (up to +125 °C)** with **Temperature compensation function**

■ Specifications

Item	Specifications
Frequency (fo)	1.2 MHz to 170 MHz
Output	CMOS
Supply voltage (V_{CC})	2.25 V to 5.5 V
Frequency tolerance / Operating temperature	±15 x 10^{-6} / -40 ° C to +105 ° C ±25 x 10^{-6} / -40 ° C to +125 ° C * Including includes Initial frequency tolerance, Frequency / temperature characteristics, Frequency / voltage coefficient, Frequency / load coefficient. and Aging (+25 ° C, First year)
Current consumption (No load)	12 mA Max. (f0 = 25 MHz) 20 mA Max. (f0 = 125 MHz)
Symmetry	45 % to 55 %
Phase jitter (@125 MHz)	1 ps Typ. / 12 kHz to 20 MHz
Function	Output enable or Stand-by

■ Block diagram



■ Schedule

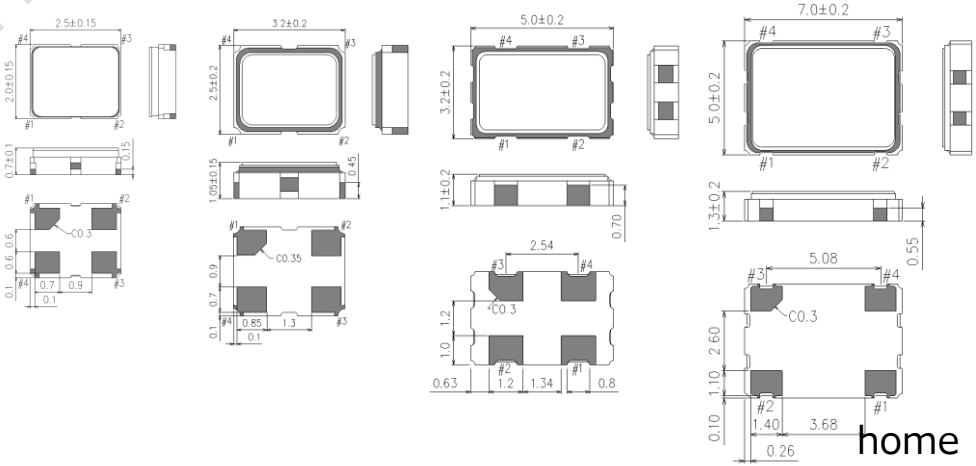
ES: TBD
MP: TBD

■ Pin map

#1	OE or ST (Active High) ST or OE (Active Low)
#2	GND
#3	OUT
#4	Vcc

■ External dimension (unit in mm)

< SG-8202CG > < SG-8202CE > < SG-8202CB > < SG-8202CA >



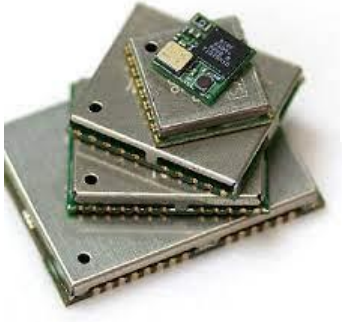
home

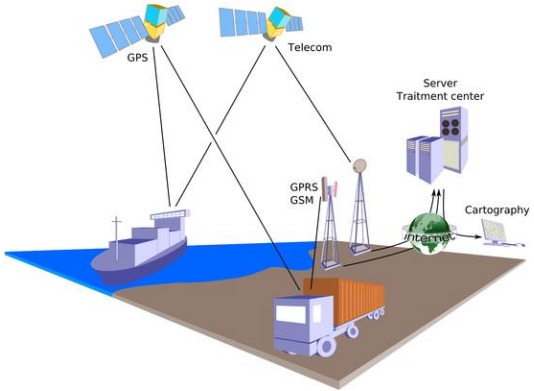
TCXO

Temperature Compensated Oscillators with Epson IC inside

home

Applications for TCXO





home

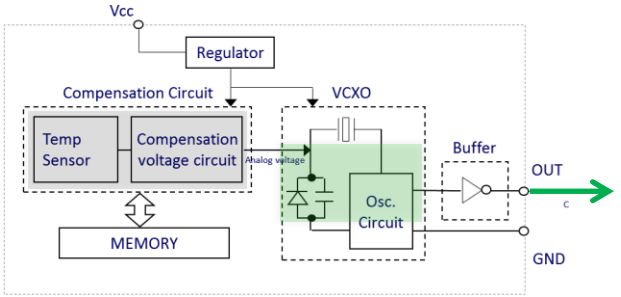
TCXO Basics

- **T**emperature
- **C**ompensated
- **X** = Crystal
- **O**scillator

- **Important Specs**
- Size
- Frequency
- Voltage
- +/-2ppm or +/-0.5ppm Stability
- Operating Temperature
- Voltage Control

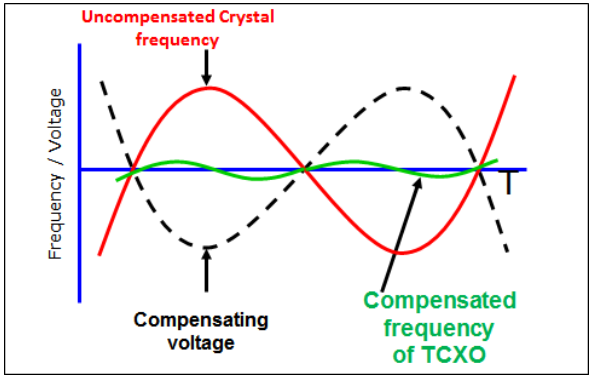
- **Key Applications**
- GPS reference
- RF reference

Basic Principle



measure temperature, adjust frequency

TCXO output: Green curve



Reference: John Vig's Tutorial

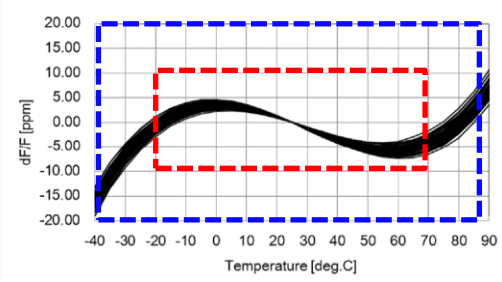
home

MHz or AT-Cut Crystal: Frequency Stability Budget

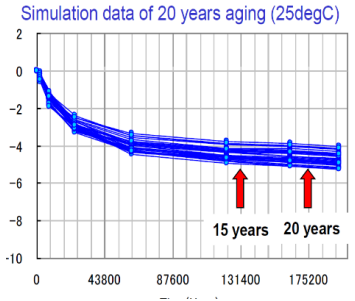
EPSON

1 Tolerance at 25C

2



3



Component	-Stability / ppm	+Stability / ppm	
1 : 25C	-10	10	
2 : Temp	-20	20	-40+85C
3 : Ageing	-10	0	20 years
TOTAL	**-40**	**+30**	

But … 20ppm ‘total’ stability is needed !

Solution : Go for Compensation Choose a TCXO

home

Crystals vs TCXOs

EPSON

MHz Crystal (50ppm)

TCXO (0.5ppm)

TCXO

EPSON

In MP | In Design (▼ ES) | Planned (▽ ES) | Considering

Current Products

For Industrial/Consumer

TG2016SMN/TG2520SMN
2.0 x 1.6 x 0.8t Max. / 2.5 x 2.0 x 0.9t Max.
10 MHz to 55 MHz
±0.5 x 10^{-6} (-40 °C to +85 °C)

TG2520CEN/TG3225CEN
2.5 x 2.0 x 0.9t Max. / 3.2 x 2.5 x 1.0t Max.
12 MHz to 52 MHz, CMOS output
±2 x 10^{-6} (-40 °C to +85 °C)

TG2016SLN
2.0 x 1.6 x 0.7t Max., ST function
10 MHz to 55.2 MHz
±0.5 x 10^{-6} (-40 to +85 °C)
±5.0 x 10^{-6} (+85 °C to +105 °C)

TG1612SLN
1.6 x 1.2 x 0.45t Max., ST function
26 MHz
±0.5 x 10^{-6} (-40 °C to +85 °C)
±5.0 x 10^{-6} (+85 °C to +105 °C)

For Automotive

TG2016SKA/TG2016SLA
2.0 x 1.6 x 0.7t Max.
13 MHz to 55 MHz,
AEC-Q100
SKA: ±0.5 x 10^{-6} (-40 °C to +105 °C)
SLA: ±0.5 x 10^{-6} (-40 °C to +85 °C)

CY25				CY26				CY27		CY28~
1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1H	2H	
Jan		Apr		Jul		Oct				

TG2520SRN/CRN
2.0 x 1.6 x 0.7t Max., ST function
10 MHz to 80 MHz
±0.5 x 10^{-6} (-40 °C to +105 °C)
ES: 1st CY26, MP: 2nd CY26

TG2016SRN/CRN
2.5 x 2.0 x 0.8t Max., ST function
10 MHz to 80 MHz
±0.5 x 10^{-6} (-40 °C to +105 °C)
ES: 1st CY26, MP: 2nd CY26

TG1612SRN/CRN
1.6 x 1.2 x 0.55t Max., ST function
26/32/38.4/52/64/76.8 MHz
±0.5 x 10^{-6} (-40 °C to +105 °C)
ES: 1st CY26, MP: 2nd CY26

TG1210SRN/CRN
1.2 x 1.0 x 0.5t Max., ST function
26/32/38.4/52/64/76.8 MHz
±0.5 x 10^{-6} (-40 °C to +105 °C)
ES: TBD, MP: TBD

TG2016STN
2.0 x 1.6 x 0.7t Max., ST function
26/32/38.4 MHz
1.2V,
±0.5 x 10^{-6} (-40 °C to +105 °C)
ES: TBD, MP: TBD

TG1210STN
1.2 x 1.0 x 0.5t Max., ST function
26/32/38.4 MHz
1.2V,
±0.5 x 10^{-6} (-40 °C to +105 °C)
ES: TBD, MP: TBD

TG1612STN
1.6 x 1.2 x 0.55t Max., ST function
26/32/38.4 MHz
1.2V,
±0.5 x 10^{-6} (-40 °C to +105 °C)
ES: TBD, MP: TBD

home

TG1612SRN/CRN

EPSON

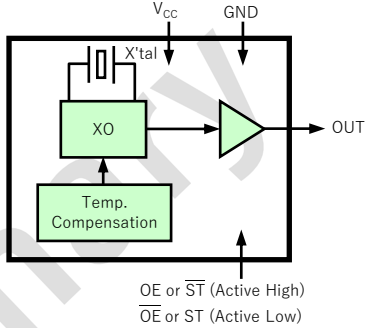
■ Feature

- **High frequency stability in up to +105 ° C**
- Tight symmetry
- Precise and Low phase noise

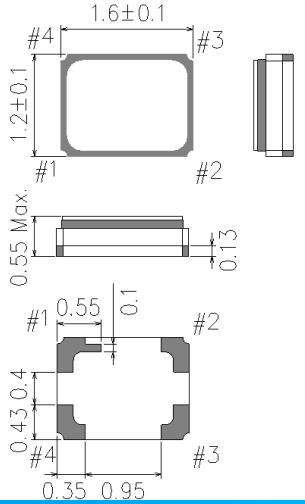
■ Specifications

Item	Specifications
Frequency (fo)	26, 32, 38.4, 39, 49.58, 52, 64, 76.8 MHz
Output	Clipped Sine / CMOS
Supply voltage (V_{CC})	1.8 V ± 5 % / 2.5 V ± 10 % / 3.3 V ± 10 %
Frequency Tolerance	±2.0 x 10^{-6} Max. / After 2 reflows, +25° C
Frequency temperature characteristics	±0.5 x 10^{-6} Max. (opt. ±0.28 x 10^{-6} Max.) / -40 ° C to +105 ° C
Current consumption (@26MHz)	1.5 mA Max. / -40 ° C to +105 ° C, 10kΩ/10pF
Symmetry	45 % to 55 % (opt. 49 % to 51 %)
Phase noise (@26MHz)	-92 dBc/Hz Typ. at 10 Hz -117 dBc/Hz Typ. at 100 Hz -138 dBc/Hz Typ. at 1 kHz -146 dBc/Hz Typ. at 10 kHz -152 dBc/Hz Typ. at 100 kHz -161 dBc/Hz Typ. at 1 MHz
Function	Output enable or Stand-by

■ Block diagram



■ External dimension (unit in mm)



■ Schedule

ES: CY25/1Q
MP: CY25/2Q

■ Pin map

#1	OE or ST (Active High) ST or OE (Active Low)
#2	GND
#3	OUT
#4	Vcc

home

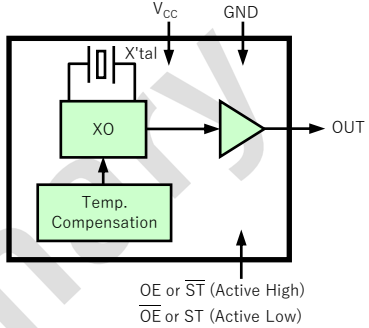
TG2016SRN/CRN, TG2520SRN/CRN

EPSON

■ Feature

- High frequency stability in up to +105 ° C
- Tight symmetry
- Precise and Low phase noise

■ Block diagram



■ Schedule

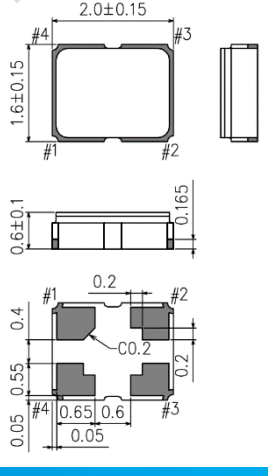
TG2016SRN: ES: TBD
MP: TBD
TG2520SRN: ES: TBD
MP: TBD

■ Specifications

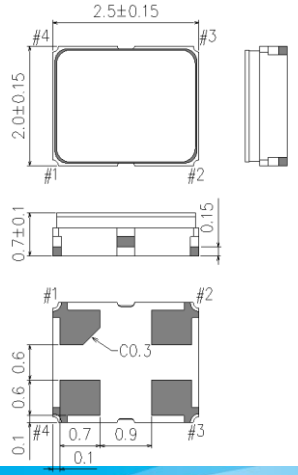
Item	Specifications
Frequency (fo)	26, 32, 38.4, 39, 49.58, 52, 64, 76.8 MHz
Output	Clipped Sine / CMOS
Supply voltage (V_{CC})	1.8 V ± 5 % / 2.5 V ± 10 % / 3.3 V ± 10 %
Frequency Tolerance	±2.0 x 10^{-6} Max. / After 2 reflows, +25° C
Frequency temperature characteristics	±0.5 x 10^{-6} Max. (opt. ±0.28 x 10^{-6} Max.) / -40 ° C to +105 ° C
Current consumption (@26MHz)	1.5 mA Max. / -40 ° C to +105 ° C, 10kΩ/10pF
Symmetry	45 % to 55 % (opt. 49 % to 51 %)
Phase noise (@26MHz)	-92 dBc/Hz Typ. at 10 Hz -117 dBc/Hz Typ. at 100 Hz -138 dBc/Hz Typ. at 1 kHz -146 dBc/Hz Typ. at 10 kHz -152 dBc/Hz Typ. at 100 kHz -161 dBc/Hz Typ. at 1 MHz
Function	Output enable or Stand-by

■ External dimension (unit in mm)

< TG2016SRN/CRN >



< TG2520SRN/CRN >



■ Pin map

#1	OE or ST (Active High) ST or OE (Active Low)
#2	GND
#3	OUT
#4	Vcc

home

TG1210SRN/CRN

EPSON

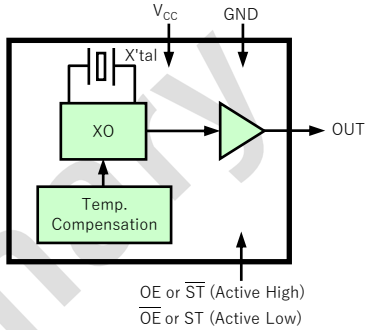
■ Feature

- **High frequency stability in up to +105 ° C**
- Tight symmetry
- Precise and Low phase noise

■ Specifications

Item	Specifications
Frequency (fo)	26, 32, 38.4, 39, 49.58, 52, 64, 76.8 MHz
Output	Clipped Sine / CMOS
Supply voltage (V_{CC})	1.8 V ± 5 % / 2.5 V ± 10 % / 3.3 V ± 10 %
Frequency Tolerance	±2.0 x 10^{-6} Max. / After 2 reflows, +25° C
Frequency temperature characteristics	±0.5 x 10^{-6} Max. (opt. ±0.28 x 10^{-6} Max.) / -40 ° C to +105 ° C
Current consumption (@26MHz)	1.5 mA Max. / -40 ° C to +105 ° C, 10kΩ/10pF
Symmetry	45 % to 55 % (opt. 49 % to 51 %)
Phase noise (@26MHz)	-92 dBc/Hz Typ. at 10 Hz -117 dBc/Hz Typ. at 100 Hz -138 dBc/Hz Typ. at 1 kHz -146 dBc/Hz Typ. at 10 kHz -152 dBc/Hz Typ. at 100 kHz -161 dBc/Hz Typ. at 1 MHz
Function	Output enable or Stand-by

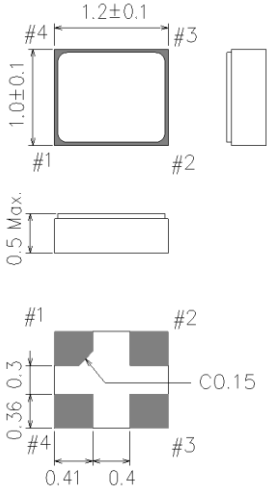
■ Block diagram



■ Schedule

ES: TBD
MP: TBD

■ External dimension (unit in mm)



■ Pin map

#1	OE or ST (Active High) ST or OE (Active Low)
#2	GND
#3	OUT
#4	Vcc

home

TG1612STN, TG2016STN

EPSON

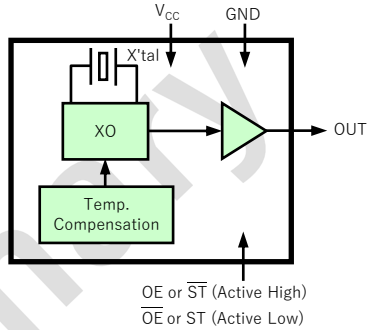
■ Feature

- **Low supply voltage 1.1 to 1.3 V**
- **High frequency stability in up to +105 ° C**
- Tight symmetry
- Precise and Low phase noise

■ Specifications

Item	Specifications
Frequency (fo)	10 MHz to 80 MHz
Output	Clipped Sine
Supply voltage (V_{CC})	1.1 ～ 1.3 V
Temperature slope	±0.1 x 10^{-6} /° C
Frequency temperature characteristics	±0.5 x 10^{-6} Max. / -40 ° C to +85 ° C
Current consumption (@26MHz)	1.55 mA Max. / -40 ° C to +85 ° C, 10kΩ/10pF
Phase noise (@26MHz)	-83 dBc/Hz Max. at 10 Hz -108 dBc/Hz Max. at 100 Hz -130 dBc/Hz Max. at 1 kHz -145 dBc/Hz Max. at 10 kHz -148 dBc/Hz Max. at 100 kHz -148 dBc/Hz Max. at 1 MHz
Function	Output enable or Stand-by

■ Block diagram

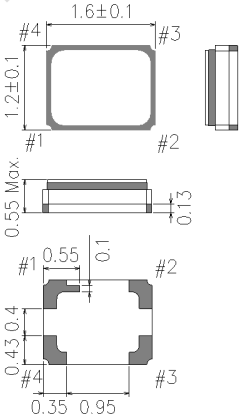


■ Schedule

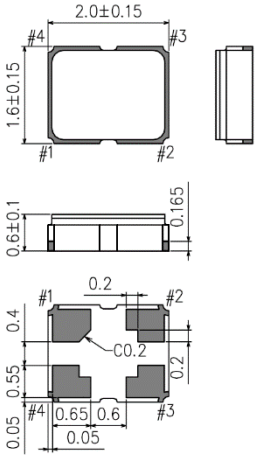
TG1612STN: ES: TBD
MP: TBD
TG2016STN: ES: TBD
MP: TBD

■ External dimension (unit in mm)

< TG1612STN >



< TG2016STN >



■ Pin map

#1	OE or ST (Active High) ST or OE (Active Low)
#2	GND
#3	OUT
#4	Vcc

home

TG1210STN

EPSON

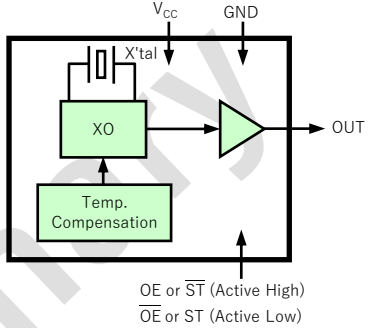
■ Feature

- **Low supply voltage 1.1 to 1.3 V**
- **High frequency stability in up to +105 ° C**
- Tight symmetry
- Precise and Low phase noise

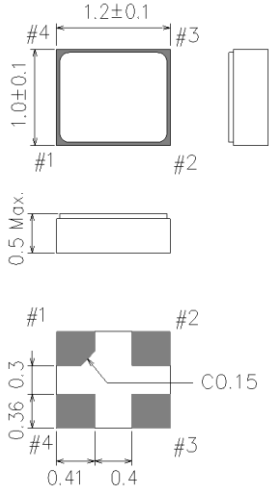
■ Specifications

Item	Specifications
Frequency (fo)	10 MHz to 80 MHz
Output	Clipped Sine
Supply voltage (V_{CC})	1.1 ～ 1.3 V
Temperature slope	±0.1 x 10^{-6} /° C
Frequency temperature characteristics	±0.5 x 10^{-6} Max. / -40 ° C to +85 ° C
Current consumption (@26MHz)	1.55 mA Max. / -40 ° C to +85 ° C, 10kΩ/10pF
Phase noise (@26MHz)	-83 dBc/Hz Max. at 10 Hz -108 dBc/Hz Max. at 100 Hz -130 dBc/Hz Max. at 1 kHz -145 dBc/Hz Max. at 10 kHz -148 dBc/Hz Max. at 100 kHz -148 dBc/Hz Max. at 1 MHz
Function	Output enable or Stand-by

■ Block diagram



■ External dimension (unit in mm)



■ Schedule

ES: TBD
MP: TBD

■ Pin map

#1	OE or ST (Active High) ST or OE (Active Low)
#2	GND
#3	OUT
#4	Vcc

home

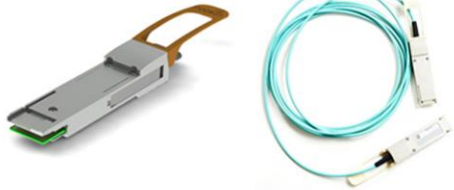
Networking Special

High end SPXO / TCXO / VCXO / OCXO

home

Applications for High end SPXO / TCXO / VCXO / OCXO

EPSON



home

SPXO: Product Portfolio

EPSON

SPXO / SPSO

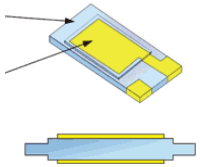
kHz SPXO

Tuning Fork Crystal

- Freq: 32.768kHz
- Output: CMOS

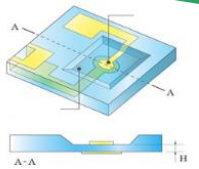
MHz SPXO

AT-Cut Crystal



- Freq: 1 to 75MHz
- Output: CMOS

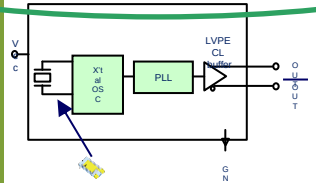
HFF Crystal



HFF = (High Frequency Fundamental)

- Freq: up to 500MHz
- Output: (LVDS, LVPECL,HCSL, CMOS)

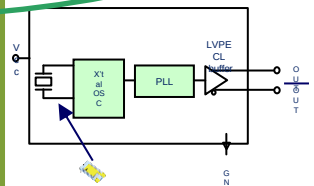
AT + PLL



- Freq: 50 to 800MHz
- Output: Differential (LVDS, LVPECL,HCSL)

P-SPXO

AT + PLL



- Freq: 0.67 to 170MHz
- & 50 to 800MHz
- Outputs: (CMOS, LVPECL)

SPSO

SAW

(Surface Acoustic Wave)

- Freq: 50 to 700MHz
- Differential Output (LVDS, LVPECL,HCSL, CMOS)

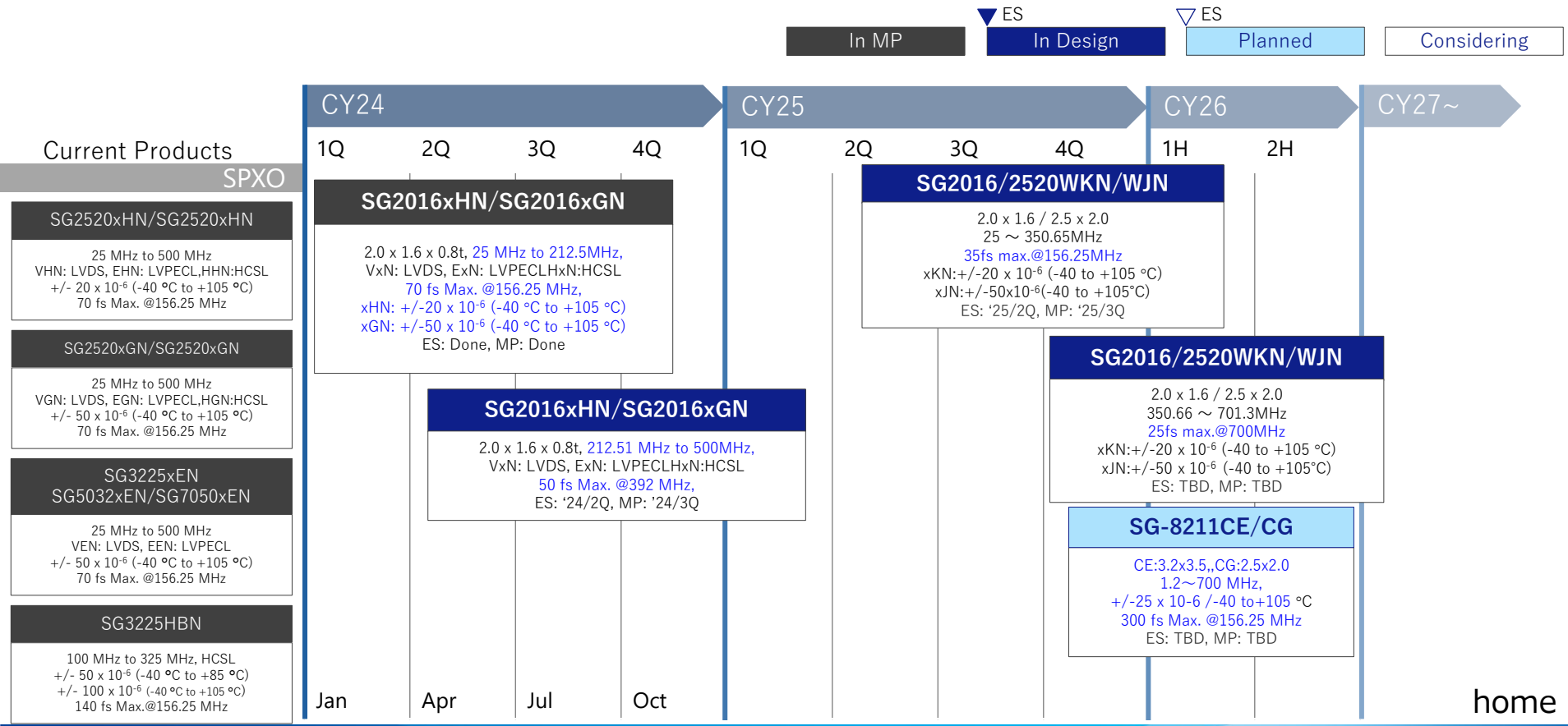
PHASE IN

PHASE OUT

home

SPXO – Differential output

EPSON



home

SG2016xHN/xGN – Low jitter, High freq. SPXO (Gen2)

EPSON

Features

- High Frequency up to 500MHz
- Low jitter 60fs max. @156.25MHz (LVDS, Vcc=3.3V/2.5V)
- High stability ±20ppm, 50ppm (Including 10 years aging)
- Built-in Fundamental Crystal
- Output : LVPECL, LVDS, HCSL
- Small SMT Package 2.0 x 1.6mm (t=0.75mm max.)

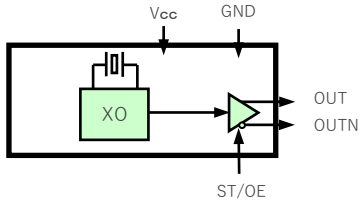
Applications

- 40G/100G/400G PHP, 400G-ZR, 800G-ZR
- Router/Switch, Server, Storage

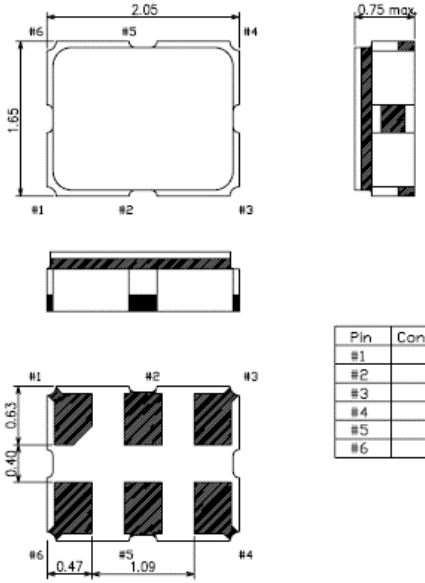
Specifications

Item	Specifications
Output Frequency	25 to 500MHz
Frequency stability (incl. calibration tolerance, temperature, supply voltage variations, and 10years aging at +25°C)	xHN : +/-20 x10^{-6} xGN : +/-50 x10^{-6}
Operating temperature	-40C to +85C (Option: -40 to +105°C)
Current consumption	60mA max. (LVPECL) 28mA max. (LVDS) 40mA max.(HCSL)
Supply voltage	3.3V / 2.5V / 1.8V (LVDS only)
Output	LVPECL / LVDS / HCSL
Symmetry	45 % to 55 %
Phase jitter (12kHz to 20MHz, 3.3V)	44fs Typ. (156.25MHz; LVPECL) 38fs Typ. (156.25MHz; LVDS) 57fs typ. (100.00MHz ; HCSL)

Block Diagram



Package and Pin Assignments



Pin	Connections
#1	ST/OE
#2	NC
#3	GND
#4	OUT
#5	OUTN
#6	VCC

Schedule
ES : Done (~212.5M)
'24/2Q (212.5M~500)
MP: Done (~212.5M)
'24/3Q (212.5M~500)

home

SG2520/2016WKN/WJN (Gen3) Target specification

EPSON

Features

- High Frequency up to 700MHz
- Low jitter 35fs max. @156.25MHz (Vcc=3.3V/2.5V)
- High stability ±20ppm,50ppm (Including 10years aging)
- Built-in Fundamental Crystal
- Output : WA-LVDS (Wide amplitude LVDS,VOD:0.35 to 0,8V)
- Small SMT Package 2.5x2.0, 2.0 x1.6mm
- The basic specifications are the same as the SG2502xGN/xHN

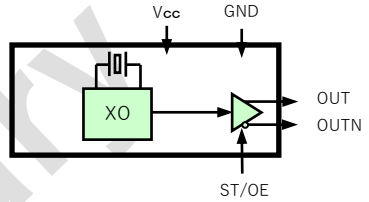
Applications

- 1.6T PHY , 1.6T-ZR
- Router/Switch, Server, Storage

Specifications

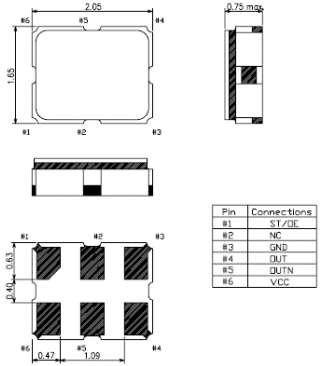
Item	Specifications
Output Frequency	25 to 700MHz
Frequency stability (incl. calibration tolerance, temperature, supply voltage variations, and 10years aging)	WKN : +/-20 x10^{-6} WJN : +/-50 x10^{-6}
Operating temperature	-40C to +85C (Option: -40 to +105C)
Current consumption	60mA max. (762.5mV) 28mA max. (350mV) 40mA max.(800mV)
Supply voltage	3.3V / 2.5V / 1.8V (0.35mV)
Output	WA-LVDS
Output option(WA-LVDS) Offset voltage switching	350 to 800mV 0.9V/1.25V/1.5V/1.64V
Symmetry	45 % to 55 %
Phase jitter (12kHz to 20MHz, 3.3V)	35fs Max. (156.25MHz)

Block Diagram

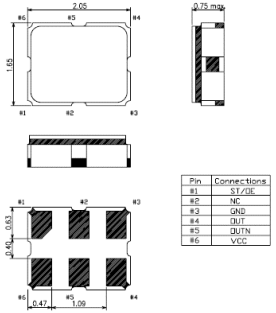


Package and Pin Assignments

【2.5x2. 0 5】



【2.0x1.6】



Schedule

ES : '25/2Q (~350.65M)

TBD (350.67~700M)

home

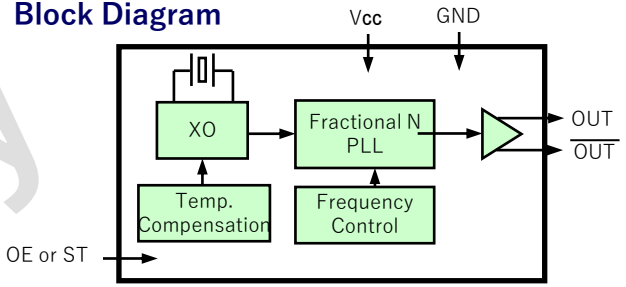
SG-8211CG/CE

EPSON

Features

- Low jitter 0.3 ps Max.
- +/-50 ppm high stability @-40 ° C to +125 ° C
- Output option
  - LVDS with 10 amplitude options
    - includes LVPECL compatible differential amplitude with LVDS termination
  - HCSL
- CGA: 2.5 x 2.0 x 0.85t, CEA: 3.2 x 2.5 x 1.2t

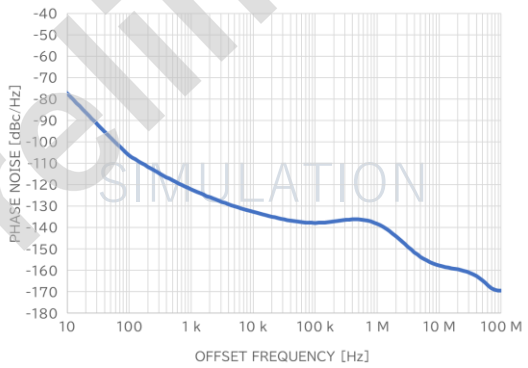
Block Diagram



Target Specifications

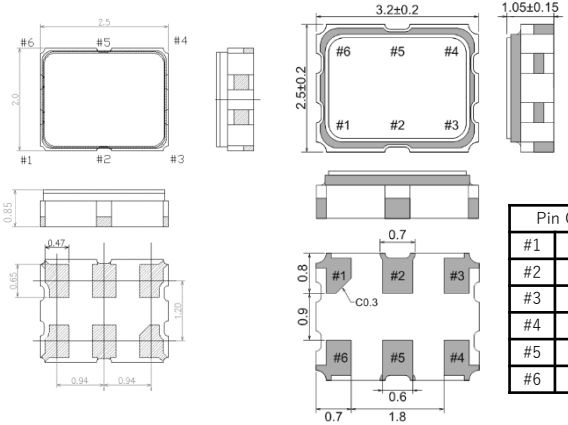
Item	Specifications
Output Frequency	3.52 MHz to 700 MHz (Option: to 1 GHz)
Frequency stability incl. calibration tolerance, temperature, supply voltage variations, reflow drift, load drift and 10 years aging at +25 ° C.	+/-20 ppm at -40 ° C~+85 ° C +/-25 ppm at -40 ° C~+105 ° C +/-50 ppm at -40 ° C~+125 ° C
Current consumption (Vcc=2.5V, @200MHz)	36 mA Max. LVDS 42 mA Max. LVPECL compatible 38 mA Max. HCSL
Supply voltage	1.71V~3.63V
Symmetry	45 % to 55 %

Phase Noise Typ. at 250MHz



Phase jitter: 0.17 ps Typ. / 0.3 ps Max.
(12 kHz to 20 MHz)

Package and Pin Assignments



Pin Connections	
#1	OE/ST/NC
#2	NC
#3	GND
#4	OUT
#5	$\overline{\text{OUT}}$
#6	Vcc

Schedule
ES : TBD
MP: TBD

home

TCXO / OCXO for Networking

EPSON

Wide Operating Temperature range

In MP | ▼ES In Design | ▽ES Planned | Considering

Current Products

TCXO

TG-5510CA
TG-5511CA

7.0 x 5.0, 10 MHz to 54 MHz, 3.3 V
CMOS / Clipped sine wave
+/- 250 x 10^{-9} (-40 °C to +105 °C)
TG-5510CA: 10 pin, TG-5510CA: 4 pin

TG7050CKN/SKN
TG7050CMN/SMN

7.0 x 5.0, 10 MHz to 54 MHz, 3.3 V
CxN: CMOS, SxN: Clipped sine wave
+/- 100 x 10^{-6} (-40 °C to +105 °C)
Temp. slope:+/- 50 x 10^{-9} / °C
TG7050xKN: 10 pin/TG7050xMN: 4 pin

TG5032CGN/SGN
TG5032CFN/SFN

5.0 x 3.2, 10 MHz to 40 MHz, 3.3 V
CxN: CMOS, SxN: Clipped sine wave
+/- 100 x 10^{-6} (-40 °C to +85 °C)
TG5032xGN: 10 pin/TG5032xFN: 4 pin

CY24 (1Q 2Q 3Q 4Q) | CY25 (1Q 2Q 3Q 4Q) | CY26 (1H 2H) | CY27~

TG-5510CB/TG-5511CB

5.0 x 3.2, 10 MHz to 54 MHz, 3.3 V
CMOS / Clipped sine wave
+/- 250 x 10^{-9} (-40 °C to +105 °C)
TG-5510CB: 10 pin, TG-5511CB: 4 pin
ES: Done, MP: Done

TG5032CKN/TG5032SKN
TG5032CMN/TG5032SMN

5.0 x 3.2, 10 MHz to 54 MHz, 3.3V
+/- 100 x 10^{-9} (-40 °C to +105 °C)
Temp. slope: +/- 50 x 10^{-9} / °C,
CKN: CMOS, 10 pin, SKN: Clipped sine wave, 10 pin
CMN: CMOS, 4 pin, SMN: Clipped sine wave, 4 pin
ES: Done, MP: Done

TG7050/5032xxN/xxN

TCXO / VC-TCXO
7.0 x 5.0 / 5.0 x 3.2
10 to 96 MHz, 3.3 V
+/- 100 x 10^{-9} /-40 to +105 °C
Phase noise at floor
-170 dBc/Hz Max.
ES: TBD MP: TBD

OG7050xAN

7.0 x 5.0
1 to 170 MHz, 3.3 V
+/- 3 ~20 x 10^{-9} /-40 to 105 °C
≦+/- 0.5 ppb/day
ES: TBD MP: TBD

Jan Apr Jul Oct

home

TG7050/5032xxx – Low noise VC-TCXO

EPSON

Features

- Frequency range 10MHz to 96MHz
- Low Phase Noise -167dBc/Hz @floor (challenge:-173dBc/Hz @floor)
- High stability ±100ppb / -40 to 85 °C (option 105 °C)
- Low Temperature Slope ±50ppb/ °C
- Output : CMOS / Clipped sine wave
- Small SMT Package 5.0 x 3.2mm (t=1.65mm max.)
  7.0 x 5.0mm (t=1.70mm max.)

Applications

- BTS(RU), Server, PTP(IEEE1588), SyncE
- Router/Switch, Small cell

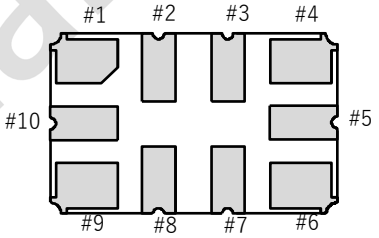
Target specifications

Item	Specifications
Output Frequency	10MHz to 96MHz
Frequency/Temperature Characteristics	±100ppb
Operating temperature	-40C to +85C (option 105°C)
Frequency Temperature Slope	±50ppb/°C
Aging	<±4.6ppm/10years
Current consumption	10mA max.
Supply voltage	3.3V
Output	CMOS / Clipped sine
Duty	49 to 51%
Start-up time	10 msec max. (Time required for output level to reach 90% Vcc or more)
Phase noise	-167dBc / floor challenge -173dBc / floor

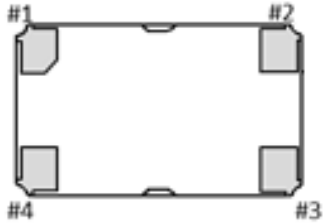
Bottom View

5.0 x 3.2mm

【10pin】



【4pin】



Pin Assignments

Pin	Connection
1	N.C. or Vc
2,5,8,10	N.C. Epson use only
3	OE
4	GND
6	OUT
7	N.C. or Filter
9	Vcc

Pin	Connection
1	N.C. or Vc
2	GND
3	OUT
4	Vcc

Schedule
ES : TBD
MP: TBD

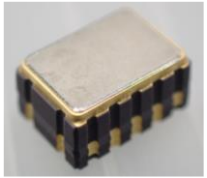
Note) Values are result of simulations in development. The contents may change without notice.

OG7050xxx – High freq. Low C/N, Hi-stab. OCXO

EPSON

Features

- High Frequency up to 170MHz　PLL technology
- Low Phase Noise -155dBc/Hz @floor　(Option:-160~-165dBc/Hz @floor)　Jitter clean
- High stability　　±3 ~ 20ppb / -40 to 95 °C　(option 105 °C)
- Output : CMOS
- Absolute Pull Range　±5ppm min. (Digital control (I2C))
- Small SMT Package 7.0 x 5.0mm　(t=3.3mm max.)



7.0 x 5.0mm (t=3.3mm max.)

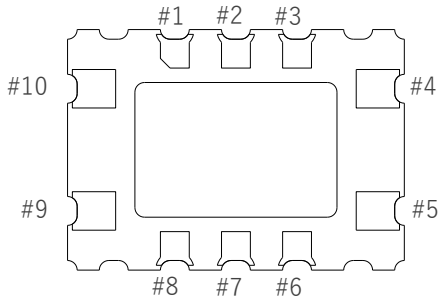
Applications

・BTS(DU/RU), Server, PTP(IEEE1588)
・Router/Switch

Target specifications

Item	Specifications
Output Frequency	**1 to 170MHz**
Frequency/Temperature Characteristics	±3～20ppb
Operating temperature	-40C to +95C (option 105°C)
Frequency Temperature Slope	**±0.1～2.0ppb/°C**
Aging	<±0.5ppb/day
Absolute Pull Range	±5ppm min. (Digital control/I2C)
Holdover	TBD (Target: 1.5us/6H)
Current consumption	400mA max. (during warm-up) 200mA max. (steady state)
Supply voltage	3.3V
Output	CMOS
Warm-up time	±20ppb / 30sec max.　(After 1 hour on)
Phase noise	A (Standard) :　-155dBc / floor B (Low noise) :　-165dBc / floor

Bottom View



Pin Assignments

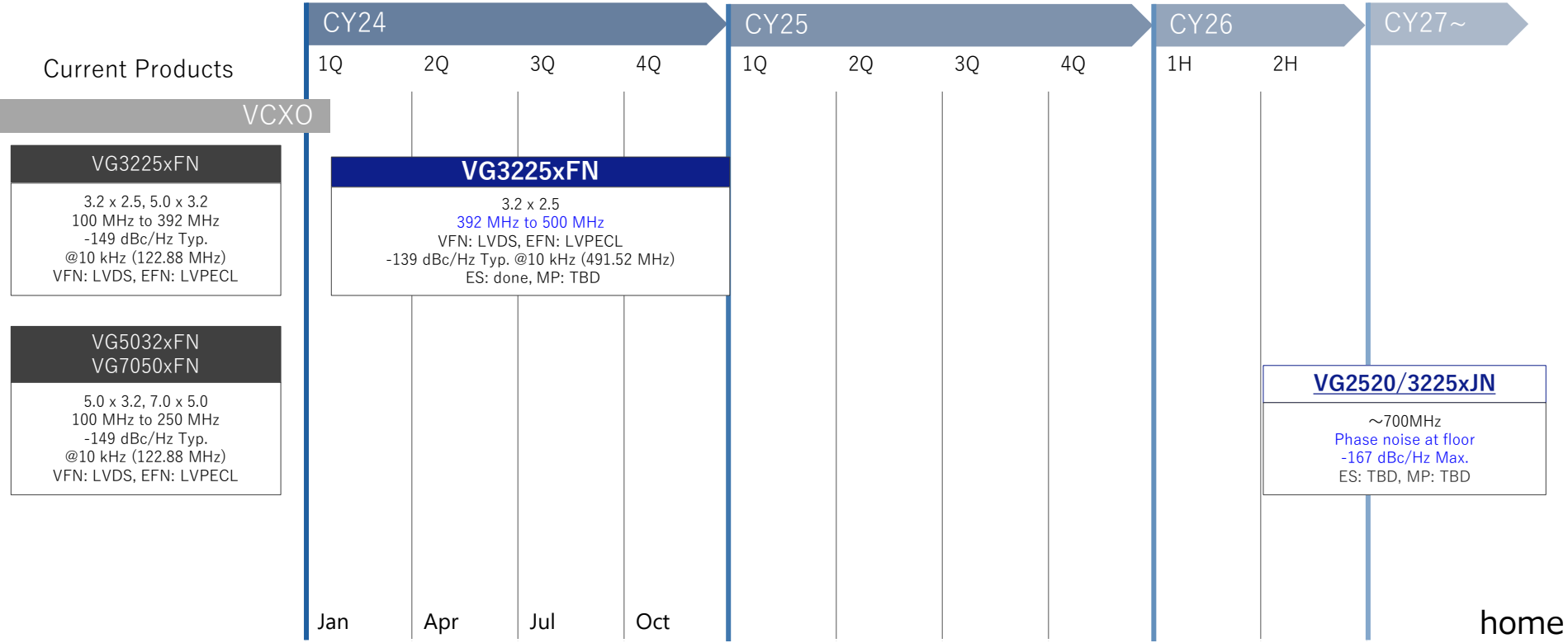
Pin	Connection
1,2,3, 6,7,8	N.C. Epson use only
4	GND
5	OUT
9	Vcc
10	N.C. or Vc

Schedule
ES : TBD
MP: TBD

Note) Values are result of simulations in development. The contents may change without notice.

High Frequency, Small Size with Low C/N

In MP | ▼ES In Design | ▽ES Planned | Considering



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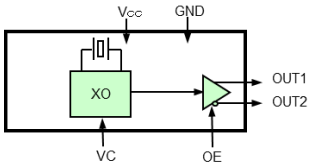
VG3225xFN – Low jitter, High freq. VCXO

EPSON

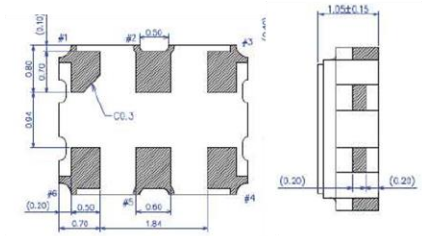
Features

- High Frequency up to 500MHz
- Low Noise
- Fundamental oscillation
- Small SMT Package3.2 x 2.5 mm (t=0.75mm max.)
- +105°C high temperature (Option)
- LV-PECL(EFN) / LVDS(VFN) Output

Block Diagram



Package and Pin Assignments



Pin Connections	
#1	VC
#2	OE
#3	GND
#4	OUT
#5	OUTN
#6	Vcc

Specifications

Item	Specifications	Conditions / Remarks
Operating temp range	-40C to +85°C	-40 C to +105 °C (Option)
Output freq. range	25 to 500MHz	250~500MHz: under designing
Supply voltage	3.3 V ± 0.165 V	
Current consumption	LV-PECL: 60mA Max. LVDS : 30mA Max	EFN : LV-PECL VFN : LVDS
Freq. tolerance	±50 ppm Max.	Includes initial tolerance, temperature change, Vcc change and 10years aging at +25°C.
Absolute Pull range	±10 ppm Min	Vc= 0 V to 3.3 V reference to f0
Input resistance	10 MΩ Min.	DC level
Output load condition	50Ω	LVPECL: Vcc-2.0V
Differential Output Voltage	Voh: Vcc-1.1V Min. Vol: Vcc-1.5V Max.	
Symmetry	45 % to 55 %	At outputs crossing point
Rise/Fall times	0.5 ns Max.	At 20 % to 80 % of output swing
High input voltage	70% Vcc	VIH or OPEN => Enable
Low input voltage	30% Vcc	VIL or GND => Disable
Oscillation start up time	10ms Max.	

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Phase noise(LV-PECL)

Offset frequency	122.88MHz	245.76MHz	491.52MHz
10Hz	-74dBc/Hz	-68dBc/Hz	-55dBc/Hz
100Hz	-104dBc/Hz	-100dBc/Hz	-86dBc/Hz
1kHz	-127dBc/Hz	-126dBc/Hz	-116dBc/Hz
10kHz	-149dBc/Hz	-146dBc/Hz	-141dBc/Hz
100kHz	-160dBc/Hz	-157dBc/Hz	-150dBc/Hz

Clock Buffers ICs

home

Clock Buffer Use-Cases

Clock Generator IC

- Generate multiple Clock signals with different frequencies based on the input Clock signal

Clock Buffer IC

- Distribute multiple Clock signals with the same frequencies as the input Clock signal

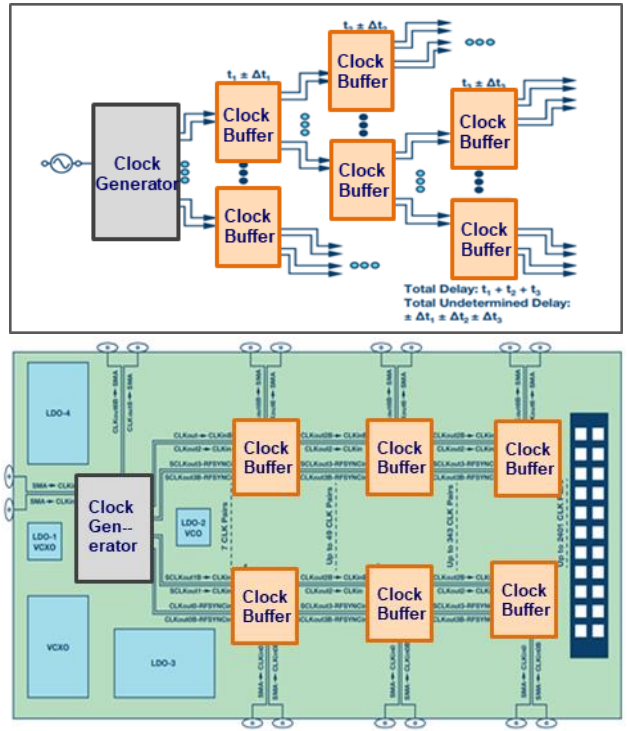
Necessity of Clock Buffer IC

- A single Clock Generator IC may not have enough outputs to drive all required Clock signals.
- Clock Buffers provide enough outputs and help synchronize multiple devices or systems.

Challenges and Solutions

- Each stage in the clock tree causes a timing delay, influenced by temperature changes, voltage variations, etc
- Accumulated inaccuracies can lead to intolerable timing variations

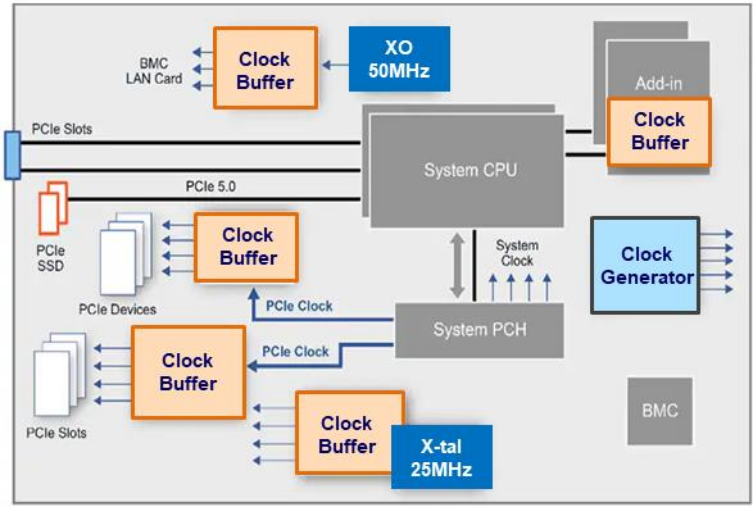
Clock tree block diagram



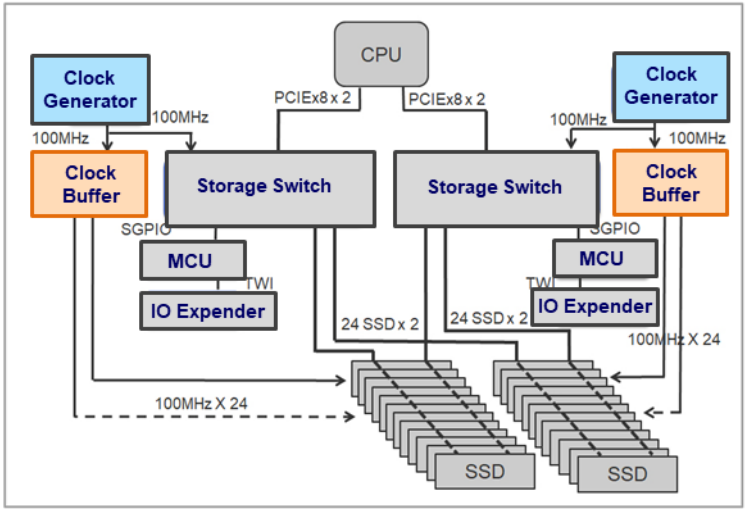
Clock Buffer Applications

- PCIe Gen-1/2/3/4/5/6 Clock Distribution
- PCIe Graphics Cards
- PCIe Based SSD Switches and Drives
- Data Centers & Gigabit Ethernet
- Servers: Micro server, tower server, rack server and FBDIMM (Fully Buffered Dual Inline Memory Module)
- Communication switches
- Network Storages & Host Bus Adapter (HBA) cards

Typical Server Application with PCIe

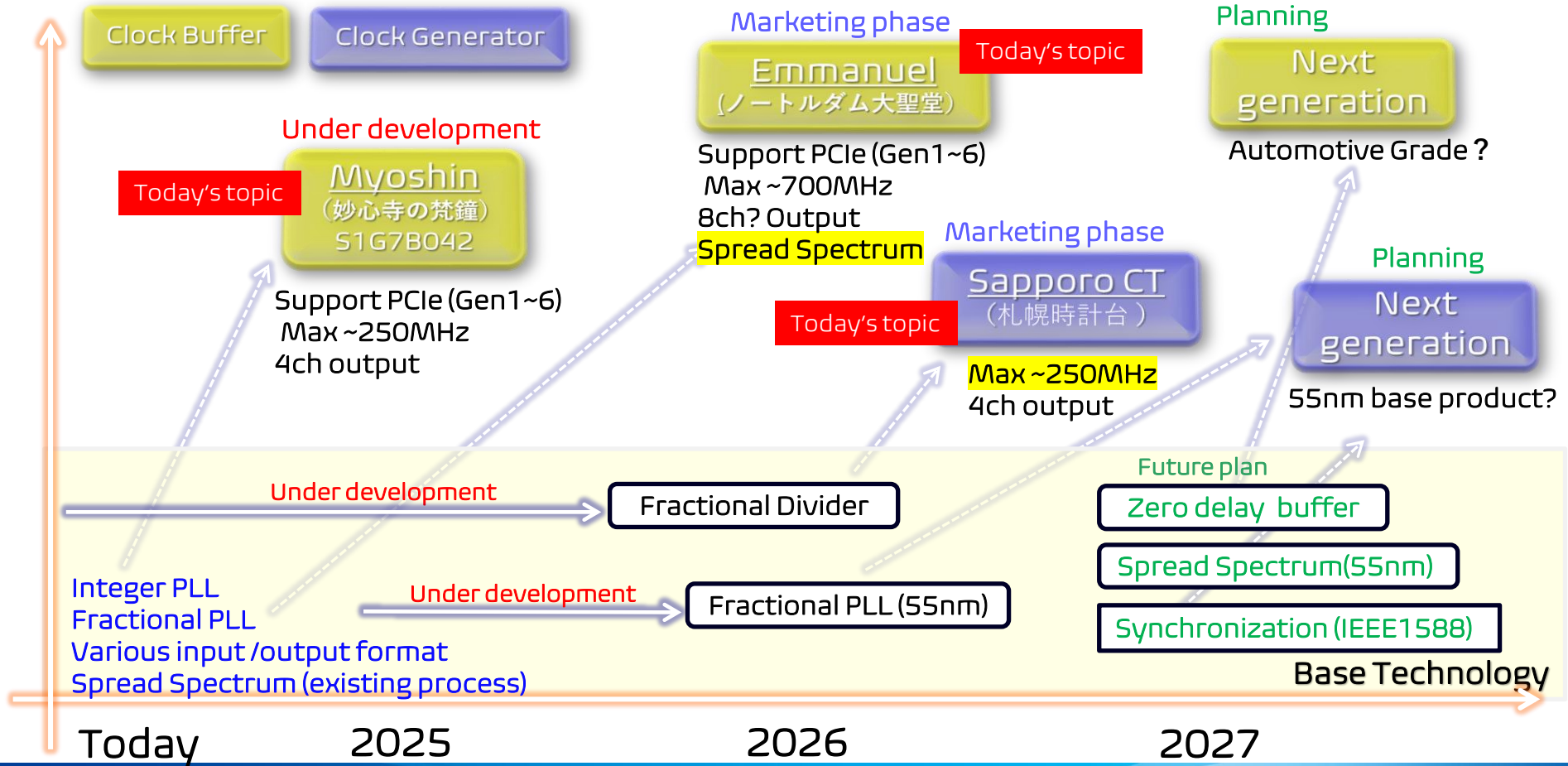


NVMe SSD Switch Application



Roadmap (Clock solution)

EPSON



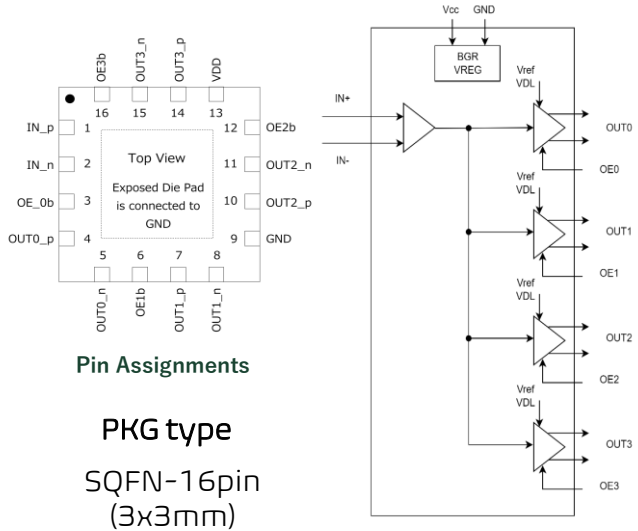
Epson 4-Output Clock Buffer: Myoshin (S1G7B042)

- 3 x 3 mm Tiny size
- Low jitter and Low skew
- Wide range of Operating temperature

PCIe	Gen 1~Gen6
Power supply	1.8V ± 5%, 2.5V ± 10%, 3.3V ± 10%
Operation Freq range	~ 250MHz
Input (format)	**Option A:** ・DC-Coupled: HCSL, LP-HCSL ・AC-Coupled: PECL, LVDS, CML, CMOS **Option B** ・DC-Coupled: LVDS, WA-LVDS
Output (format)	LP-HCSL (Max 4 outputs)
Operating Temperature	-40C~105C (Operation)
Power consumption	**Core device current** : T.B.D (Target 13 mA) **Output current (100 Ω termination)** : T.B.D (Target 3.9mA) ※Per 1 output **Output current (85 Ω termination)** : T.B.D (Target 4.4mA) ※Per 1 output
Slew rate	0.6 V/ns ~ 4.0 V/ns
Additive Jitter	TBD (target 30fs? 12Khz~20MHz)
Output Skew	30ps
Duty	45%~55% (Input Duty 50%)

Under development
TS : Q4/25
MP : Q1/26

Block Diagram



Pin Assignments

PKG type

SQFN-16pin
(3x3mm)

P2P compatible to Microchip SY75604

Emmanuel (Multi-output Clock Buffer) Marketing Phase

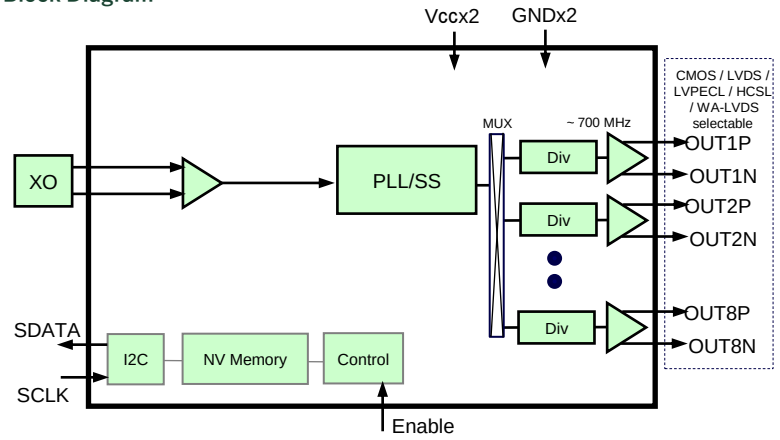
EPSON

Multi output Clock buffer with Higher freq range (~700MHz)

Part # : S1Gxxx	
Power supply	1.8V ± 5%, 2.5V ± 10%, 3.3V ± 10%
Operation Freq range	~ 700MHz?
Output Ports	Max 4~16?
Output (format)	TBD LVPECL, LVDS? Or WA-LVDS? (*1)
Temperature range	-40C~105C (Operation) -65C~150C (Storage)
Power consumption	TBD
Slew rate	TBD
Additive Jitter	TBD (target 30fs? 12Khz~20MHz)
Output Skew	30ps (In part skew 50ps)
Spread spectrum	Yes?
PKG type	TBD

(*1) Wide amplitude LVDS

Block Diagram



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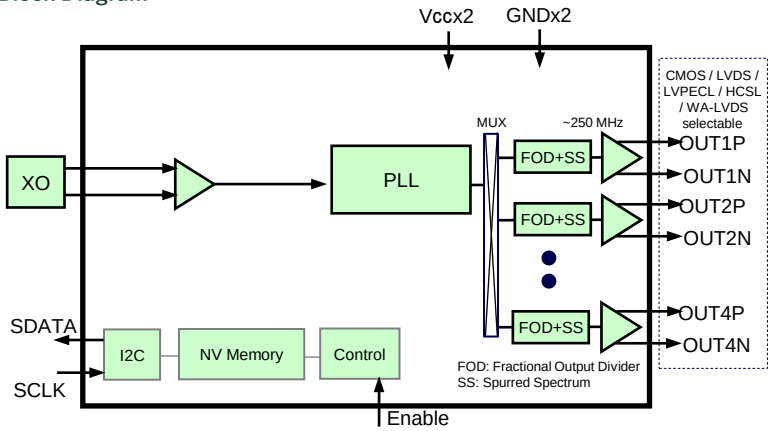
Sapporo CT (4-output Clock Generator) Marketing Phase

EPSON

1st Clock Generator product 4 output with Higher freq range up to (~250MHz)

Part # : S1Gxxx	
Power Supply	1.8V±5%, 2.5V±10%, 3.3V±10%
Operation Freq range	~ 250MHz?
Output Ports	max 4
Output (format)	TBD? Selectable? (HCSL, LP-HCSL,CMOS,LVDS, WA-LVDS(Wide amplitude LVDS)
Temperature range	-40C~105C (Operation) -65C~150C (Storage)
Spread Spectrum	Yes
Additive Jitter	TBD
Other	*Programmable (FAMOS base) *Fractional Divider
Power consumption	TBD
PKG type	TBD

Block Diagram



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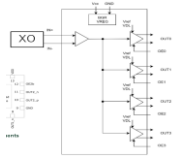
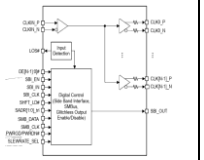
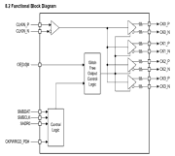
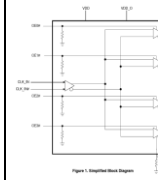
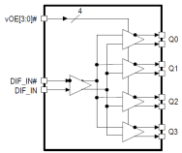
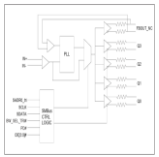
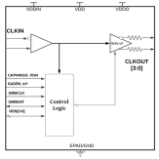
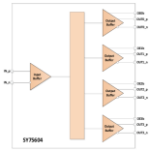
Comparison: 4CH - HCSL / LP-HCSL Output

Key Features	Epson	TI	TI	ONSEMI	Renesas	Diode	SiTime	Microchip
Part name	S1G7B042 (Myoshin)	LMKDB1104 (NEW)	CDCDB400	NB3L204K	9INT31H400	PI6CBE33045	SiT92314	SY75604
PCIe Compliant	Gen 1~Gen6	Gen 1~Gen6	Gen 1~Gen6	Gen 3, Gen 4	TBC	Gen 1~Gen6	Gen 1~Gen6	Gen 1~Gen6
Power supply Typ.	1.8V, 2.5V, 3.3V	1.8V, 3.3V	3.3V Typ	2.5 V, 3.3 V	4.6V Max	3.3V Typ	3.3V Typ	1.8V, 2.5V, 3.3V Typ
Freq range	250MHz Max.	400MHz Max.	250MHz Max.	350MHz Max.	350MHz Max	400MHz Max	400MHz Max	250MHz Max
Input CH	1	1	1	1	1	1	1	1
Output CH	4	4	4	4	4	4	4	4
Output (Format)	LP-HCSL	LP-HCSL	LP-HCSL	HCSL	LP-HCSL	LP-HCSL	LP-HCSL	LP-HCSL
Logic control	No (EN pin)	Yes	Yes	No (EN pin)	No (EN pin)	Yes	Yes	No (EN pin)
Operating Temp.	-40C~105C	-40C~105C	-40C~105C	-40C~85C	-40C~85C	-40C~85C	-40C~85C	-40C~105C
SBI (Side Band Interface)	No	Yes	No	No	No	No	No	No
LOS (Loss of Signal) input detection	No	Yes	No	No	No	No	No	No
Additive Jitter (12Khz~20MHz)	TBD (target 30fs?)	31fs RMS Max. @ 156.25MHz	38fs RMS Max.	80fs RMS Max.	61fs RMS Typ. @ 156.25MHz	110fs RMS Max.	10 fs RMS Typ. After DB800Z filter	68fs RMS Max. @ 100MHz
Skew (Output-to-output)	30ps	50ps Max	50ps Max	100ps Max	40ps Typ.	50ps Max	50ps Pyp	50ps Max
Duty	45%~55%	45%~55%	40%~60%	45%~55%	45%~55%	45%~55%	TBC	48%~52%
PKG type	16pin-SQFN (3x3mm)	28pin-VQFN (4x4mm)	32pin-VQFN (5x5mm)	24pin-VQFN (4x4mm)	24pin-VFQFN (4x4mm)	32pin-TQFN (5x5mm)	32pin-VQFN (5x5mm)	16pin-VQFN (3x3mm)
Compliance	??	DB2000QL	DB800ZL	DB400H	DB400H			
Block Diagram								

Target schedule

EPSON

Product	1st sample	MP Qualification
Myoshin (4 output CB)	Oct CY2025	Dec CY2025
Emmanuel (8-16 output CB)	Early CY2026	Within CY2026
Sapporo CT (4 output CG)	Early CY2026	Within CY2026

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Automotive Grade for Industry

AECQ-200/100 quality for
-> 125°C operation
-> Long lifetime
-> harsh environments

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FA1612AA

Samples available

For Automotive

EPSON

❖ **Features:**

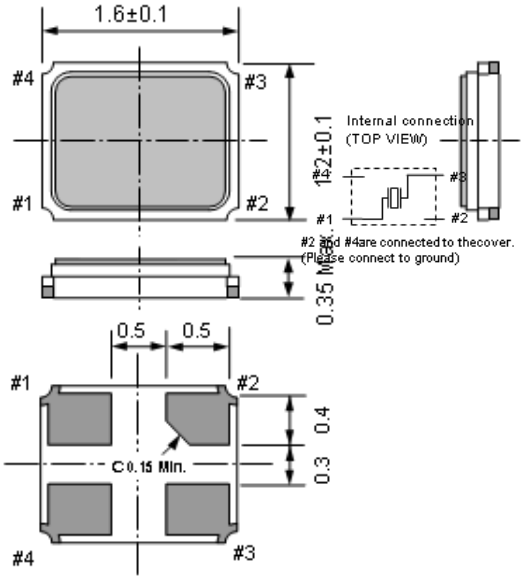
- Very small package size, best for small size requirements
- Temperature range from -40 to +125°C
- 1612 Package
- AEC-Q200

❖ **Applications:**

- Car accessories, Camera, Telematics, and Smart key,

Item	Specifications
Nominal frequency range	24 MHz to 80 MHz
Storage temperature range	-40 °C to +125 °C
Operating temperature range	-40 °C to +125 °C
Frequency tolerance(standard)	±10 x 10^{-6}
Overtone order	Fundamental
Motional resistance(ESR)	170 Ω Max. (24 ≤ f < 32 MHz) 60 Ω Max. (32 ≤ f < 38 MHz) 50 Ω Max. (38 ≤ f ≤ 80 MHz)
Frequency versus temperature characteristics. (standard)	±20 x 10^{-6} / -40 °C to +85 °C (±50 x 10^{-6} / -40 °C to +125 °C)
Frequency Aging	±1 × 10^{-6} / year Max. (24 ≤ f ≤ 54 MHz) ±3 × 10^{-6} / year Max. (54 < f ≤ 80 MHz)

❖ **Package and Pin Assignments**



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FC3215BA Same Sensitivity as FC-13A with Pb Free

Planned

For Automotive

EPSON

Added New

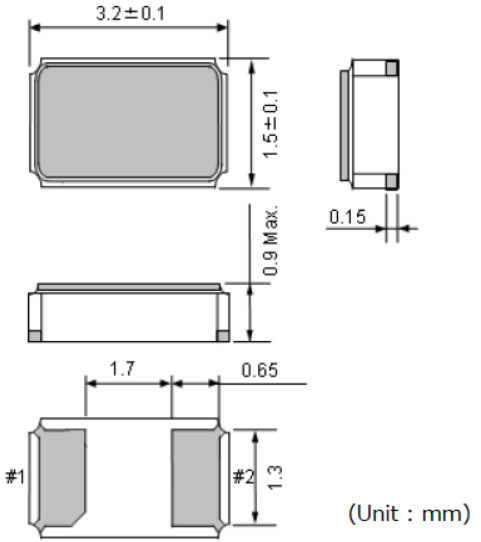
❖ Feature

- Frequency range: 32.768 kHz
- Low ESR: 40 kΩ typ. At +25 ℃
- Size: 3.2 x 1.5 x 0.9 t mm
- ✓ Applications: Automotive applications (AEC-Q200)

❖ Overview

Item	Symbol	Specification	Conditions / Remarks
Nominal frequency range	f_nom	32.768 kHz	
Storage temperature	T_stg	-55 °C to + 125°C	Storage as single product.
Operating temperature	T_use	-44°C to +125°C	
Level of drive	DL	0.5 µW Max.	
Frequency tolerance	f_tol	±20 x 10^{-6}	+25°C, DL = 0.1µW
Turnover temperature	Ti	+25°C ±5°C	
Parabolic coefficient	B	-0.04 x 10^{-6} / °C² Max.	
Load capacitance	CL	7 pF, 9 pF, 12.5 pF	Please specify
Motional resistance (ESR)	R1	40 kΩ typ. at +25°C 65 kΩ Max. At -40°C + 105°C 70 kΩ Max. At -40°C + 125°C	
Motional capacitance	C1	3.4 fF typ.	
Shunt capacitance	C0	1.0 pF typ.	
Frequency aging	f_age	±3 x 10^{-6} / year Max.	+25 °C, First year

❖ External dimensions



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FC2012AA

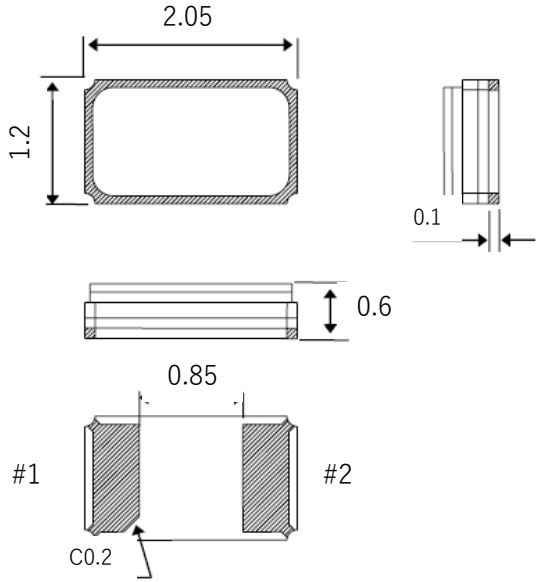
❖ Features

- Low ESR : 40kΩ typ. at +25°C
- Temperature range from -40 to +125°C
- 2012 Package
- AEC-Q200

❖ Specifications:

Item	Symbol	Specifications	Conditions / Remarks
Nominal frequency range	f_nom	32.768 kHz	
Storage temperature	T_stg	-55 °C to +125 °C	Storage as single product.
Operating temperature	T_use	-40 °C to +125 °C	
Level of drive	DL	0.1 µW (0.5 µW Max.)	
Frequency tolerance	f_tol	±20 × 10^{-6}	+25 °C, DL=0.1 µW
Turnover temperature	Ti	+25 °C ±5 °C	
Parabolic coefficient	B	-0.04 × 10^{-6} / °C^2 Max.	
Load capacitance	CL	9 pF, 12.5 pF	Please specify
Motional resistance (ESR)	R1	40 kΩ typ. at +25°C 70 kΩ Max. at -40 to +105°C 75 kΩ Max. at -40 to +125°C	
Motional capacitance	C1	8.4 fF Typ.	
Shunt capacitance	C0	1.6 pF Typ.	
Frequency aging	f_age	±3 × 10^{-6} / year Max.	+25 °C, First year

❖ Package and Pin Assignments



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FA2016ASA / 55.2 MHz - UWB Automotive Application

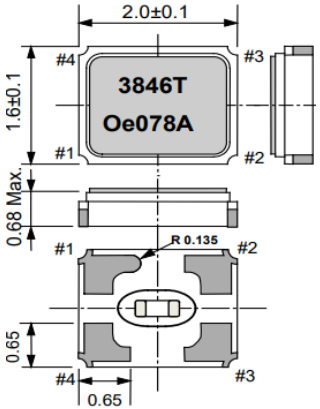
❖**Features**
- Xtal with integrated thermistor
- Temperature range from -40 to +105 °C
- 2016 Package
- AEC-Q200
- Also available with 38.4 MHz

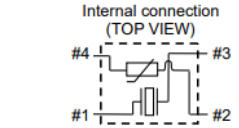
❖ **Applications**
- Anti-relay attack smart key for Automotive zone
- Gesture recognition

❖ **Specifications:**

No.	Parameters	Requirements
1	Package type	2.0 x 1.6 mm, t=0.68 mm Max.
2	Nominal frequency	55.200000 MHz
3	Mode of vibration	AT-cut / Fundamental
4	Storage temperature range	-40 to +125 deg.C
5	Operating temperature range	-40 to +105 deg.C
6	Drive level	200 µW Max.
7	Frequency tolerance	± 10 ppm at 25 +/-3 deg.C
8	Frequency versus temperature characteristics	± 20 ppm at -40 to +105 deg.C, Ref. 25 deg.C
9	Frequency aging	± 10 ppm / 10 years at 25 deg.C *2
10	Reflow shift	± 2 ppm / After tow reflows
11	Load capacitance	8.0 pF
12	Equivalent series resistance	50 ohm Max.
13	Insulation resistance	Min. 500 M ohm Min. / DC 100V +/-15V

❖ **Package and Pin Assignments**





Pin map

Pin	connection
1	Crystal
2	GND, thermistor
3	Crystal
4	thermistor

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Programmable SPXO: SG-8101CGA

❖ Features

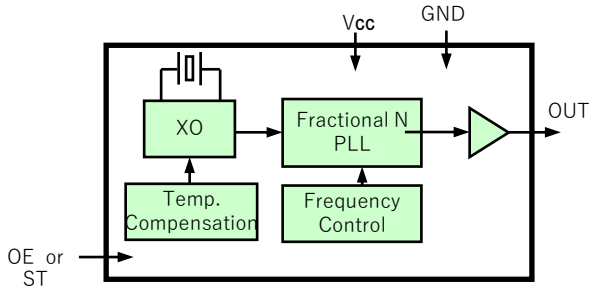
- Any Frequency: accurate to 6 decimal places between 0.67MHz to 170MHz
- High stability LVCMOS output
- Temperature range from -40 to +125 °C
- 2520 Package
- AEC-Q100

❖ Applications

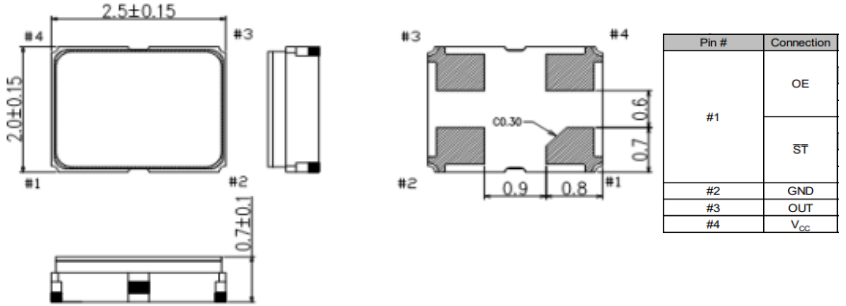
- Camera System, Navigation System, Car network Ethernet

Item	Symbol	Specification
Output Center Frequency range	f_{OUT}	0.67M to 170MHz
Supply voltage	Vcc	1.62 V ～ 3.63V
Frequency tolerance (Include variations : initial, temperature, supply voltage, load, reflow, 1year/25°C aging)	f_{temp}	+/-15ppm (-40 to 85°C) +/-20ppm (-40 to 105°C) +/-50ppm (-40 to 125°C)
Function of PIN No.1	Func_PIN1	Programmable OE or ST
RMS Phase jitter(170MHz) (12kHz to 20MHz)	tphj(σ)	50 ps typ
RMS Period Jitter(170MHz)	tpej(σ)	2.3 ps typ
Internal Crystal Frequency (f_out Initial Accuracy)	f_{REF}	26MHz Photo AT (Maximum variation is +/- 1 ppm)
Power Consumption (no load)	I_{DD}	3.4mA Max. (f_out=20MHz ） 7.7mA Max. (f_out=170MHz) 3.6mA Max. (Output disable） 3.3uA Max. (Stand by)
Package	PKG	2520

❖ Block Diagram



❖ Package and Pin Assignments



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SG-8201CGA

In design | Added New | For Automotive | EPSON

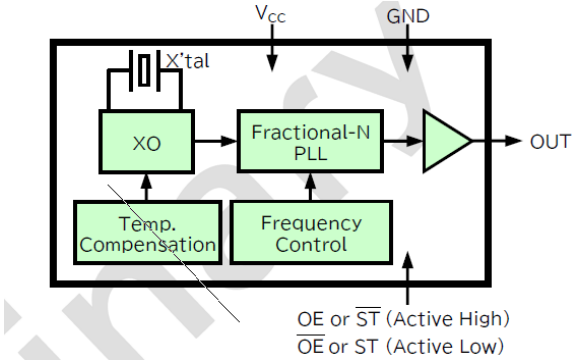
❖ Feature

- Low noise Fractional PLL technology support any frequency
  - ➢ Between 1.2 MHz and 170 MHz with quick turn-around time
  - ➢ Low jitter characteristics 1.1 ps Typ. at fo = 125 MHz
- ±15 x 10^{-6} (up to +105°C) / ±25 x 10^{-6} (up to +125 °C) with Temperature Compensation function
- AEC-Q100 compliant

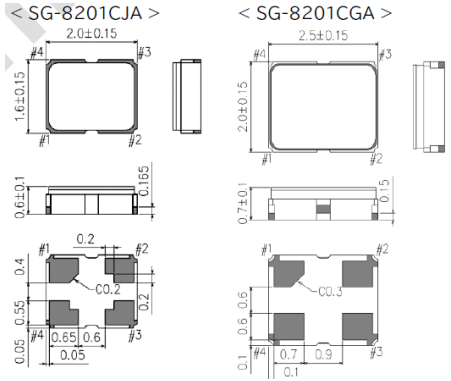
❖ Specifications

Item	Specifications
Frequency (fo)	1.2 MHz to 170 MHz
Output	CMOS
Supply Voltage (Vcc)	1.62 V to 3.63 V
Frequency tolerance / Operating temperature	±15 x 10^{-6} / -40°C to +105 °C ±25 x 10^{-6} / -40°C to +125 °C ±50 x 10^{-6} / -40°C to +125 °C * Includes Initial frequency tolerance, Frequency / temperature characteristics, Frequency / voltage coefficient, Frequency / load coefficient and Aging (+25°C , First year)
Current Consumption (No load)	7.5 mA Max. (fo = 25 MHz) 12.4 mA Max. (fo = 125 MHz)
Symmetry	45% to 55%
Rise/Fall time	2.0 ns Max. (fo > 125 Mhz) 2.5 ns Max. (75 MHz < fo ≤ 125 Mhz) 4.0 ns Max. (50MHz < fo ≤ 75 MHz) 6.0 ns Max. (fo ≤ 50 MHz)
Phase Jitter (@125 MHz)	1.1 ps Typ. / 12 kHz to 20 Mhz
Function	Output enable or Stand-by

❖ Block diagram



❖ External dimension (unit in mm)



❖ Pin map

#1	OE or ST (Active High) ST or OE (Active Low)
#2	GND
#3	OUT
#4	Vcc

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Low Jitter Programmable SPXO: SG-8201CJA

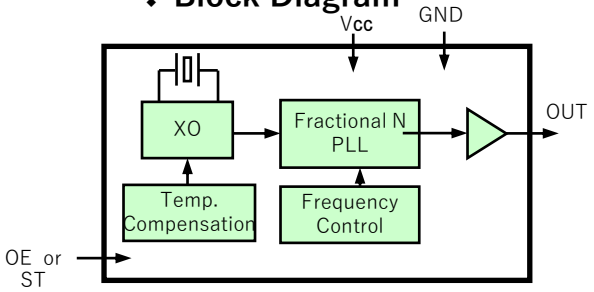
❖ **Features**

- PLL technology to enable short lead time
- Low jitter 1ps typ. @125MHz
- Temperature range from -40 to +125 °C
- 2016 Package
- AEC-Q100

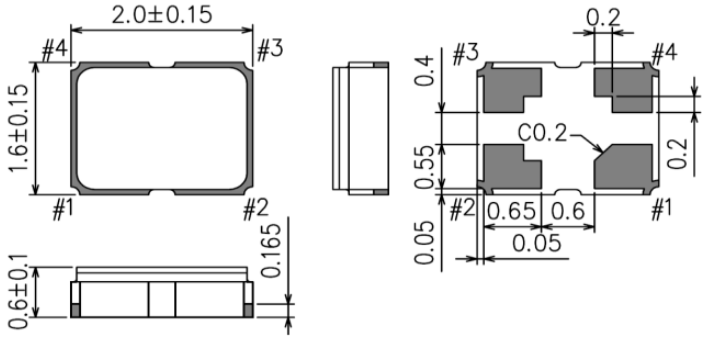
❖ **Specification:**

Item	Specifications
Output Frequency	1.2MHz to 170MHz
Frequency stability incl. calibration tolerance, temperature, supply voltage variations, reflow drift, load drift and aging	Incl. 1year aging at 25degC +/-15ppm at -40℃~+105℃ +/-25ppm at -40℃~+125℃
	Incl. 15years aging at 25degC (approx.) +/-25ppm at -40℃~+105℃ +/-35ppm at -40℃~+125℃
Current consumption (No load condition)	5mA Typ.
Supply voltage	1.71V~3.63V
Output	CMOS
Symmetry	45 % to 55 %
Rise / Fall Time (20% to 80%)	2.0ns Max. (125MHz ≤ fo ≤ 170MHz) 2.5ns Max. (75MHz ≤ fo < 125MHz) 4.0ns Max. (50MHz ≤ fo ≤ 75MHz) 6.0ns max. (fo < 50MHz)
Phase jitter (12kHz to 20MHz)	1ps Typ. (125MHz)

❖ **Block Diagram**



❖ **Package and Pin Assignments**



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❖ Applications

Camera System, Navigation System, High Speed Car network

Differential Output Oscillator: SG2520 / 3225C*A

Planned

For Automotive

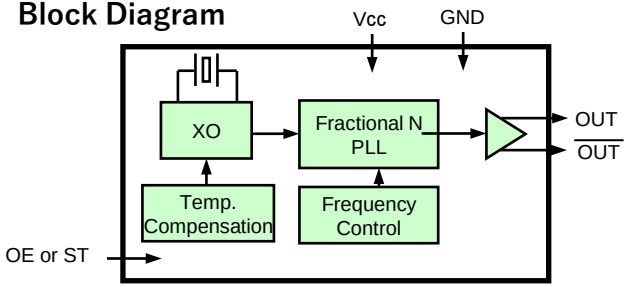
EPSON

Features

Added New

- Conform to AEC-Q100
- Low jitter 0.3 ps Max.
- +/-50 ppm high stability @-40 ° C to +125 ° C
- Output option
  - LVDS with 10 amplitude options
    - includes LVPECL compatible differential amplitude with LVDS termination
  - WA-LVDS, LVPECL, HCSL, LP-HCSL

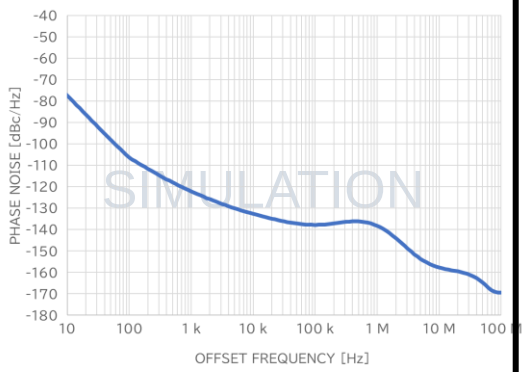
Block Diagram



Target Specifications (preliminary)

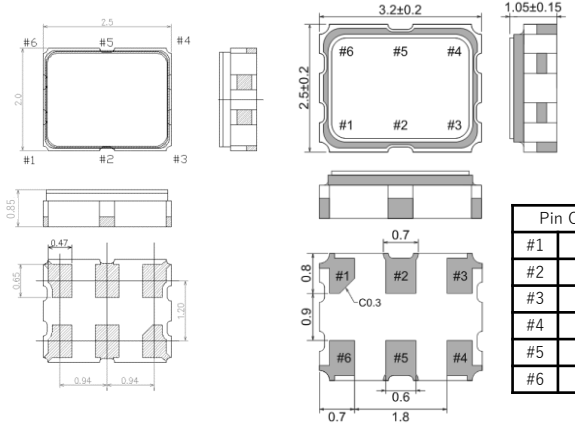
Item	Specifications
Output Frequency	3.52 MHz to 1000 MHz (NA: 750 to 800MHz)
Frequency stability incl. calibration tolerance, temperature, supply voltage variations, reflow drift, load drift and 10 years aging at +25 ° C.	±20 x 10^{-6} at -40 ° C to +85 ° C ±25 x 10^{-6} at -40 ° C to +105 ° C ±50 x 10^{-6} at -40 ° C to +125 ° C
Current consumption (Vcc=2.5V, @200MHz)	36 mA Max. LVDS 42 mA Max. LVPECL compatible 38 mA Max. HCSL
Supply voltage	1.71 V to 3.63 V
Symmetry	45 % to 55 %
Phase jitter (12 kHz to 20 MHz)	0.3 ps Max. 0.22 ps Typ. (@268 MHz WA-LVDS)

Phase Noise Typ. at 250MHz



Phase jitter: 0.22 ps Typ. / 0.3 ps Max.
(12 kHz to 20 MHz)

Package and Pin Assignments



Pin Connections	
#1	OE/ST/NC
#2	NC
#3	GND
#4	OUT
#5	$\overline{\text{OUT}}$
#6	Vcc

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SG2016CBA / SG2520CBA

Samples Available

EPSON

Added New

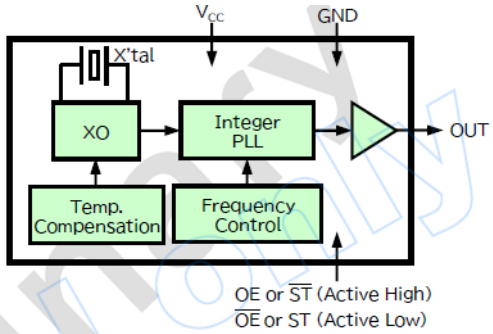
❖ Features

- Low noise Integer PLL technnology support
  - ➢ Jitter characteristics 0.6 ps Max. At fo=125 MHz
- ±15 x 10^{-6} (up to +105 ℃) / ±25 x 10^{-6} (up to +125℃) with Temperature compensation function
- AEC-Q100 compliant

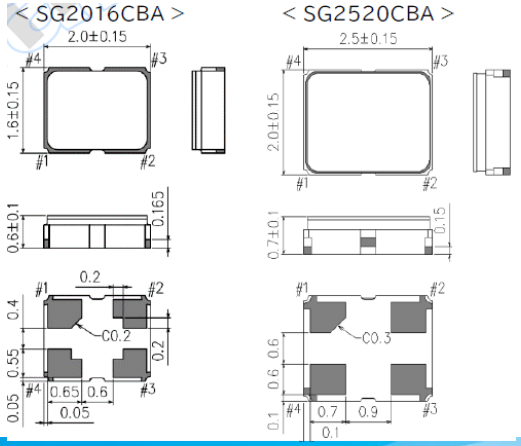
❖ Specifications

Item	Specification
Standard frequency (fo)	76.8 MHz / 98.304 MHz / 100 MHz / 125 MHz / 150 MHz / 156.25 MHz
Output	CMOS
Supply voltage (V_{CC})	1.62 V to 3.63 V
Frequency tolerance / Operating temperature	±15 x 10^{-6} / -40°C to +105°C ±25 x 10^{-6} / -40°C to +125°C ±50 x 10^{-6} / -40°C to +125°C *Including Initial frequency tolerance, Frequency / temperature characteristics, Frequency / voltage coefficient, Frequency / load coefficient and Aging (+25°C, 1 year)
Current Consumption	11.6 mA Max. (fo ≤ 100MHz) 13.2 mA Max. (100 Mhz < fo ≤ 125 MHz) 16.6 mA Max. (fo > 125 MHz)
Symmetry	45 % to 55%
Rise / Fall Time	2.5 ns Max. (fo ≤ 125 MHz) 2.0 ns Max. (fo > 125 MHz)
Phase Jitter (@125MHz)	0.6 ps Max. / 12 kHz to 20 MHz
Function	Output enable or Stand-by

❖ Block Diagram



❖ External Dimension in mm



❖ Pin map

#1	OE or $\overline{ST}$ (Active High) ST or $\overline{OE}$ (Active Low)
#2	GND
#3	OUT
#4	Vcc

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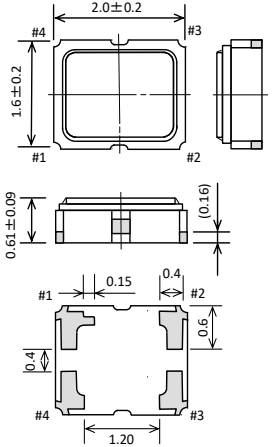
TCXO - TG2016SKA

❖ Features

- High stability & Wide temperature range
  +/-0.5ppm/-40 to 105°C
- Output Frequency 26 to 55MHz
- Clipped sine wave output
- SMT Package :2.0 x 1.6 x 0.61mm
- AEC-Q100

❖ Package and Pin Assignments



Pin	Connection
#1	NC
#2	GND
#3	OUT
#4	VCC

❖ Applications:

GNSS, ETC, ADAS, BT

❖ Specifications

Item	Symbol	Specifications
Output Frequency	fo	26MHz to 55MHz
Operating temperature	T_use	-40°C to +105°C
Supply voltage	Vcc	3.3V / 3.0V / 2.8V / 1.8V
Frequency tolerance	f_tol	+/-2.0ppm Max. 25°C +/-2°C, After reflow soldering
Frequency / temperature Characteristics	fo-Tc	+/-0.5ppm Max -40°C to +105°C
Frequency / voltage coefficient	fo-Vcc	+/- 0.2 ppm Max. Vcc +/- 5%
Frequency / Load coefficient	fo-Load	+/- 0.2 ppm Max. 10kΩ//10pF +/-10% each
Frequency aging	f_age	+/- 1.0 ppm Max. First year T_use = +25° C
Current consumption Output frequency = 26MHz	Icc	2.0mA Max.
Output	OUT	0.8Vpp Min. / load 10kΩ//10pF Clipped sine wave
Symmetry	SYM	40% to 60%
G sensitivity Output frequency = 26MHz	Sg	1.5ppb/G (30Hz to 1.5kHz,sinewave,3axes)

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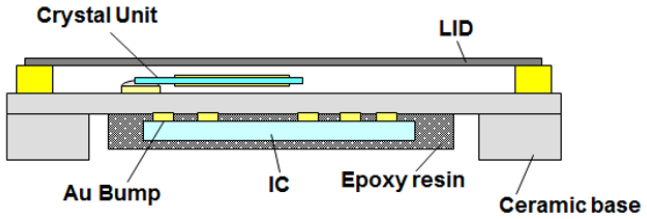
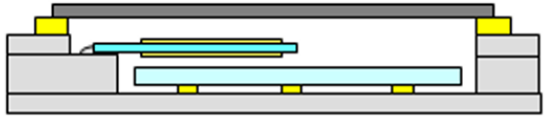
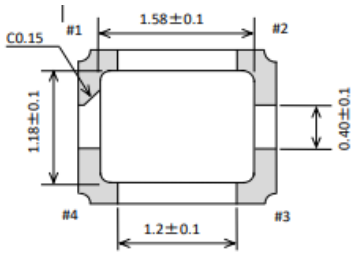
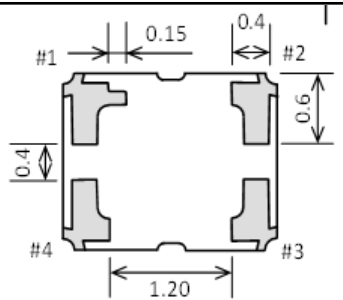
TXCO - TG2016SKA – Technical Advantage

The most mentionable advantage of the TG2016SKA in comparison to competitor model is that the integrated thermistor within the semiconductor face same temperature as the Xtal (single cavity).

H-Shape -Competitor	Single Cavity TG2016SKA
	



Equal recommended foot print

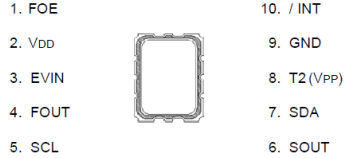


RTC: RA8804CE

❖ Features

- Built in 32.768 kHz DTCXO
- High stability (frequency Adjustment)
- Temperature range from -40 to +105 °C
- 3225 Package
- AEC-Q100
- Interface: I2C

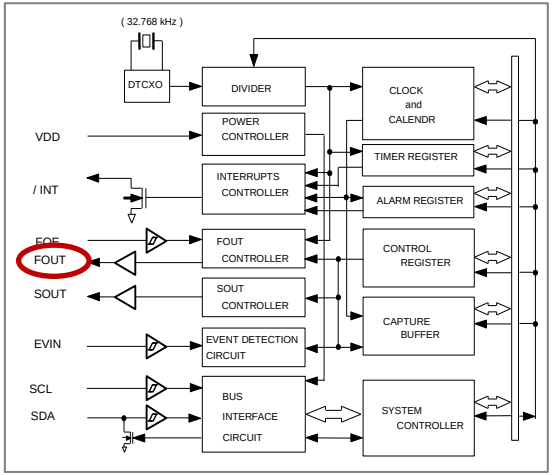
RA8804CE



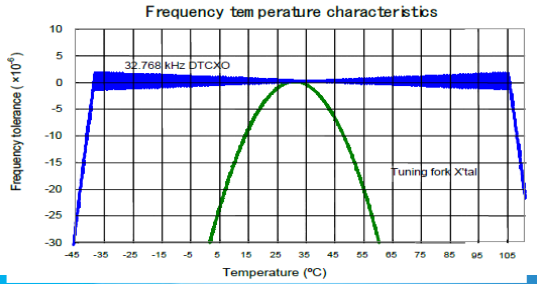
❖ Specifications:

Item	Symbol	Conditions		Min.	Typ.	Max.	Unit
Operating voltage	V_{DD}	-		1.6	3.0	5.5	V
Temp. compensated Voltage	V_{TEM}	-		1.5	3.0	5.5	V
Clock supply voltage	V_{CLK}	-		1.5	3.0	5.5	V
Operating temperature	T_a	-		-40	+25	+105	°C
Stability	$\Delta f / f$	XA	T_a = -40 °C to +85 °C		±3.4		x 10^{-6}
			T_a = +85 °C to +105 °C		±8.0		
		XB	T_a = -40 °C to +85 °C		±5.0		
			T_a = +85 °C to +105 °C		±8.0		
Current consumption (1)	I_{DD1}	fSCL = 0 Hz, /INT = V_{DD}, FOE = GND, FOUT: OFF, Temp. Compensation interval 2.0 s	V_{DD} = 5 V	-	0.4	1.6	µA
Current consumption (2)	I_{DD2}		V_{DD} = 3 V	-	0.35	1.5	

❖ Block Diagram



❖ Temperature compensation



❖ Applications

- Cluster & Infotainment
- Gateway / time sensitive network to control high speed bus systems like LIN,CAN, Ethernet, Flexray
- Service on demand solution with independent timer & event detection for anti-tamper.

RTC: RA8000CE / KHz TCXO

❖ **Features**

- Built in 32.768 kHz DTCXO
- High stability (frequency Adjustment)
- Temperature range from -40 to +125 °C
- 3225 Package
- Long Time Availability
- / **RST controller** to detect Vdd drop optional available
- AEC-Q100
- Interface: I2C

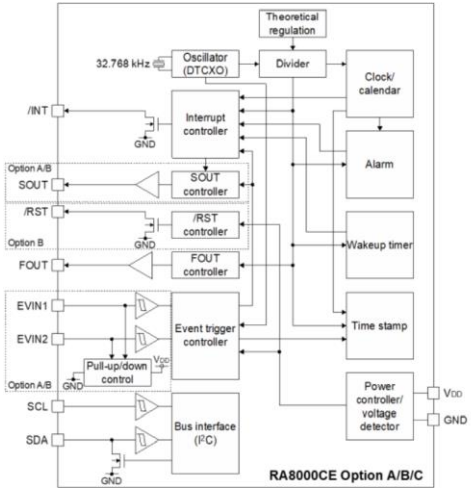
❖ **Specifications:**

Item	Symbol	Conditions			Min.	Typ.	Max.	Unit
Operating voltage	V_{DD}	-			1.6	3.0	5.5	V
Temp. compensated Voltage	V_{TEM}	-			1.6	3.0	5.5	V
Clock supply voltage	V_{CLK}	-			1.3	3.0	5.5	V
Operating temperature	T_a	-			-40	+25	+125	°C
Frequency tolerance	$\Delta f / f$	YB	T_a = -40 °C to +85 °C			±5.0		x 10^{-6}
			T_a = +85 °C to +105 °C			±8.0		
			T_a = +105 °C to +125 °C			±50.0		
Current consumption	I_{DD1}	/INT = Hi-Z, FOUT: Output OFF (Hi-Z), Temp. Compensation interval 2.0 s, SCL = SDA = H	No /RST pin	V_{DD} = 5 V	-	0.35	1.8	µA
	I_{DD2}			V_{DD} = 3 V	-	0.3	1.7	
	I_{DD11}		With /RST pin	V_{DD} = 5 V	-	1.5	3.7	
	I_{DD12}			V_{DD} = 2 V	-	0.6	2.25	

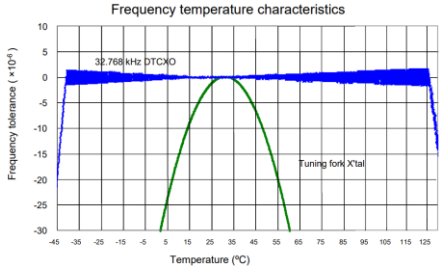
❖ Applications

- Cluster & Infotainment
- Gateway / time sensitive network to control high speed bus systems like LIN,CAN, Ethernet, Flexray
- Service on demand solution with independent timer & event detection for anti-tamper.

❖ **Block Diagram**



❖ **Temperature compensation**



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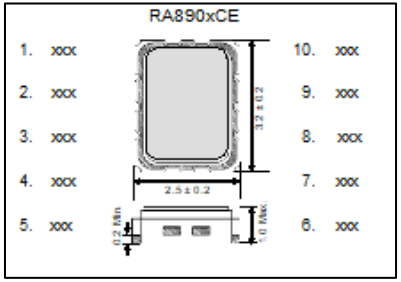
■ Main Features

- Built-in frequency adjusted 32.768 kHz crystal unit and **DTCXO**
- Interface Type ：I2C-Bus
- Selectable clock output ：32.768 kHz, 1024 Hz, 1 Hz
- Auto power switching function ：Automatically switches to backup power supply by monitoring the V_{DD} voltage
- Alarm interruption ：Day, date, hour, minute, second
- Auto repeat wakeup timer interruption
- AEC-Q100 compliant
- Fault detection (Self-monitoring interrupt at crystal oscillation stop)

■ Specifications

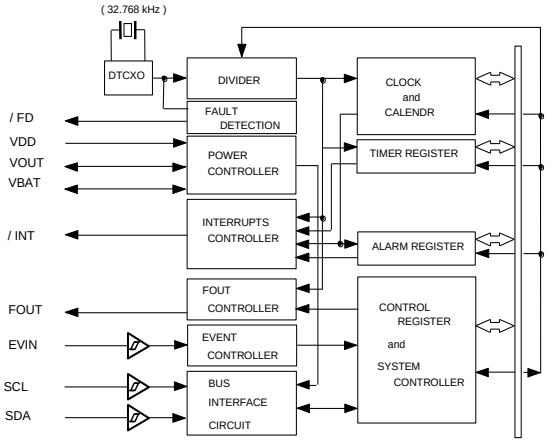
Item		Symbol		Specs
Operating Conditions	Operating supply voltage	V_{DD}		1.6 V to 5.5 V
	Clock supply voltage	V_{CLK}		1.3 V to 2.5 V
	Operating temperature	T_a		-40 ° C to +125 ° C
Characteristics	Frequency tolerance	$\Delta f/f$	YB	$\pm 3.4 \times 10^{-6}$ (-40 ° C to 85 ° C) $\pm 8 \times 10^{-6}$ (85 ° C to 105 ° C) $\pm 50 \times 10^{-6}$ (105 ° C to 125 ° C)
	Current consumption	I_{DD2}		350 nA / Typ. 3 V 1800 nA / Max. 3 V (Temp. Compensation interval: 2.0 s)

■ Pin & Function(TBD)



Signal Name	I / O
EVIN	Input
SCL	Input
SDA	Input / Output
FOUT	Output
/INT	Output
/FD	Output
V_{DD}	-
V_{OUT}	-
V_{BAT}	-
GND	-

■ Block diagram



■ Schedule

ES : TBD

MP : TBD

Product line-up , Specification (RTC Module)

EPSON

Item	RA8900CE	RA8804CE	RA8000CE	RA4000CE	Planning RA890xCE
DTCXO	Yes	Yes	Yes	Yes	Yes
Interface	I²C	I²C	I²C	SPI	I²C
Operation temp. Max.	+85 ° C	+105 ° C	+125 ° C	+125 ° C	+125 ° C
Frequency tolerance (x 10^{-6})	UA : ±3.4 (-40 to +85°C) UB : ± 5.0 (-40 to +85°C)	XA : ± 3.4 (-40 to +85°C) ± 8.0 (+85 to +105°C) XB : ± 5.0 (-40 to +85°C) ± 8.0 (+85 to +105°C)	YB : ±5.0 (-40 to +85°C) ±8.0 (+85 to +105°C) ±50.0 (+105 to +125°C)	YB : ±5.0 (-40 to +85°C) ±8.0 (+85 to +105°C) ±50.0 (+105 to +125°C)	YB : ±5.0 (-40 to +85°C) ±8.0 (+85 to +105°C) ±50.0 (+105 to +125°C)
Backup current Typ. / 3 V	700 nA	350 nA	300 nA	300 nA	350 nA
Time stamp	-	1 time	2 times	2 times	-
Power switching	Yes	-	-	-	Yes
Reset output	-	-	Yes (optional)	Yes (optional)	-
Fault detection (non-recoverable fault)	-	-	-	-	Yes
Automotive grade	AEC-Q200	AEC-Q100	AEC-Q100	AEC-Q100	AEC-Q100

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Appendix – Useful Links

Global Epson Timing Device
https://www.epsondevice.com/crystal/en/

Products / Parametric Search / Stock
https://www.epsondevice.com/crystal/en/products/

RTC / PLL / Discontinued / Various
https://www.epsondevice.com/crystal/en/products/discon/

Reference Design
https://www.epsondevice.com/crystal/en/techinfo/ic-partners/

EIOS (Epson Information and Ordering Portal) -> ask your admin for access
https://eios.epson-electronics.de/epson/en/login

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