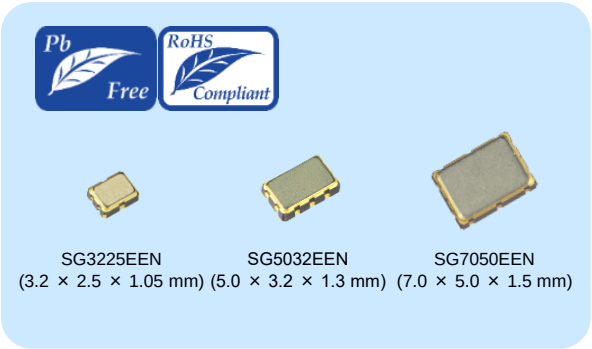
Low Phase Jitter Crystal Oscillator: SG3225 / 5032 / 7050EEN

Features

- Crystal oscillator (SPXO)
- Frequency range (fo): 25 MHz to 500 MHz
- Output: LVPECL
- Supply voltage: 2.5 V Typ. / 3.3 V Typ.
- Operating temperature: -40 ºC to +105 ºC
- Low phase jitter: 50 fs Typ. (fo = 156.25 MHz)



Applications

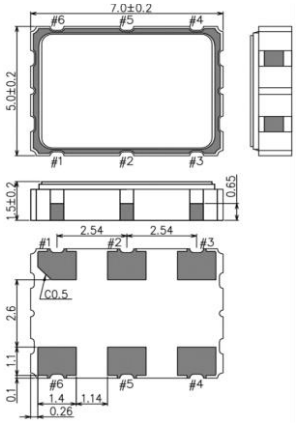
- Network equipment (Router, Switch, Optical module, etc.)
- Data center
- Test and Measurement Equipment, Factory Automation
- High Speed Converters like ADC and DAC

Description

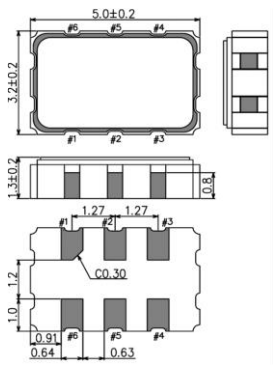
5G will increase the communication traffic exponentially. A 5G communication network requires high-speed and wide-band, while keeping the noise level to a minimum. This can be achieved with a high frequency low jitter reference clock for the communication equipment. Using the above XO, customers can input a high frequency reference (up to 500 MHz) with extremely low phase jitter and power, from a fundamental mode crystal to achieve excellent phase noise.

Outline Drawing and Terminal Assignment

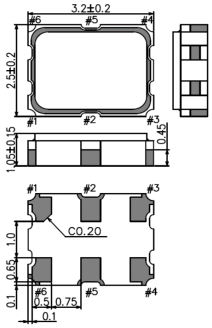
SG7050EEN



SG5032EEN



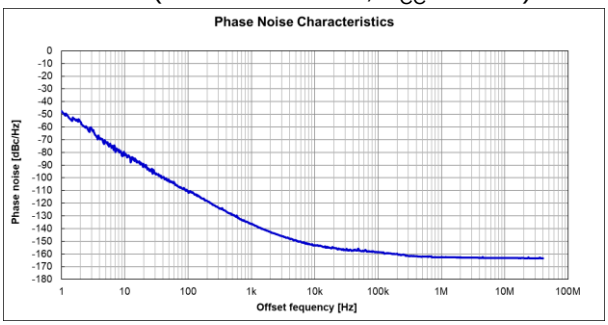
SG3225EEN



Pin	Connection
1	OE
2	N.C. (Open or V_{CC})
3	GND
4	OUT
5	$\overline{OUT}$
6	V_{CC}

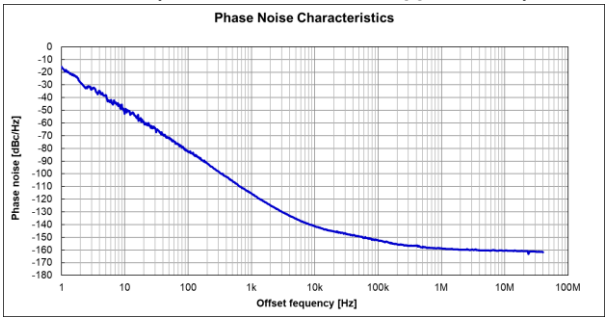
Typical Performance

Phase Noise (fo = 156.25 MHz, V_{CC} = 3.3 V)



Phase Jitter (12 kHz to 20 MHz): 50 fs Typ.

Phase Noise (fo = 491.52 MHz, V_{CC} = 3.3 V)



Phase Jitter (12 kHz to 20 MHz): 20 fs Typ.

[1] Product Number / Product Name

(1-1) Product Number

SG3225EEN: X1G005221xxxx00 (fo ≤ 200 MHz)
X1G005511xxxx00 (fo > 200 MHz)
SG5032EEN: X1G005531xxxx00 (fo > 200 MHz)
SG7050EEN: X1G005131xxxx00 (fo ≤ 200 MHz)
X1G005551xxxx00 (fo > 200 MHz) (Please contact Epson for details)

(1-2) Product Name (Standard Form)

SG3225 E EN 156.250000MHz C D G A (⑤⑥: Unavailable code DH and DG, JH at fo > 200 MHz)
① ② ③ ④ ⑤ ⑥ ⑦

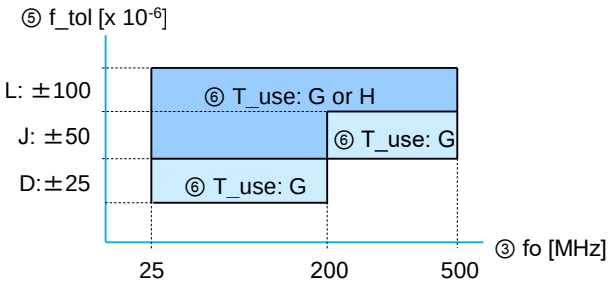
①Model
②Output (E: LVPECL)
③Frequency
④Supply voltage
⑤Frequency tolerance
⑥Operating temperature
⑦Internal identification code ("A" is default)

④Supply voltage	
D	2.5 V Typ.
C	3.3 V Typ.

⑤Frequency tolerance	
D	±25 × 10^{-6}
J	±50 × 10^{-6}
L	±100 × 10^{-6}

⑥Operating temperature	
G	-40 ºC to +85 ºC
H	-40 ºC to +105 ºC

Available code for ⑥Operating temperature



Please note that the available code for ⑥Operating temperature (T_use) depends on ③Frequency (fo) and ⑤Frequency tolerance (f_tol).

[2] Absolute Maximum Ratings

Parameter	Symbol	Specification			Unit	Conditions
		Min.	Typ.	Max.		
Maximum supply voltage	V_{CC}	-0.5	-	4	V	fo ≤ 200 MHz
		-0.5	-	5	V	fo > 200 MHz
Input voltage	Vin	-0.5	-	V_{CC} + 0.5	V	OE terminal
Storage temperature range	T_stg	-55	-	125	ºC	

[3] Operating Range

Parameter	Symbol	Specification			Unit	Conditions
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	2.375	2.5	2.625	V	Suffix: D
		3.135	3.3	3.465	V	Suffix: C
Supply voltage	GND	0.0	0.0	0.0	V	
Operating temperature range	T_use	-40	+25	+85	ºC	Suffix: G
		-40	+25	+105	ºC	Suffix: H
ECL load condition	L_ECL	50			Ω	Terminated to V_{CC} - 2.0 V

* Power supply startup time (0 %V_{CC}→90 %V_{CC}) should be more than 150 µs

* A 0.01 µF and a 0.1 µF bypass capacitor should be connected between V_{CC} and GND pins located close to the device

[4] Frequency Characteristics (Unless stated otherwise [3] Operating Range)

Parameter	Symbol	Specification			Unit	Conditions
		Min.	Typ.	Max.		
Output frequency *1	fo	25	-	500	MHz	SG3225EEN / SG7050EEN
		200	-	500	MHz	SG5032EEN
Frequency tolerance	f_tol	-25	-	+25	$\times 10^{-6}$	*2 Suffix: D fo ≤ 200 MHz, T_use: G
		-50	-	+50	$\times 10^{-6}$	*3 Suffix: J T_use: G
						*3 Suffix: J fo ≤ 200 MHz, T_use: H
		-100	-	+100	$\times 10^{-6}$	*3 Suffix: L T_use: H

*1 Please contact Epson for available frequencies

*2 Frequency tolerance includes Initial frequency tolerance, Frequency / temperature characteristics, Frequency / voltage coefficient and aging (5 years, +25 ºC).

*3 Frequency tolerance includes Initial frequency tolerance, Frequency / temperature characteristics, Frequency / voltage coefficient and aging (10 years, +25 ºC).

[5] Electrical Characteristics (Unless stated otherwise [3] Operating Range)

Parameter	Symbol	Specification			Unit	Conditions
		Min.	Typ.	Max.		
Startup time	t_str	-	-	10	ms	t = 0 at 90 %V_{CC}
Current consumption	I_{CC}	-	-	60	mA	
Disable current	I_dis	-	-	25	mA	OE = GND
Rise time / Fall time	tr / tf	-	-	0.3	ns	V_{CC} = 3.3 V ± 10 %, fo ≤ 200 MHz, 20 % - 80 % (V_{OH} - V_{OL})
		-	-	0.35	ns	All other, 20 % - 80 % (V_{OH} - V_{OL})
Symmetry	SYM	45	50	55	%	At output crossing point
Output voltage	V_{OH}	V_{CC} - 1.1	-	-	V	DC characteristics
	V_{OL}	-	-	V_{CC} - 1.5	V	
Input voltage	V_{IH}	70 % V_{CC}	-	-	V	OE terminal
	V_{IL}	-	-	30 % V_{CC}	V	
Output disable time (OE)	tstp_oe	-	-	100	ns	OE terminal HIGH → LOW
Output enable time (OE)	tsta_oe	-	-	200	ns	fo ≤ 200 MHz, OE terminal LOW → HIGH
		-	-	500	ns	fo > 200 MHz, OE terminal LOW → HIGH
Phase jitter (fo = 25 MHz)	t_{PJ}	-	-	250	fs	Offset frequency 12 kHz to 5 MHz
Phase jitter (fo = 50 MHz)	t_{PJ}	-	-	250	fs	Offset frequency 12 kHz to 20 MHz
Phase jitter (fo = 100 MHz)	t_{PJ}	-	-	100	fs	
Phase jitter (fo = 125 MHz)	t_{PJ}	-	-	90	fs	
Phase jitter (fo = 156.25 MHz)	t_{PJ}	-	-	70	fs	
Phase jitter (fo = 212.5 MHz)	t_{PJ}	-	-	60	fs	
Phase jitter (fo = 312.5 MHz)	t_{PJ}	-	-	60	fs	
Phase jitter (fo = 491.52 MHz)	t_{PJ}	-	-	40	fs	

[6] Thermal resistance (For reference only)

Parameter	Symbol	Specification			Unit	Conditions
		Min.	Typ.	Max.		
Junction temperature	Tj	-	-	140	ºC	
Junction to case	θjc	-	97.9	-	ºC/W	SG3225EEN
		-	102.6	-	ºC/W	SG5032EEN
		-	42.6	-	ºC/W	SG7050EEN
Junction to ambient	θja	-	155.4	-	ºC/W	SG3225EEN
		-	150.1	-	ºC/W	SG5032EEN
		-	75.2	-	ºC/W	SG7050EEN

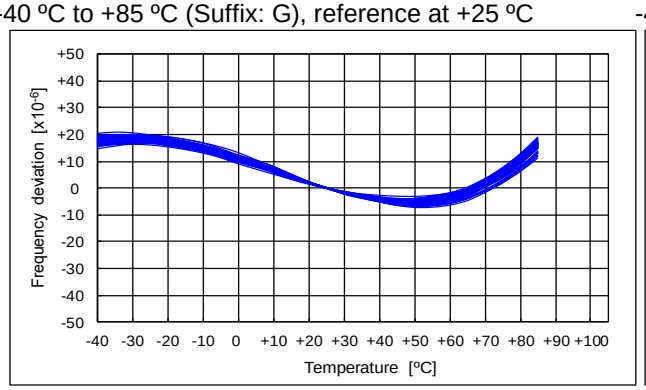
[7] Typical Performance Characteristics (For reference only)

The following data shows typical performance characteristics

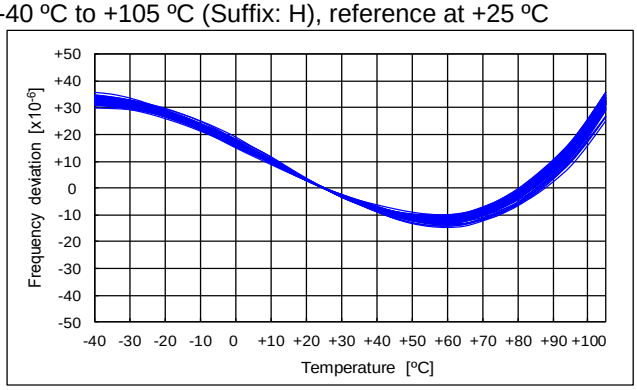
(7-1) Frequency / Temperature Characteristics

fo = 100 MHz n = 50 pcs

-40 ºC to +85 ºC (Suffix: G), reference at +25 ºC

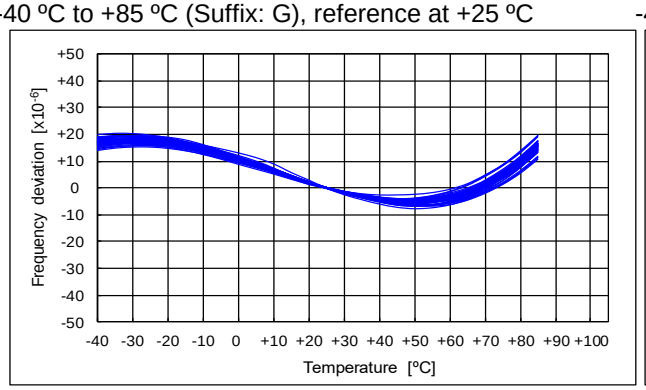


-40 ºC to +105 ºC (Suffix: H), reference at +25 ºC

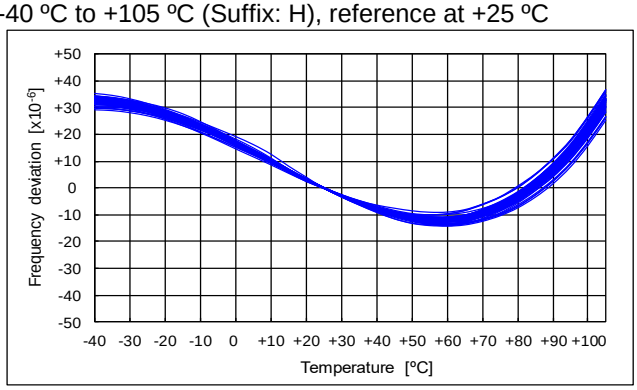


fo = 125 MHz n = 50 pcs

-40 ºC to +85 ºC (Suffix: G), reference at +25 ºC

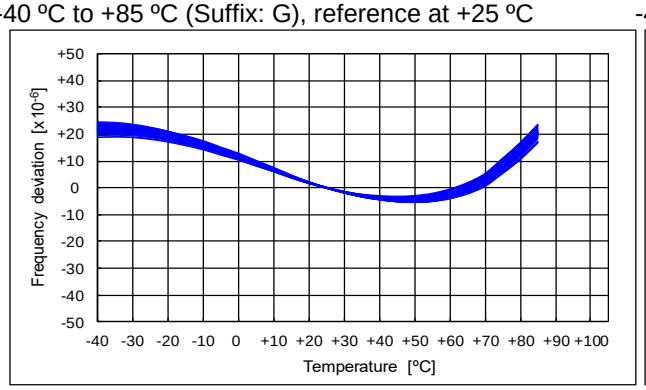


-40 ºC to +105 ºC (Suffix: H), reference at +25 ºC

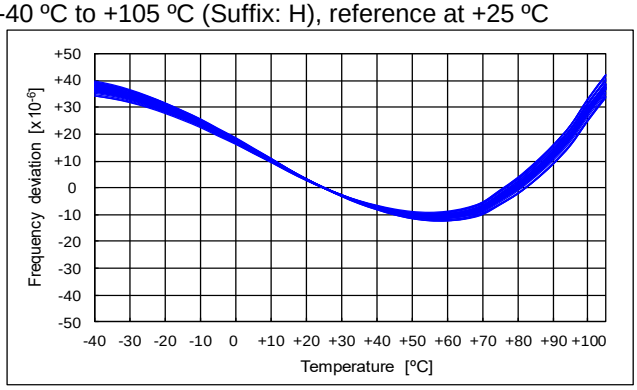


fo = 156.25 MHz n = 50 pcs

-40 ºC to +85 ºC (Suffix: G), reference at +25 ºC



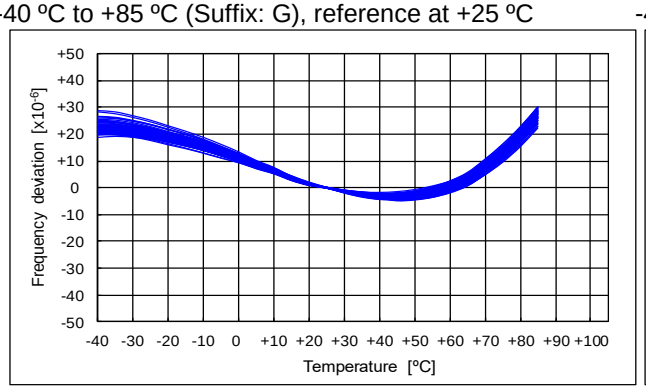
-40 ºC to +105 ºC (Suffix: H), reference at +25 ºC



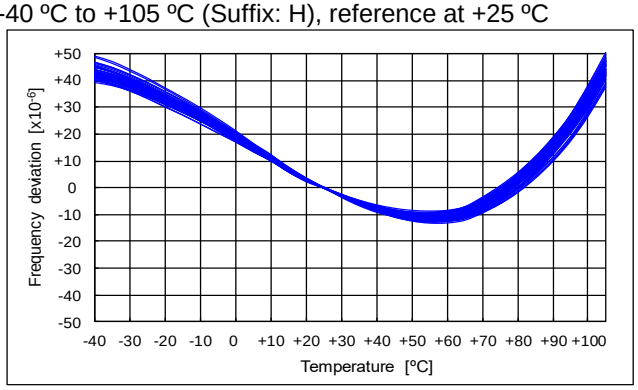
(7-1) Frequency / Temperature Characteristics [cont'd]

fo = 212.5 MHz n = 50 pcs

-40 ºC to +85 ºC (Suffix: G), reference at +25 ºC

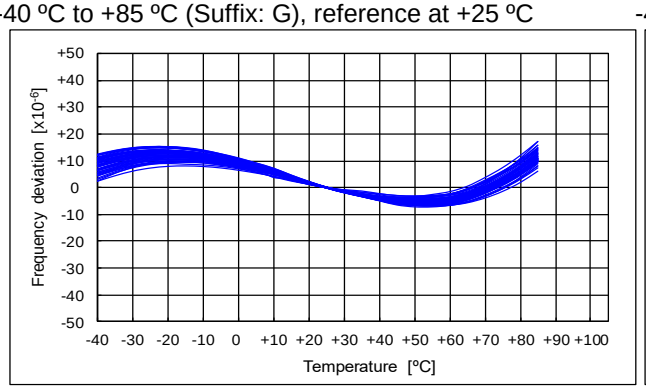


-40 ºC to +105 ºC (Suffix: H), reference at +25 ºC

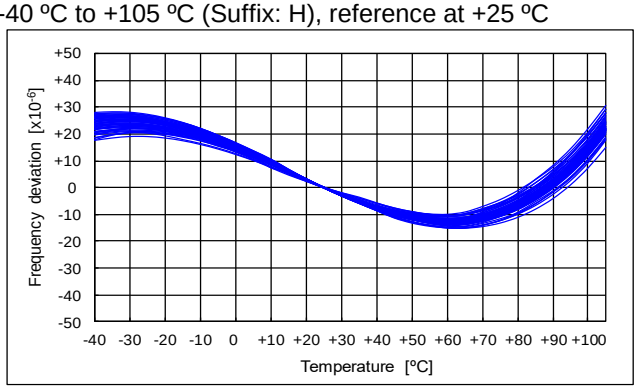


fo = 312.5 MHz n = 50 pcs

-40 ºC to +85 ºC (Suffix: G), reference at +25 ºC

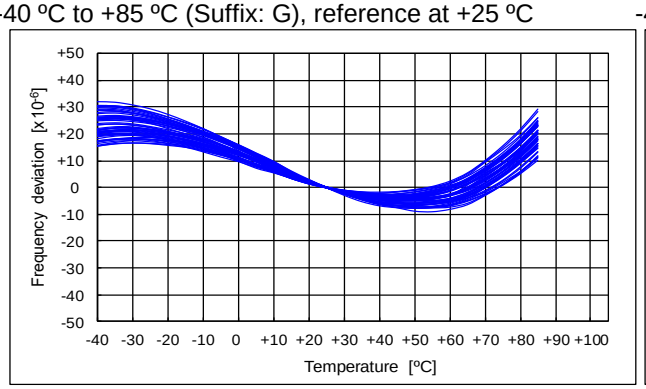


-40 ºC to +105 ºC (Suffix: H), reference at +25 ºC

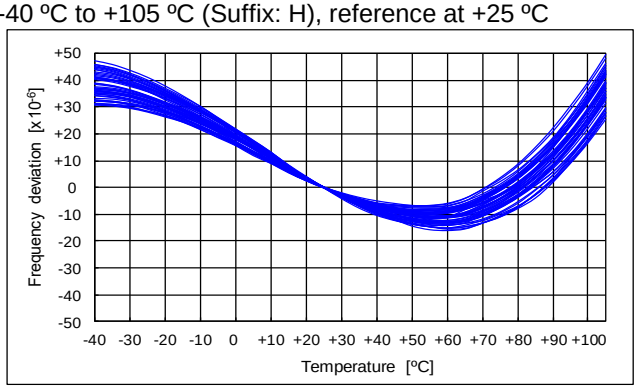


fo = 491.52 MHz n = 50 pcs

-40 ºC to +85 ºC (Suffix: G), reference at +25 ºC

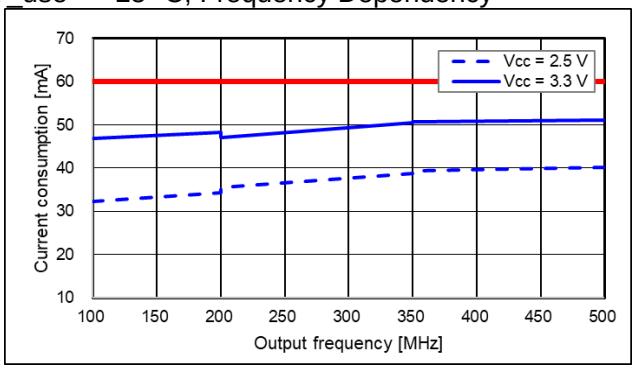


-40 ºC to +105 ºC (Suffix: H), reference at +25 ºC

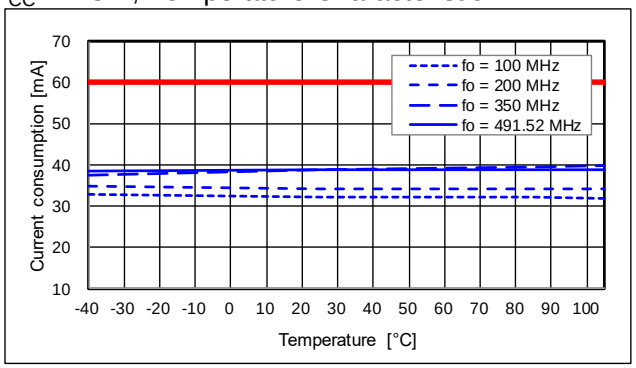


(7-2) Current Consumption

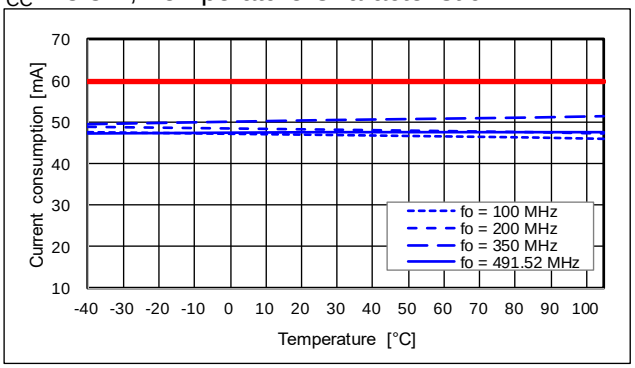
T_use = +25 ºC, Frequency Dependency



V_{CC} = 2.5 V, Temperature Characteristic



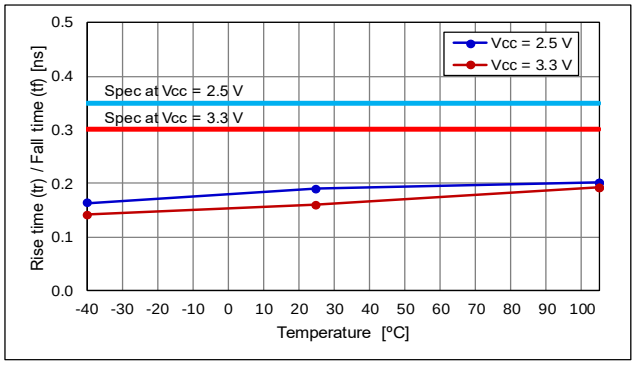
V_{CC} = 3.3 V, Temperature Characteristic



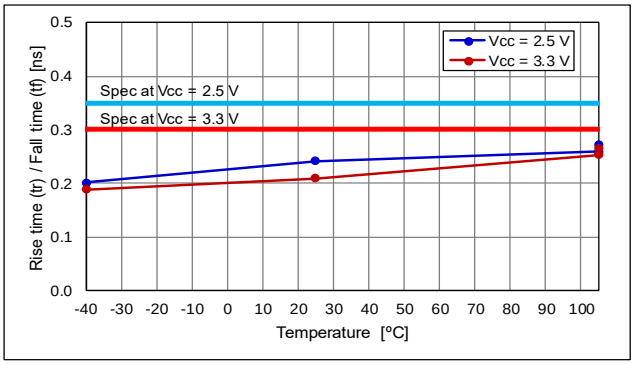
(7-3) Rise Time / Fall Time Temperature Characteristic

fo = 100 MHz

Rise Time

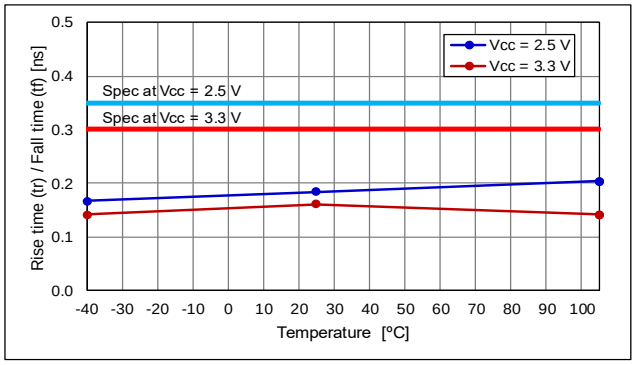


Fall Time

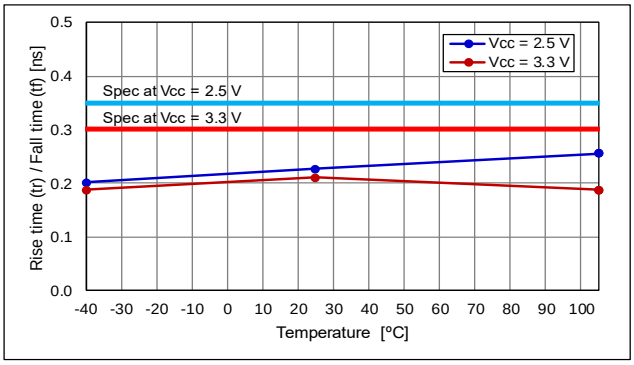


fo = 200 MHz

Rise Time

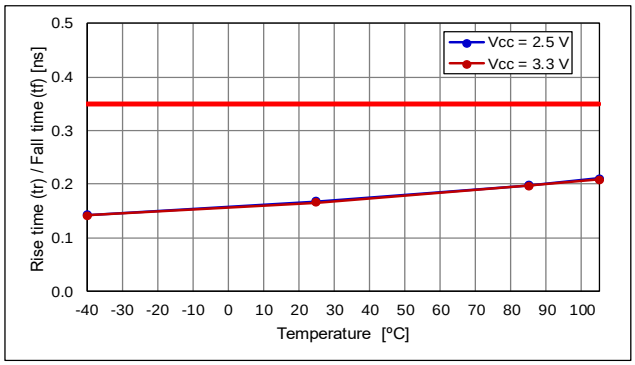


Fall Time

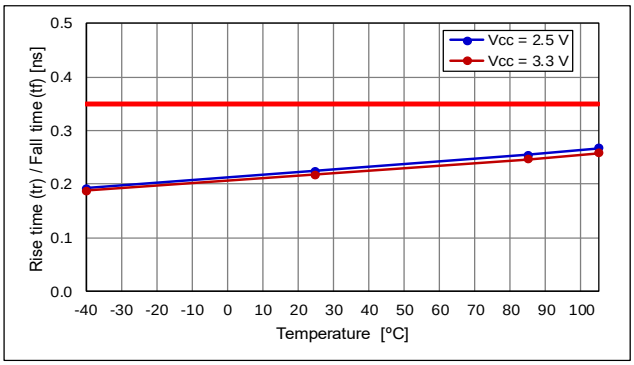


fo = 350 MHz

Rise Time

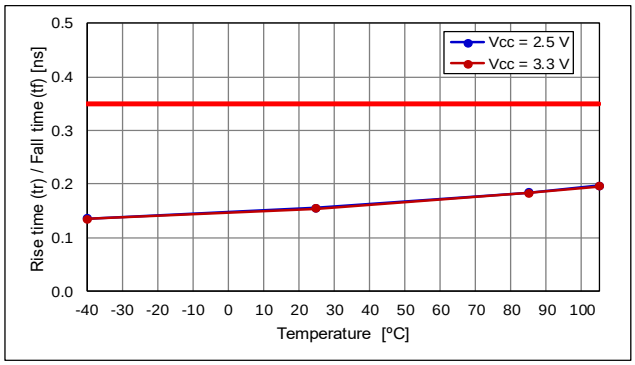


Fall Time

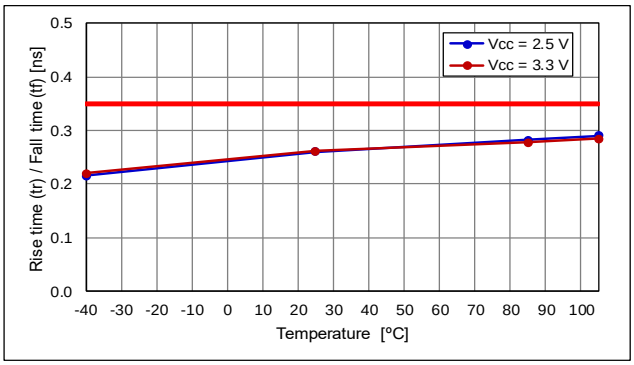


fo = 491.52 MHz

Rise Time

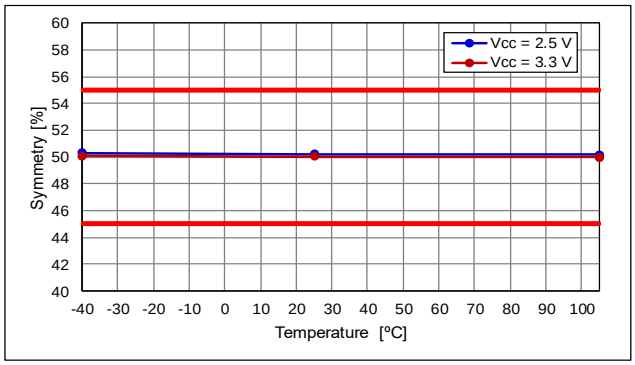


Fall Time

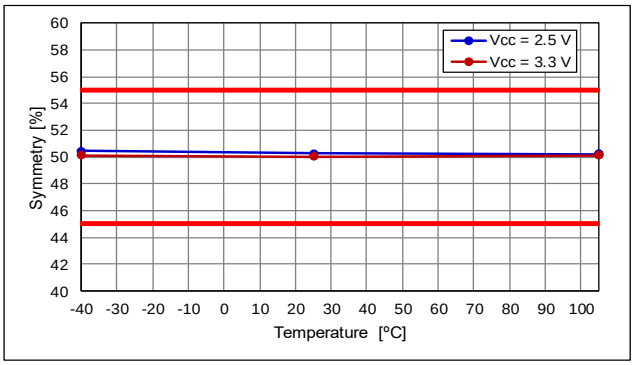


(7-4) Symmetry Temperature Characteristic

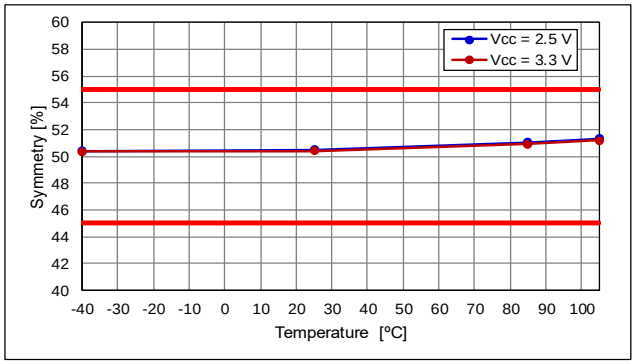
fo = 100 MHz



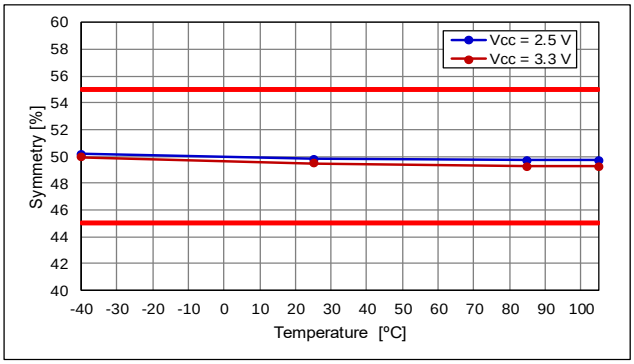
fo = 200 MHz



fo = 350 MHz

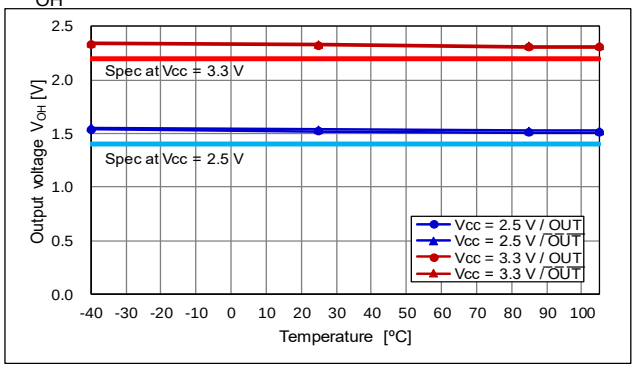


fo = 491.52 MHz

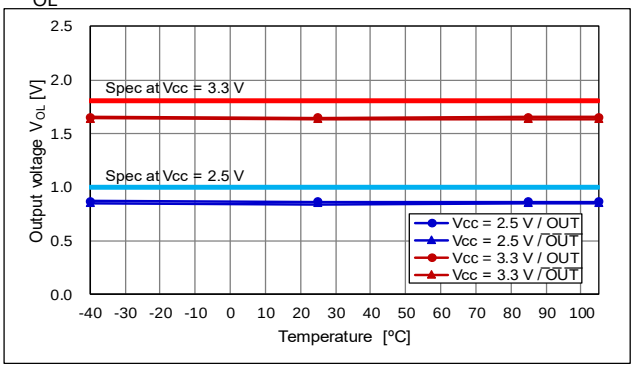


(7-5) Output Voltage Temperature Characteristic

V_{OH}

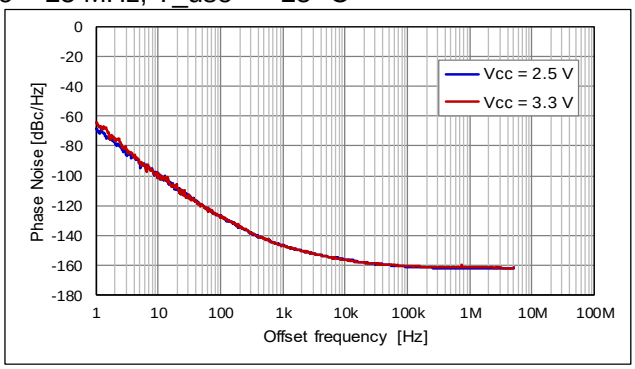


V_{OL}



(7-6) Phase Noise and Phase Jitter

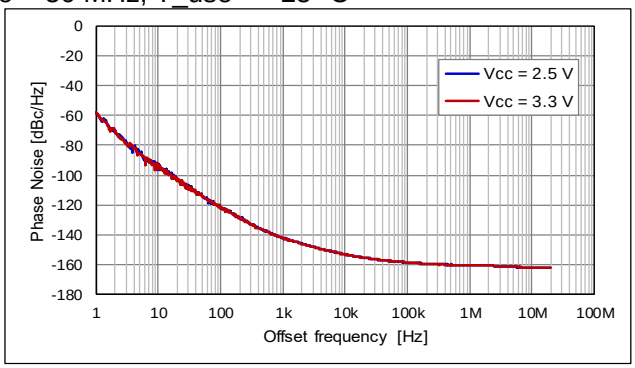
fo = 25 MHz, T_use = +25 ºC



V_{CC}	Phase Jitter*
2.5 V	155 fs
3.3 V	165 fs

* Offset frequency: 12 kHz to 5 MHz

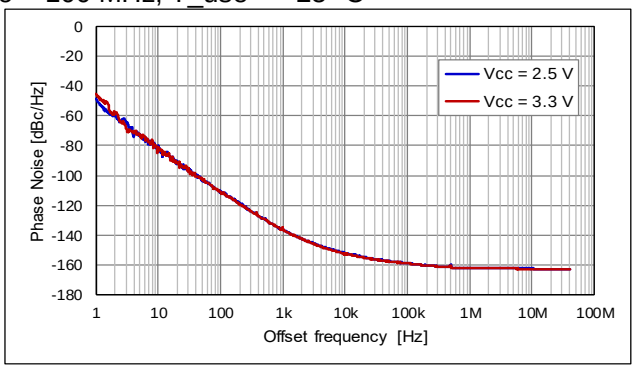
fo = 50 MHz, T_use = +25 ºC



V_{CC}	Phase Jitter*
2.5 V	161 fs
3.3 V	164 fs

* Offset frequency: 12 kHz to 20 MHz

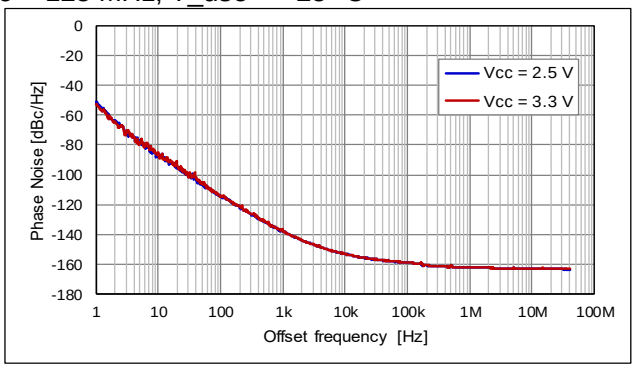
fo = 100 MHz, T_use = +25 ºC



V_{CC}	Phase Jitter*
2.5 V	75 fs
3.3 V	74 fs

* Offset frequency: 12 kHz to 20 MHz

fo = 125 MHz, T_use = +25 ºC

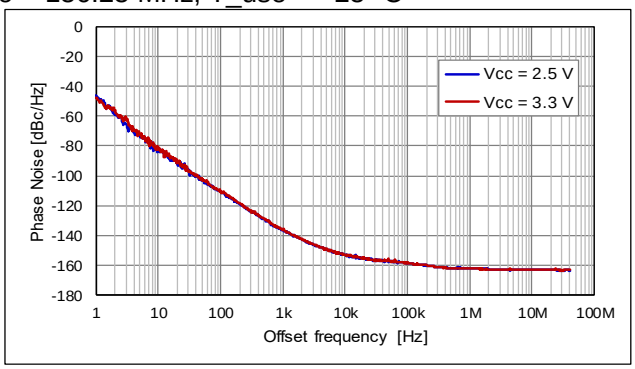


V_{CC}	Phase Jitter*
2.5 V	57 fs
3.3 V	57 fs

* Offset frequency: 12 kHz to 20 MHz

(7-6) Phase Noise and Phase Jitter [cont'd]

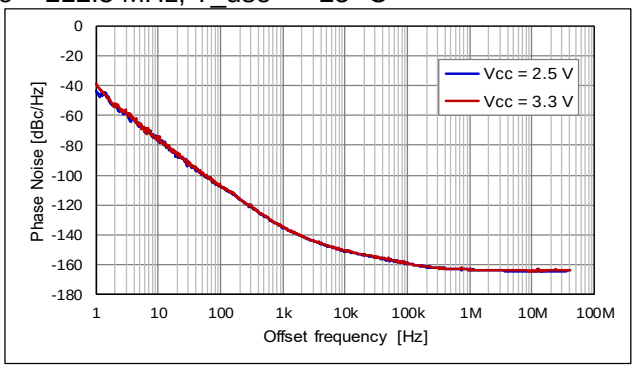
fo = 156.25 MHz, T_use = +25 ºC



V_{CC}	Phase Jitter*
2.5 V	45 fs
3.3 V	46 fs

* Offset frequency: 12 kHz to 20 MHz

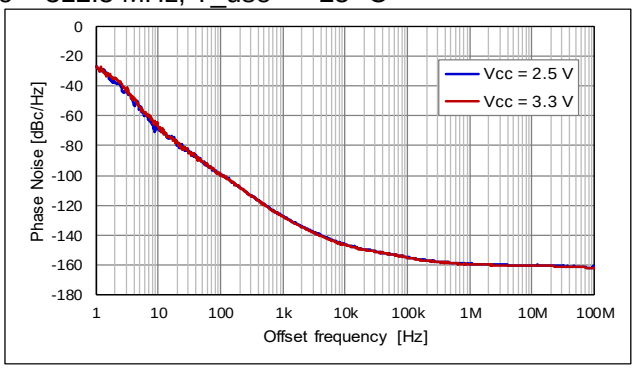
fo = 212.5 MHz, T_use = +25 ºC



V_{CC}	Phase Jitter*
2.5 V	29 fs
3.3 V	30 fs

* Offset frequency: 12 kHz to 20 MHz

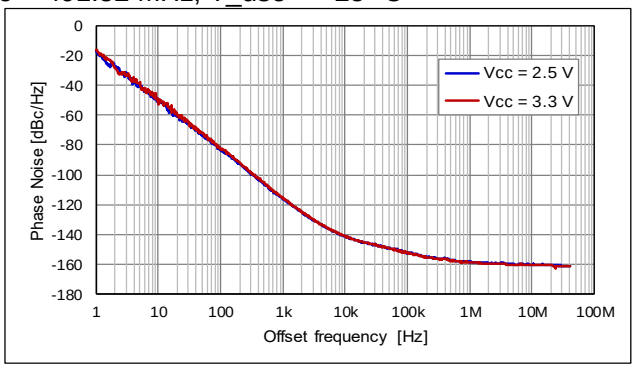
fo = 312.5 MHz, T_use = +25 ºC



V_{CC}	Phase Jitter*
2.5 V	32 fs
3.3 V	31 fs

* Offset frequency: 12 kHz to 20 MHz

fo = 491.52 MHz, T_use = +25 ºC

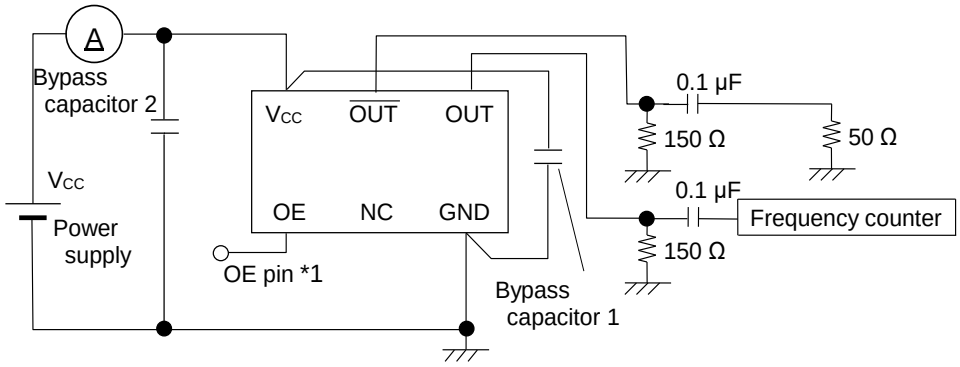


V_{CC}	Phase Jitter*
2.5 V	21 fs
3.3 V	21 fs

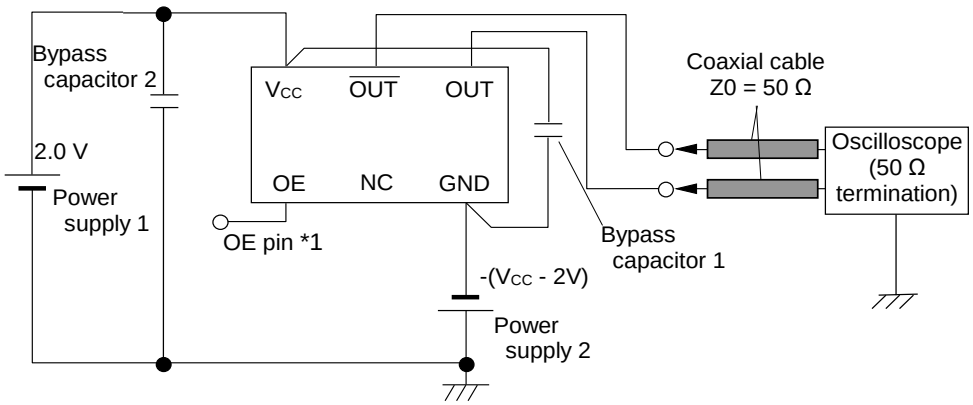
* Offset frequency: 12 kHz to 20 MHz

[8] Test Circuit

(8-1) Output Frequency and Current Consumption Test Setup



(8-2) Waveform Observation Test Setup



* Each output trace should be same length

* To measure Disable Current, OE terminal is connected to GND

(8-3) Conditions

(1) Oscilloscope

The bandwidth should be a minimum of 5 times wider than the measurement frequency

(2) A 0.1 µF and a 10 µF bypass capacitor should be connected between V_{CC} and GND pins located close to the device

(3) Use a current meter with a low internal impedance

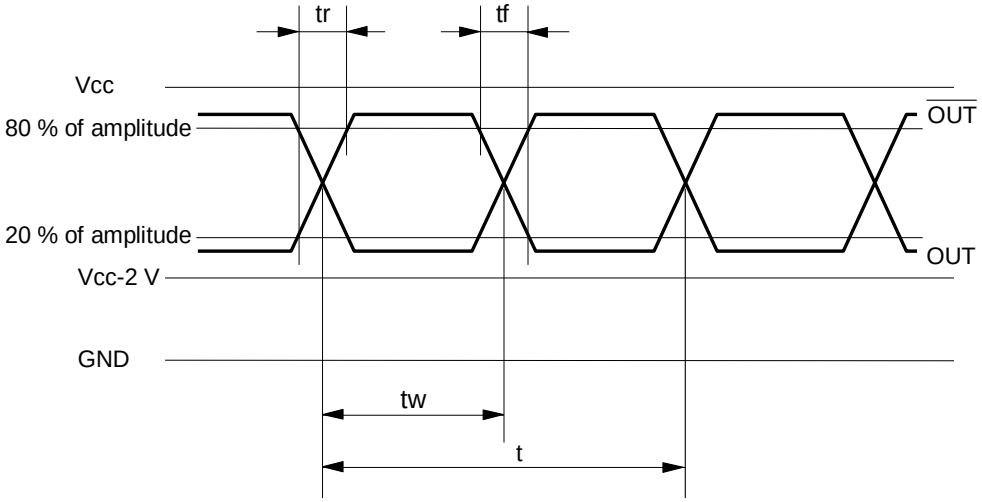
(4) Power Supply

Power supply startup time (0 %V_{CC}→90 %V_{CC}) should be more than 150 µs

Power supply impedance should be as low as possible

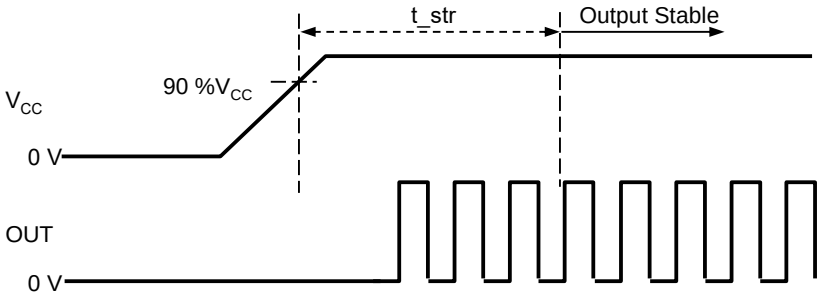
(8-4) Timing Chart

(1) Output Waveform and Level



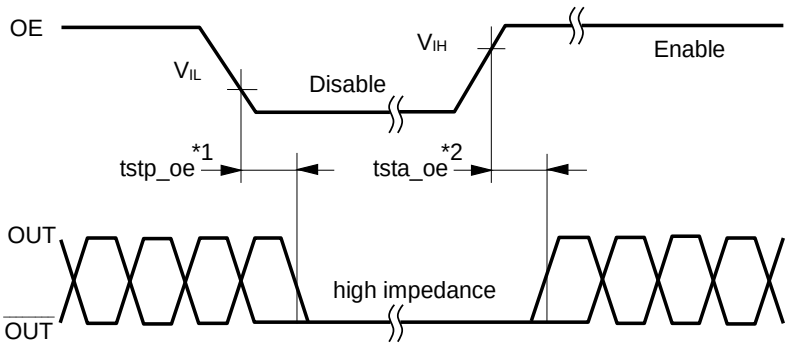
SYM = tw / t× 100 [%]

(2) Output Frequency Timing



(3) OE Function and Timing

OE Terminal	Osc. Circuit	Output status
"H" or OPEN	Oscillation	Specified frequency is output: Enable
"L"	Oscillation	Output becomes high impedance: Disable



*1 The period from OE = V_{IL} to OUT = High impedance (Disable)

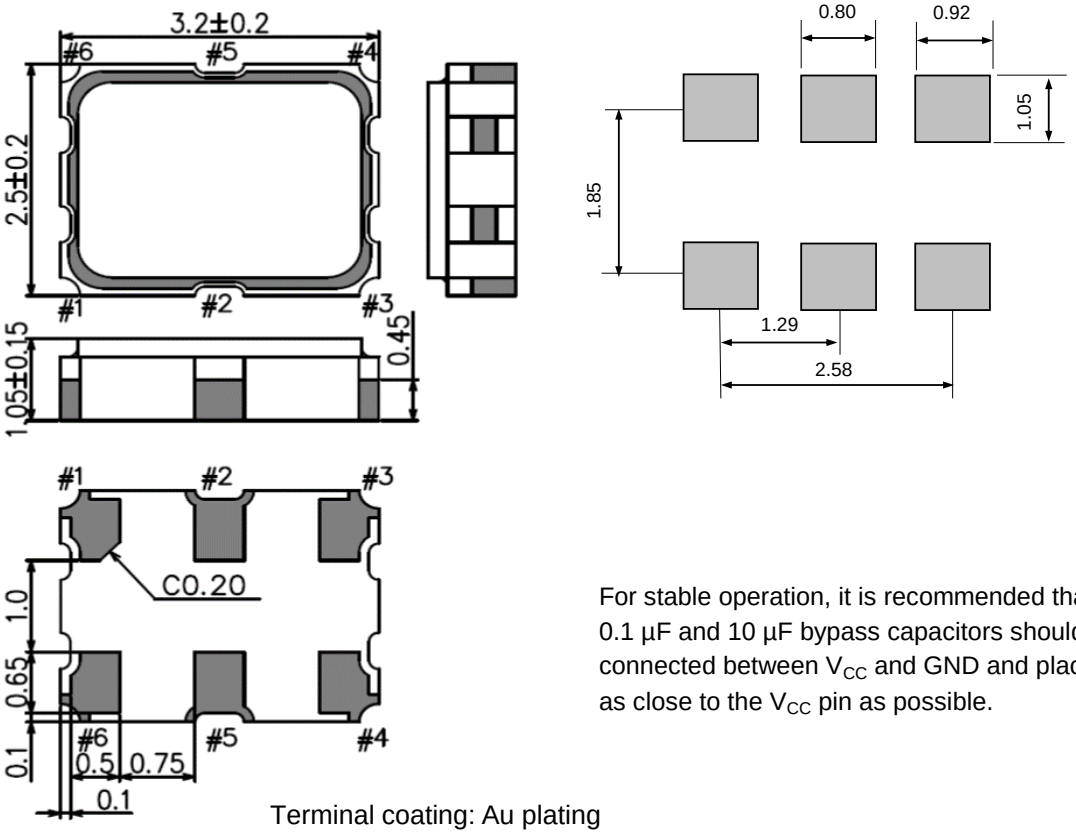
*2 The period from OE = V_{IH} to OUT = Enable

* OE terminal voltage level should not exceed supply voltage when using OE function.
Please note that OE rise time should not exceed supply voltage rise time at the start-up.

[9] Outline Drawing and Recommended Footprint

(9-1) SG3225EEN

Units: mm



For stable operation, it is recommended that 0.1 µF and 10 µF bypass capacitors should be connected between V_{CC} and GND and placed as close to the V_{CC} pin as possible.

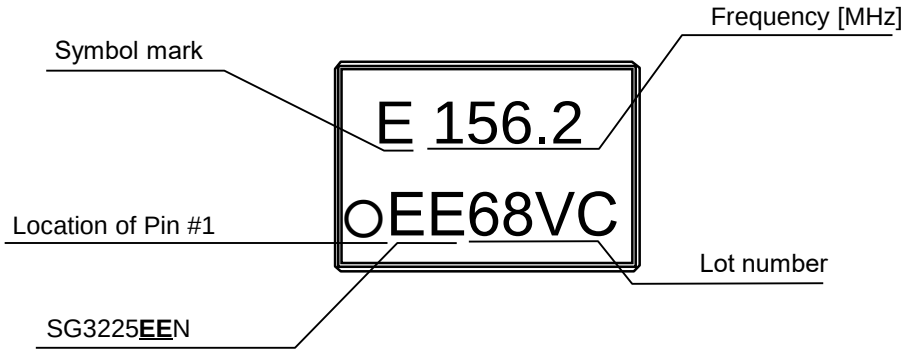
Terminal coating: Au plating

Reference Weight Typ.: 26 mg

Terminal Assignment

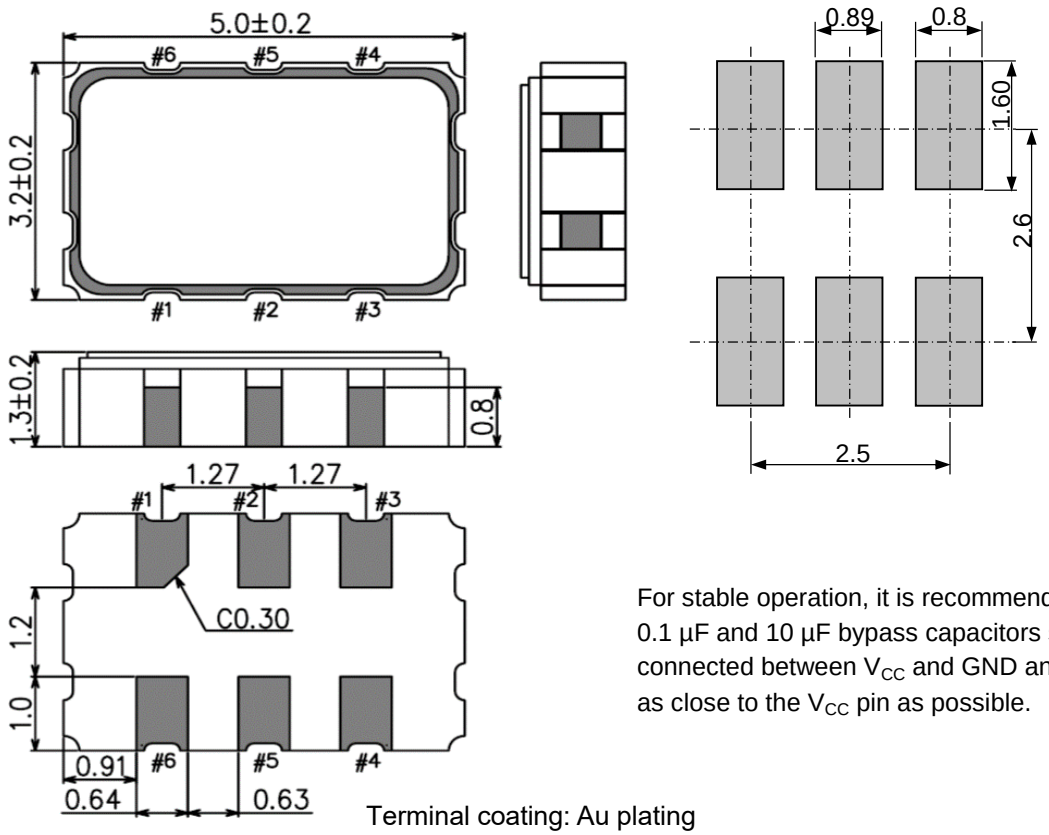
Pin #	Connection	Function		
#1	OE	OE terminal / active high		
		OE function	Osc. circuit	Output
		"H" or OPEN	Oscillation	Specified frequency: Enable
		"L"	Oscillation	High impedance: Disable
#2	NC	–		
#3	GND	GND terminal		
#4	OUT	Output terminal (Positive)		
#5	$\overline{OUT}$	Output terminal (Negative)		
#6	V_{CC}	V_{CC} terminal		

Marking



(9-2) SG5032EEN

Units: mm



For stable operation, it is recommended that 0.1 µF and 10 µF bypass capacitors should be connected between V_{CC} and GND and placed as close to the V_{CC} pin as possible.

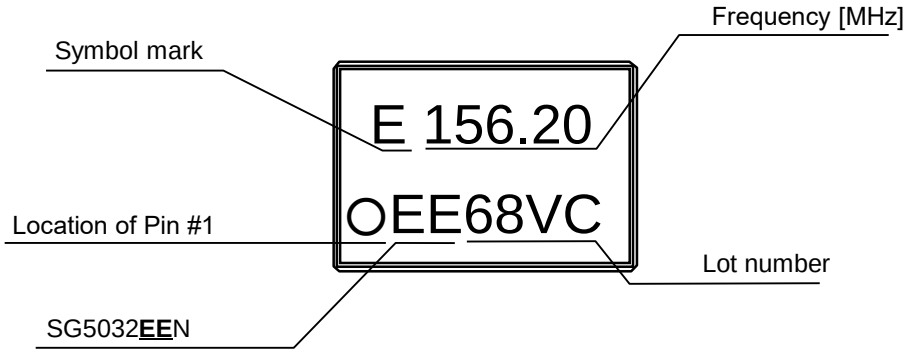
Terminal coating: Au plating

Reference Weight Typ.: 65 mg

Terminal Assignment

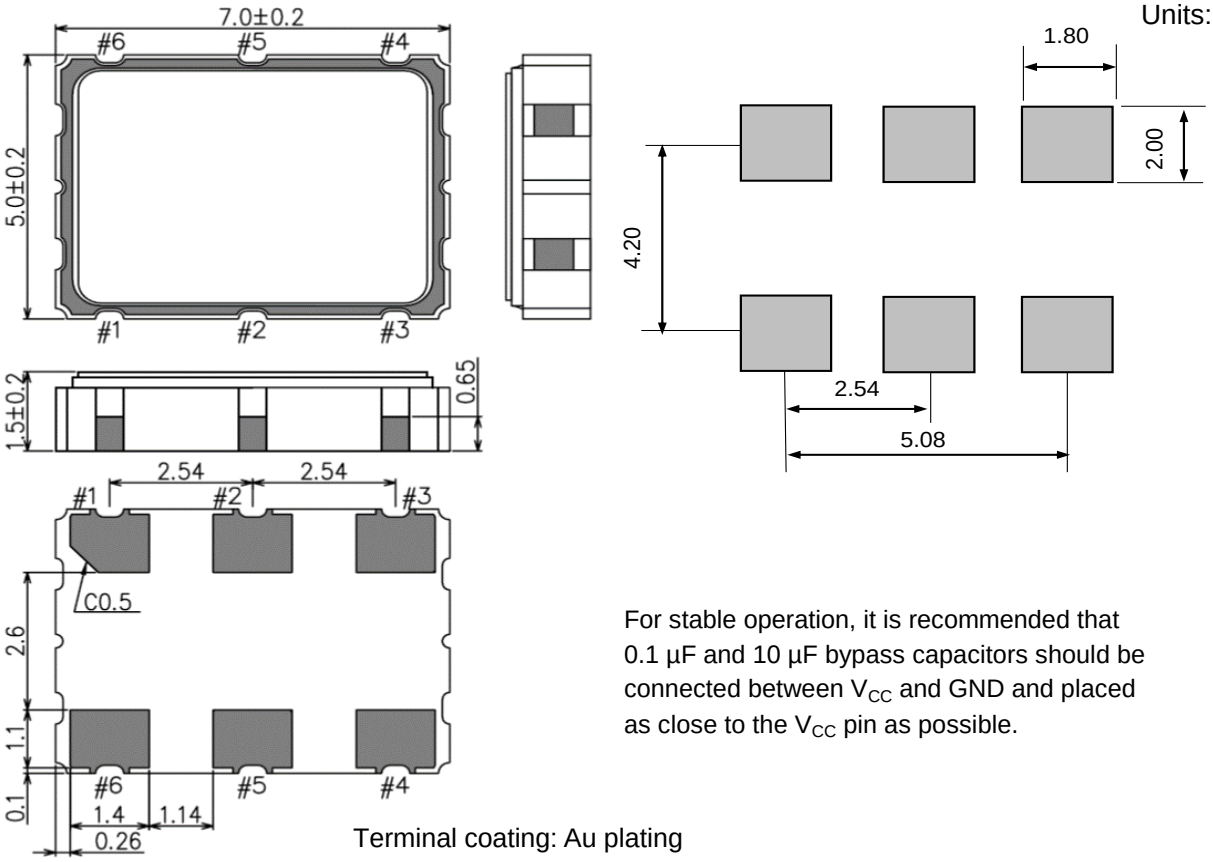
Pin #	Connection	Function		
#1	OE	OE terminal / active high		
		OE function	Osc. circuit	Output
		"H" or OPEN	Oscillation	Specified frequency: Enable
		"L"	Oscillation	High impedance: Disable
#2	NC	–		
#3	GND	GND terminal		
#4	OUT	Output terminal (Positive)		
#5	$\overline{OUT}$	Output terminal (Negative)		
#6	V_{CC}	V_{CC} terminal		

Marking



(9-3) SG7050EEN

Units: mm



For stable operation, it is recommended that 0.1 µF and 10 µF bypass capacitors should be connected between V_{CC} and GND and placed as close to the V_{CC} pin as possible.

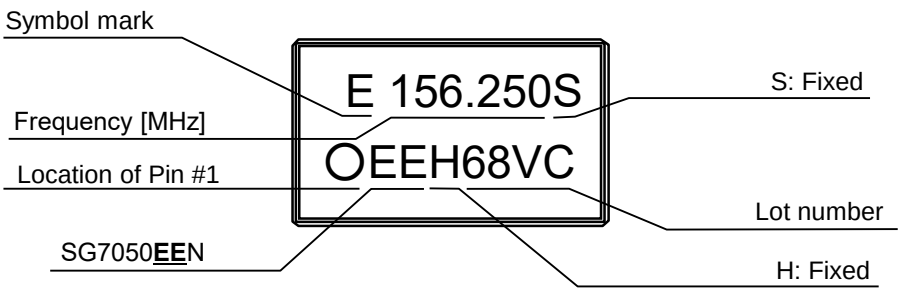
Terminal coating: Au plating

Reference Weight Typ.: 165 mg

Terminal Assignment

Pin #	Connection	Function		
#1	OE	OE terminal / active high		
		OE function	Osc. circuit	Output
		"H" or OPEN	Oscillation	Specified frequency: Enable
		"L"	Oscillation	High impedance: Disable
#2	NC	–		
#3	GND	GND terminal		
#4	OUT	Output terminal (Positive)		
#5	$\overline{OUT}$	Output terminal (Negative)		
#6	V_{CC}	V_{CC} terminal		

Marking



[10] Moisture Sensitivity Level and Electro-Static Discharge Ratings

(10-1) Moisture Sensitivity Level (MSL)

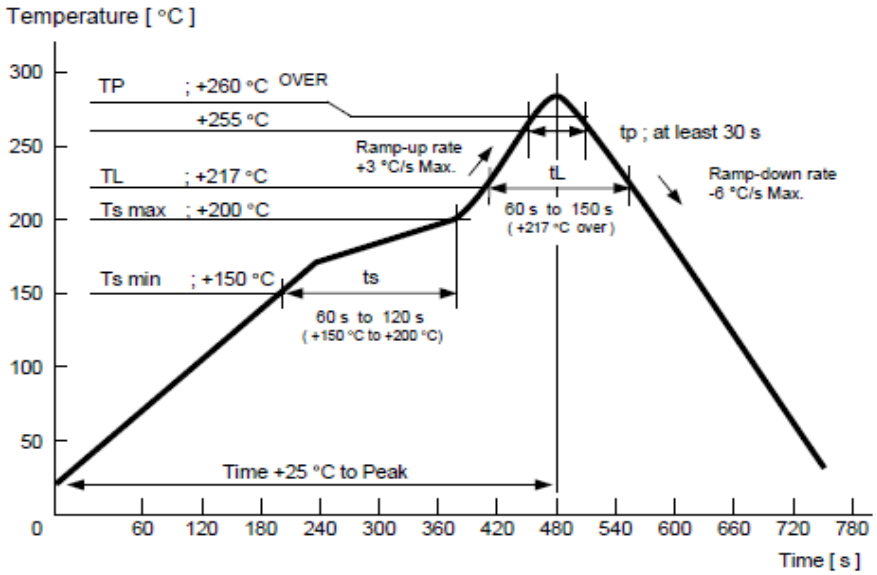
Parameter	Specification	Conditions
MSL	LEVEL 1	IPC/JEDEC J-STD-020D.1

(10-2) Electro-Static Discharge (ESD)

Parameter	Specification	Conditions
HBM	2 000 V Min.	IEC 60749-26 Ed. 2.0:2006 (b), 100 pF, 1.5 kΩ, 3 times
MM	200 V Min.	IEC 60749-27 Ed. 2.0:2006 (b), 200 pF, 0 Ω, 1 time

[11] Reflow Profile

IPC/JEDEC J-STD-020D.1



[12] Packing Information

(12-1) SG3225EEN

(1) Packing Quantity

The last two digits of the Product Number (X1G005221xxxx**xx** / X1G005511xxxx**xx**) are a code that defines the packing quantity. The standard is "00" for a 2 000 pcs/Reel.

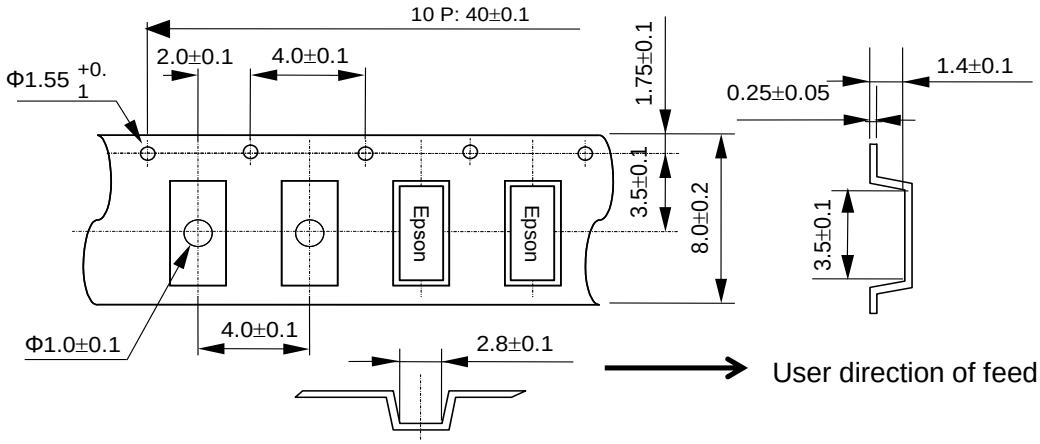
(2) Taping Specification

Subject to EIA-481, IEC-60286 and JIS C0806

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene)

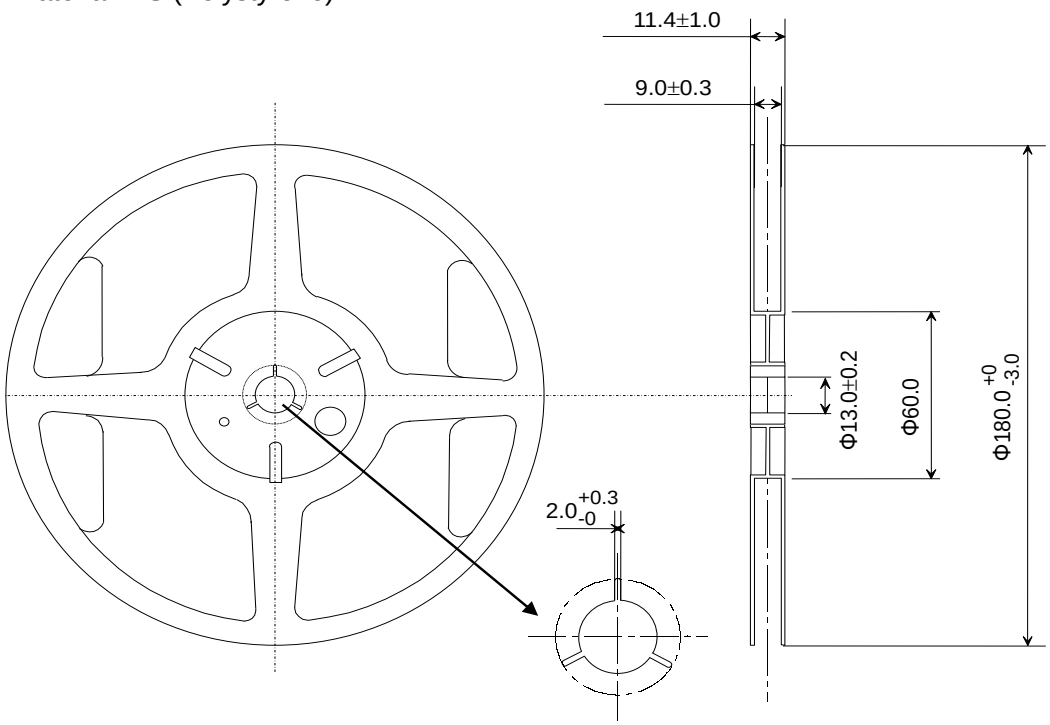
Top Tape Material: PET (Polyethylene Terephthalate) + PE (Polyethylene) Units: mm



2) Reel Dimensions

Center Material: PS (Polystyrene)

Reel Material: PS (Polystyrene) Units: mm



3) Storage Environment

We recommend to keep at normal temperature and normal humidity in a packed condition.

(12-2) SG5032EEN

(1) Packing Quantity

The last two digits of the Product Number (X1G005531xxxx**xx**) are a code that defines the packing quantity. The standard is "00" for a 1 000 pcs/Reel.

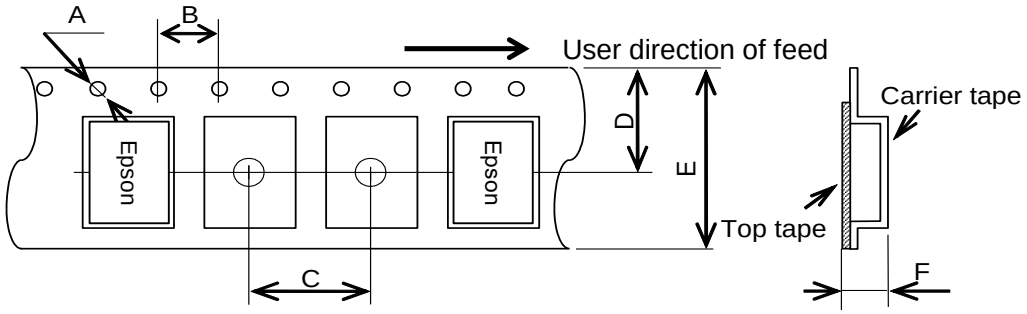
(2) Taping Specification

Subject to EIA-481, IEC-60286 and JIS C0806

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene)

Top Tape Material: PET (Polyethylene Terephthalate) Units: mm

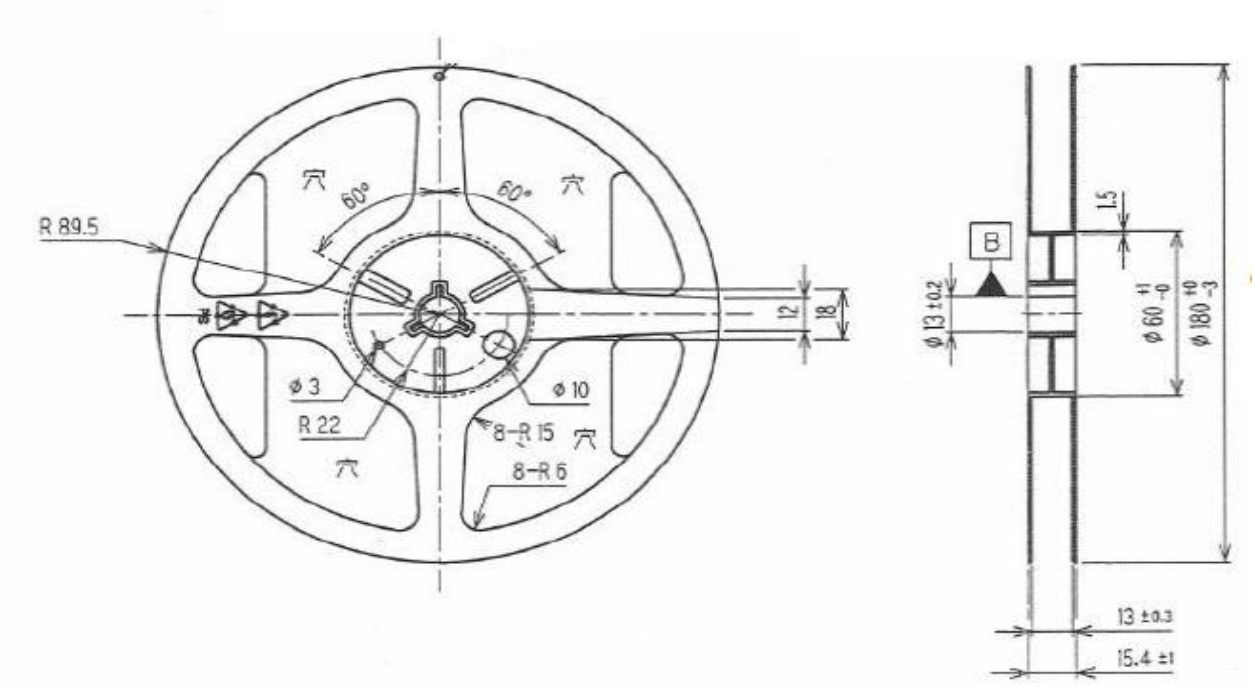


Symbol	A	B	C	D	E	F	G	H
Dimension	Φ1.5	4.0	8.0	7.25	12.0	1.7	3.5	5.4

2) Reel Dimensions

Center Material: PS (Polystyrene)

Reel Material: PS (Polystyrene) Units: mm



3) Storage Environment

We recommend to keep at normal temperature and normal humidity in a packed condition.

(12-3) SG7050EEN

(1) Packing Quantity

The last two digits of the Product Number (X1G005131xxxx**xx** / X1G005551xxxx**xx**) are a code that defines the packing quantity. The standard is "00" for a 1 000 pcs/Reel.

(2) Taping Specification

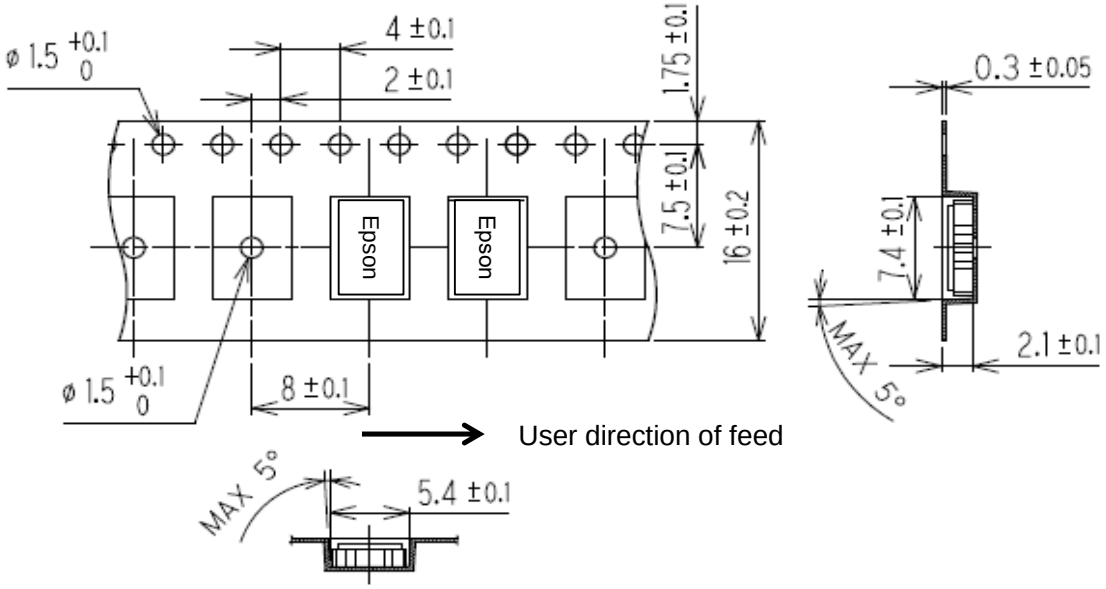
Subject to EIA-481, IEC-60286 and JIS C0806

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene)

Top Tape Material: PET (Polyethylene Terephthalate)

Units: mm

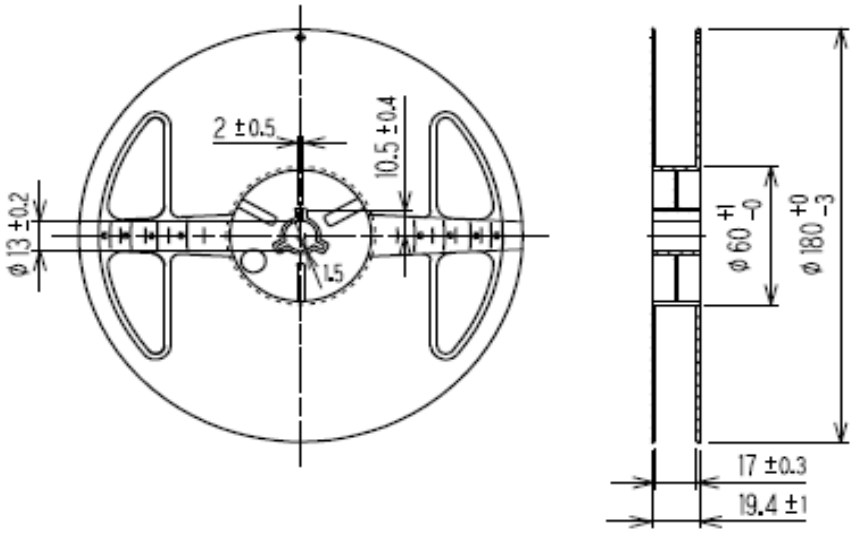


2) Reel Dimensions

Center Material: PS (Polystyrene)

Reel Material: PS (Polystyrene)

Units: mm



3) Storage Environment

We recommend to keep at normal temperature and normal humidity in a packed condition.

[13] Handling Precautions

Prior to using this product, please carefully read the section entitled “Precautions” on our Web site (https://www5.epsondevice.com/en/information/#precaution) for instructions on how to handle and use the product properly to ensure optimal performance of the product in your equipment.
Before using the product under any conditions other than those specified therein, please consult with Epson to verify and confirm that the performance of the product will not be negatively affected by use under such conditions.
In addition to the foregoing precautions, in order to avoid degrading the performance of the product, we strongly recommend that you DO NOT use the product under ANY of the following conditions:

(1) Mounting the product on a board using water-soluble solder flux without completely removing the flux residue from the board. The residue of such flux is soluble in water or water-soluble cleaning agents and the residue, especially the residues which contain active halogens, will negatively affect the performance and reliability of the product.
(2) Using the product in any manner that will result in any shock or impact to the product.
(3) Using the product in places where the product is exposed to water, chemicals, organic solvent, sunlight, dust, corrosive gasses, or other materials.
(4) Using the product in places where it is exposed to static electricity or electromagnetic waves.
(5) Applying ultrasonic cleaning without advance verification and confirmation that the product will not be affected by such a cleaning process which may damage the crystal.
(6) Using the product under any other conditions that may negatively affect the performance and/or reliability of the product.
(7) Using a power supply with ripple may cause of incorrect operation or degradation of phase noise characteristics, so please evaluate before use.
(8) Supply voltage should be increased monotonically.
In addition, please do not power on at midpoint potential since that may cause malfunction or not output.
(9) Frequency aging is calculated from environmental tests results to estimate the amount of frequency variation over time. This does not guarantee the length of the product's life-cycle.

Should any customer use the product in any manner contrary to the precautions and/or advice herein, such use shall be done at the customer’s own risk.

PROMOTION OF ENVIRONMENTAL MANAGEMENT SYSTEM CONFORMING TO INTERNATIONAL STANDARDS

At Seiko Epson, all environmental initiatives operate under the Plan-Do-Check-Action (PDCA) cycle designed to achieve continuous improvements. The environmental management system (EMS) operates under the ISO 14001 environmental management standard.

All of our major manufacturing and non-manufacturing sites, in Japan and overseas, completed the acquisition of ISO 14001 certification.

ISO 14000 is an international standard for environmental management that was established by the International Standards Organization in 1996 against the background of growing concern regarding global warming, destruction of the ozone layer, and global deforestation.

WORKING FOR HIGH QUALITY

In order provide high quality and reliable products and services than meet customer needs, Seiko Epson made early efforts towards obtaining ISO9000 series certification and has acquired ISO9001 for all business establishments in Japan and abroad. We have also acquired IATF 16949 certification that is requested strongly by major manufacturers as standard.

IATF 16949 is the international standard that added the sector-specific supplemental requirements for automotive industry based on ISO9001.

■ Explanation of marks used in this datasheet

Pb Free	**●Pb free.**
RoHS Compliant	**●Complies with EU RoHS directive.** *About the products without the Pb-free mark. Contains Pb in products exempted by EU RoHS directive (Contains Pb in sealing glass, high melting temperature type solder or other)