Crystal Oscillator (SPXO)

· Package size (3.2 mm × 2.5 mm × 1.05 mm)
· Fundamental mode SPXO
· Output: HCSL
· Reference weight Typ.26 mg

[1] Product Number / Product Name / Marking

(1-1) Product Number / Ordering Code

X1G0051410004xx

Last 2 digits code(**xx**) defines Quantity.
The standard is "00", 2 000 pcs/Reel.

(1-2) Product Name / Model Name

SG3225HBN 100.000000MHz CJGA

[2] Operating Range

Parameter	Symbol	Specifications			Unit	Conditions
		Min.	Typ.	Max.		
Supply voltage	V_{CC}	3.135	3.3	3.465	V	-
	GND	0	-	0	V	-
Operating temperature range	T_use	-40	-	85	°C	-
HCSL load condition	L_HCSL	-	50	-	Ω	-
	R_S	-	33	-	Ω	-

[3] Frequency Characteristics

(Unless stated otherwise [2] Operating Range)

Parameter	Symbol	Specifications			Unit	Conditions
		Min.	Typ.	Max.		
Output frequency	fo	-	100.000000	-	MHz	-
Frequency tolerance *1	f_tol	-50	-	+50	$\times 10^{-6}$	T_use

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

[4] Electrical Characteristics

(Unless stated otherwise [2] Operating Range)

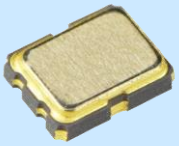
Parameter	Symbol	Specifications			Unit	Conditions
		Min.	Typ.	Max.		
Start-up time	t_str	-	-	10	ms	t = 0 at 90 % Vcc
Current consumption	I_{CC}	-	25	35	mA	OE = Vcc, with HCSL load condition
Disable current	I_dis	-	-	15	mA	OE = GND
Output voltage	V_{OH}	0.66	-	0.85	V	DC characteristics
	V_{OL}	-0.15	-	0.15	V	DC characteristics
Differential swing	V_{SW}	0.3	-	-	V	-
Crossing voltage	V_{CR}	0.25	-	0.55	V	-
Differential output rise slew rate	Rr	1	-	4	V/ns	Between -0.15 V and 0.15 V of differential output
Differential output fall slew rate	Rf	1	-	4	V/ns	Between -0.15 V and 0.15 V of differential output
Symmetry	SYM	45	50	55	%	At output crossing point
Input voltage	V_{IH}	70 % Vcc	-	-	V	OE Terminal
	V_{IL}	-	-	30 % Vcc	V	OE Terminal
Output disable time (OE)	tstp_oe	-	-	100	ns	OE terminal HIGH → LOW
Output enable time (OE)	tsta_oe	-	-	100	ns	OE terminal LOW → HIGH

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

Low Jitter Crystal Oscillator: SG3225HBN

Features

- HCSL Output, Low Jitter SPXO
- Phase Jitter: 180 fs Max.
  fo = 100 MHz, 12 kHz to 20 MHz RMS
- Frequency range: 100 MHz to 325 MHz
- Supply Voltage Options: 2.5 V Typ. / 3.3 V Typ.
- Frequency Tolerance Options: ±50 × 10^{-6}, ±100 × 10^{-6}
- Operating Temperature Options:
  -40 ºC to +85 ºC and -40 ºC to +105 ºC



(3.2 × 2.5 × 1.05 mm)

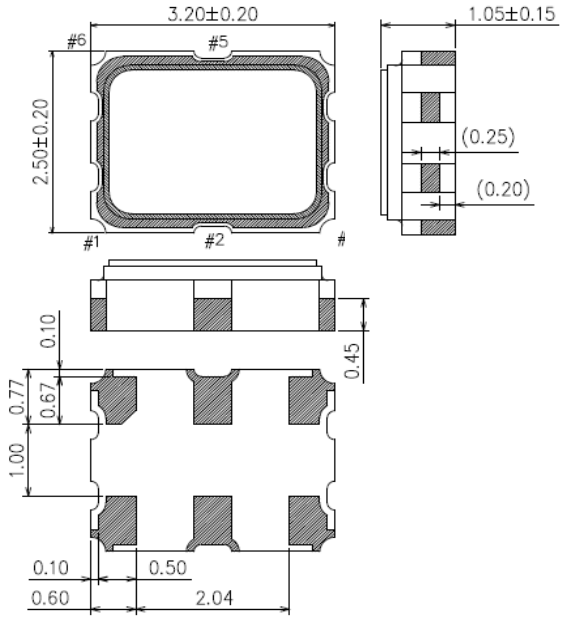
Applications

- Server
- NIC, HBA
- PCI Express® serial communications
- Various high-speed serial communications

Description

SG3225HBN is a low jitter, HCSL output crystal oscillator. This product is excellent as a PCI Express® reference clock meeting PCIe® 1.0 to PCIe® 5.0 jitter requirements

Outline Drawing

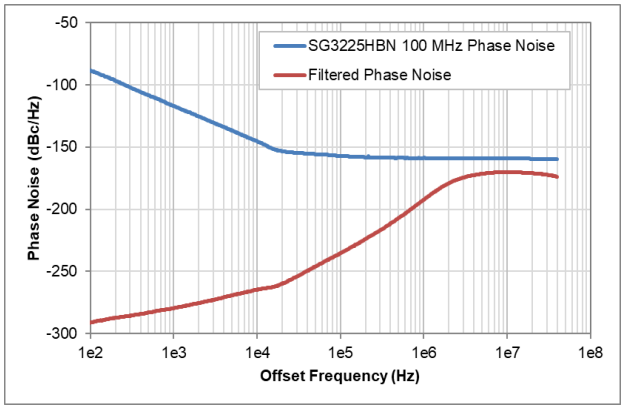


Typical Performance

Conform to PCIe® Jitter Requirement*

[Units: ps]

SG3225HBN	Gen3 limit	Gen4 limit	Gen5 limit
0.04	1.0	0.5	0.15



* PCI Express® Base Specification Revision 5.0
8.6.6 Common Refclk Rx Architecture (CC)
8.6.7 Jitter Limits for Refclk Architectures

Terminal Assignment

Pin #	Connection	Function	
#1	OE	OE terminal / active high	
		OE function	Output
		"H" or OPEN	Specified frequency is output: Enable
		"L"	Output becomes 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	

* PCI Express and PCIe are a registered trademark of PCI-SIG

[1] Product Number / Product Name

(1-1) Product Number

X1G005141xxxx00 (Please contact Epson for details)

(1-2) Product Name (Standard Form)

SG3225 H BN 156.250000MHz C J G A (⑤⑥: Unavailable code JH)

① ② ③ ④⑤⑥⑦

①Model ②Output(H: HCSL) 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	
J	±50 × 10^{-6}
L	±100 × 10^{-6}

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

[2] Absolute Maximum Ratings

Parameter	Symbol	Specification			Unit	Conditions
		Min.	Typ.	Max.		
Maximum supply voltage	V_{CC}	-0.5	-	4	V	-
Input voltage	Vin	-0.3	-	V_{CC} + 0.3	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
HCSL load condition	L_HCSL	50			Ω	

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

* A 0.1 µF and a 10 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	100	-	325	MHz	
Frequency tolerance *2	f_tol	-50	-	+50	×10^{-6}	Suffix: J T_use: G
		-100	-	+100	×10^{-6}	Suffix: L T_use: G or H

*1 Please contact Epson for available frequencies

*2 Frequency tolerance includes initial frequency tolerance, temperature variation, supply voltage change and 10 years aging at +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}	-	25	35	mA	
Disable current	I_dis	-	-	15	mA	OE = GND
Differential output rise slew rate	Rr	1	-	4	V/ns	Between -0.15 V and 0.15 V of differential output
Differential output fall slew rate	Rf	1	-	4	V/ns	
Symmetry	SYM	45	50	55	%	At output crossing point
Output voltage	V_{OH}	0.66	-	0.85	V	DC characteristics, fo ≤ 200 MHz
		0.57	-	0.77	V	DC characteristics, fo > 200 MHz
	V_{OL}	-0.15	-	0.15	V	DC characteristics
Differential swing	V_{SW}	0.3	-	-	V	
Crossing voltage	V_{CR}	0.25	-	0.55	V	
Crossing voltage variation	V_{DCR}	-	-	0.14	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	100 MHz ≤ fo ≤ 200 MHz
		-	-	200	ns	200 MHz < fo ≤ 325 MHz
Output enable time (OE)	tsta_oe	-	-	100	ns	100 MHz ≤ fo ≤ 200 MHz
		-	-	200	ns	200 MHz < fo ≤ 325 MHz
Phase jitter (12 kHz to 20 MHz)	t_{PJ}	-	-	180	fs	fo=100 MHz
		-	-	160	fs	fo=125 MHz
		-	-	140	fs	fo=156.25 MHz
		-	-	125	fs	fo=200 MHz
		-	-	110	fs	fo=322.265625 MHz

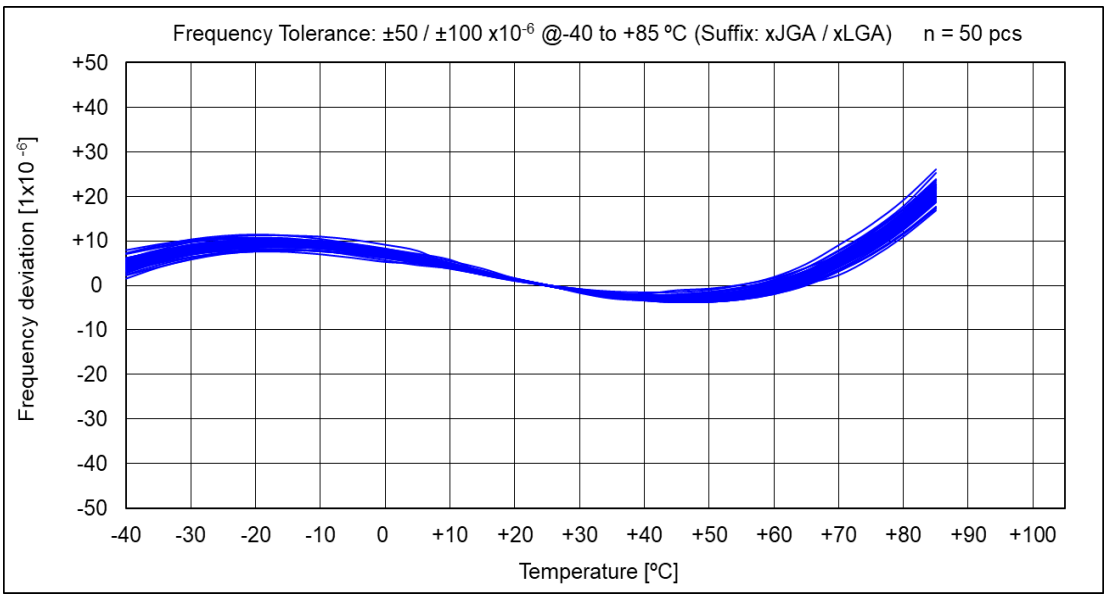
[6] Thermal resistance (For reference only)

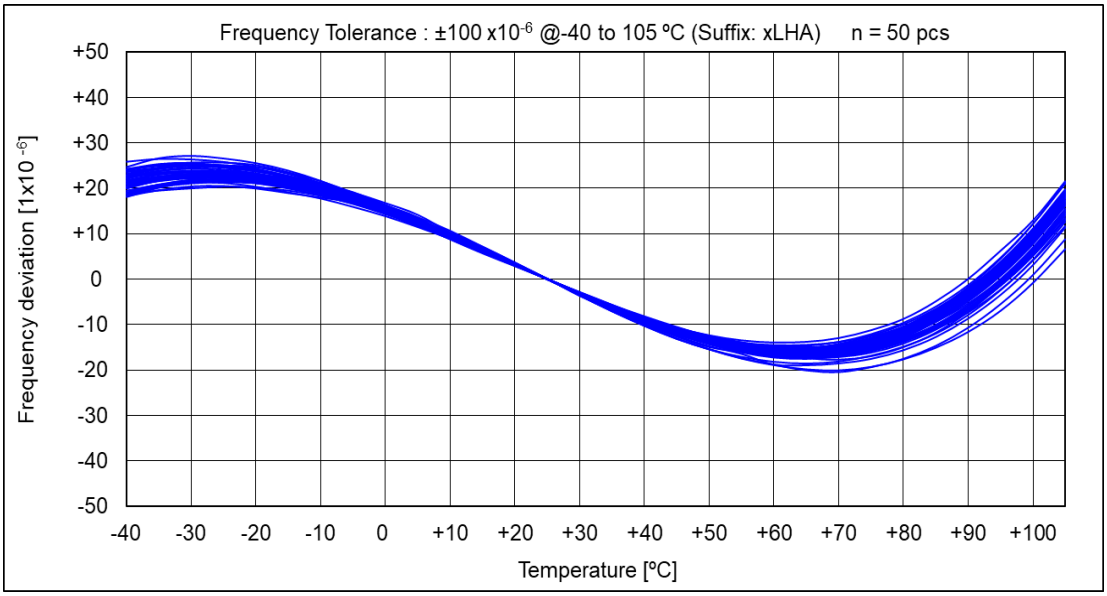
Parameter	Symbol	Specification			Unit	Conditions
		Min.	Typ.	Max.		
Junction temperature	Tj	-	-	125	ºC	
Junction to case	θjc	-	97.9	-	ºC/W	
Junction to ambient	θja	-	155.4	-	ºC/W	

[7] Typical Performance Characteristics (For reference only)

The following data shows typical performance characteristics

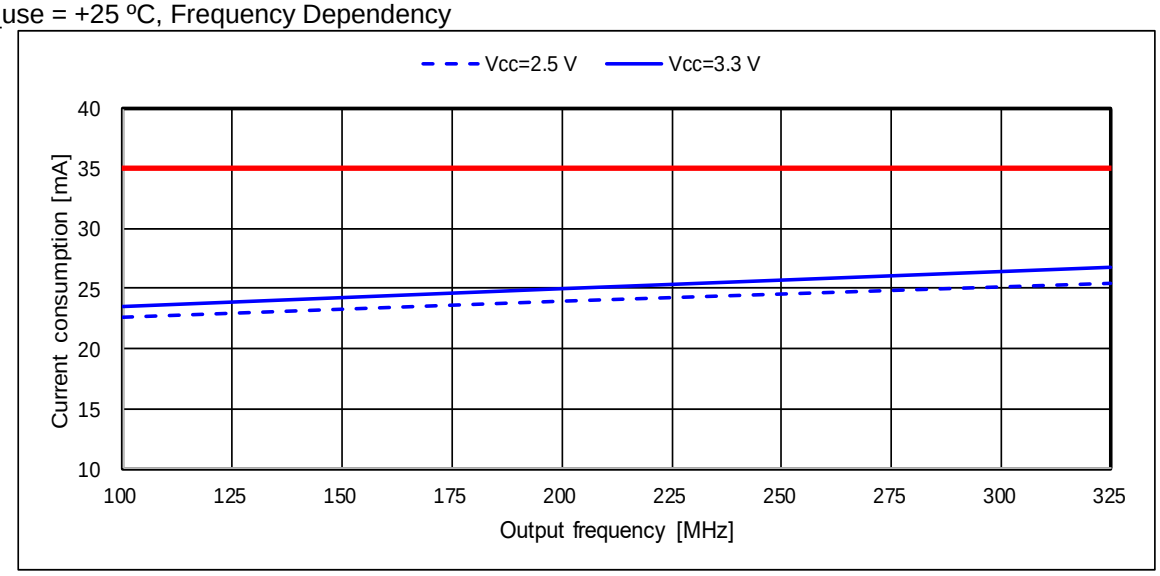
(7-1) Frequency / Temperature Characteristics



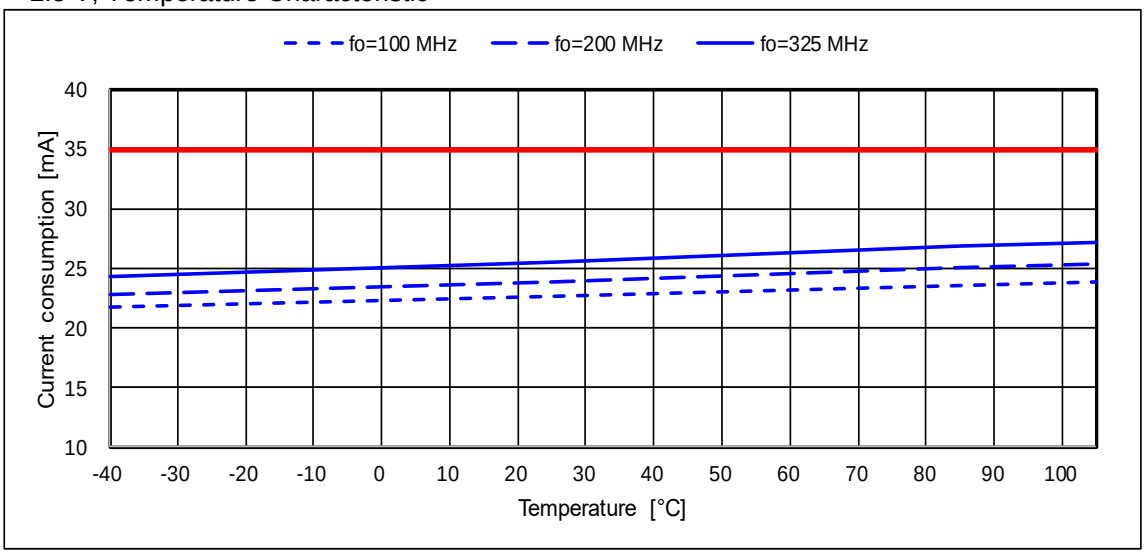


(7-2) Current Consumption

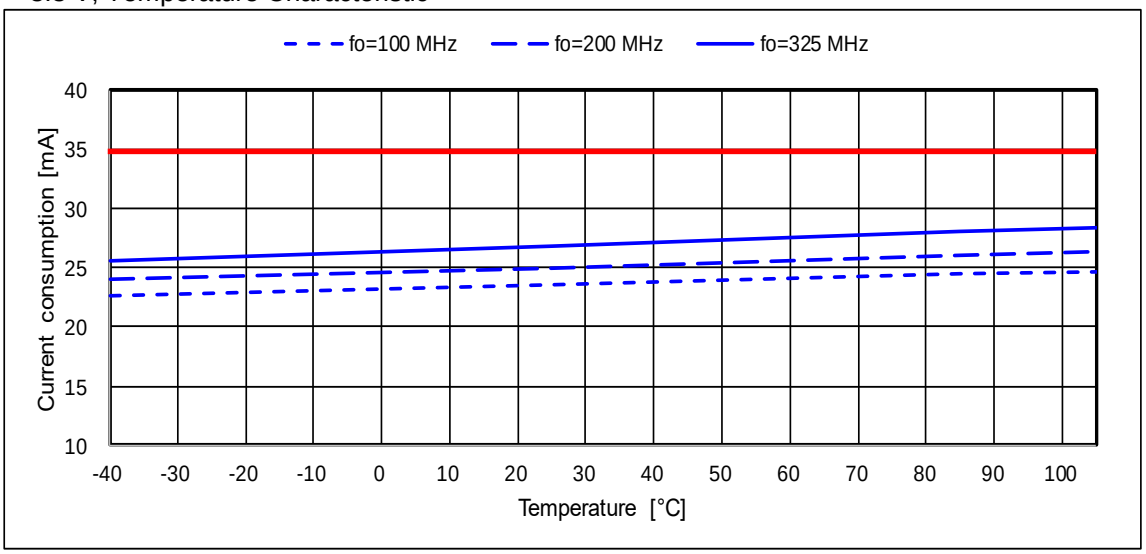
T_use = +25 ºC, Frequency Dependency



V_{CC} = 2.5 V, Temperature Characteristic



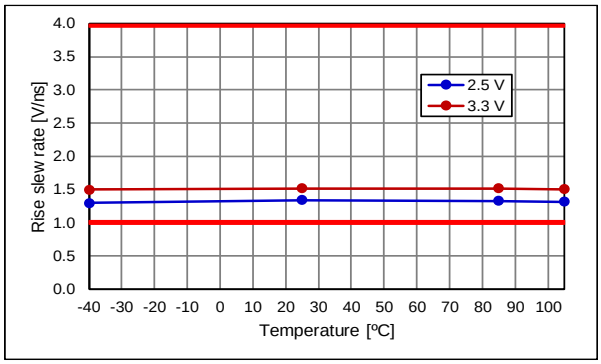
V_{CC} = 3.3 V, Temperature Characteristic



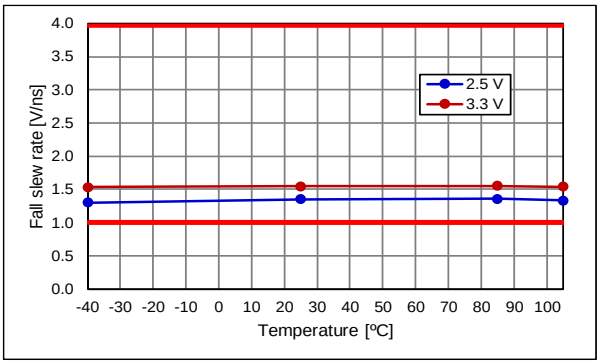
(7-3) Differential Output Rise / Fall Slew Rate Temperature Characteristic

fo = 100 MHz

Rise Slew Rate

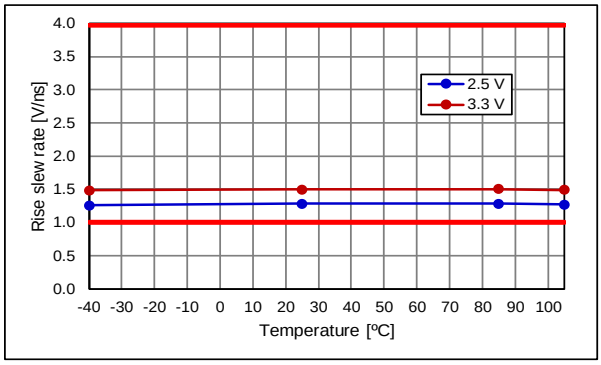


Fall Slew Rate

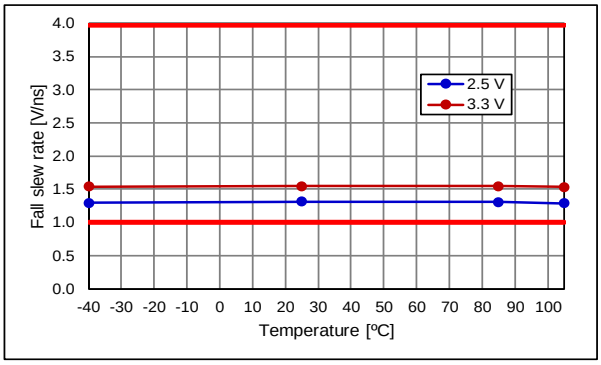


fo = 200 MHz

Rise Slew Rate

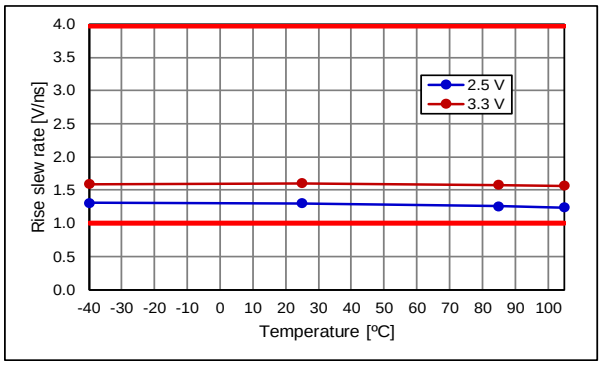


Fall Slew Rate

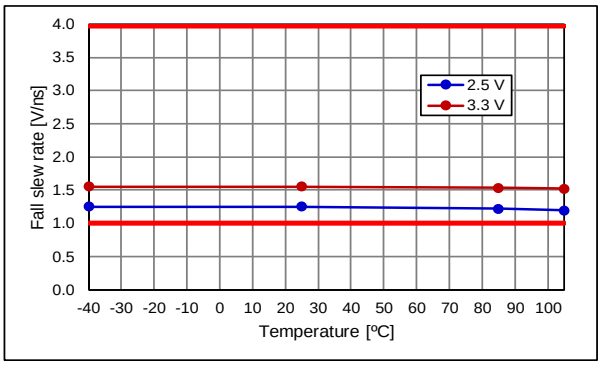


fo = 322.265625 MHz

Rise Slew Rate

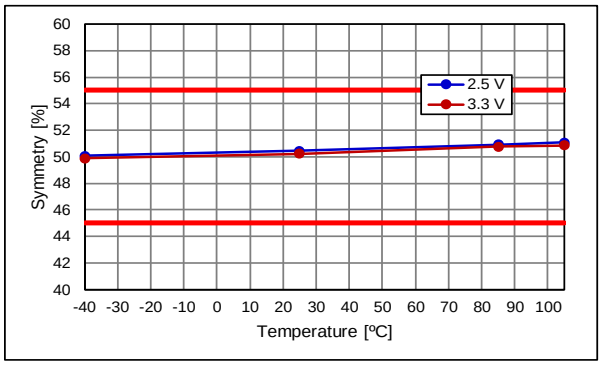


Fall Slew Rate

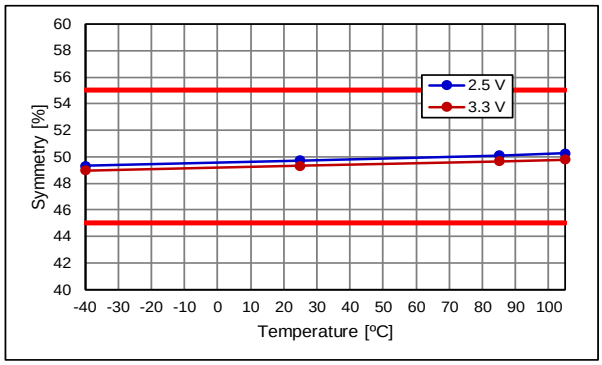


(7-4) Symmetry Temperature Characteristic

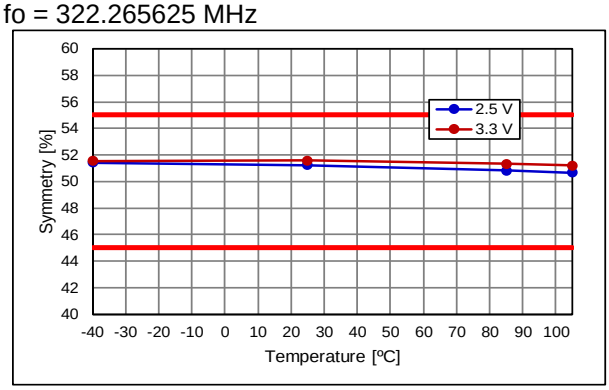
fo = 100 MHz



fo = 200 MHz

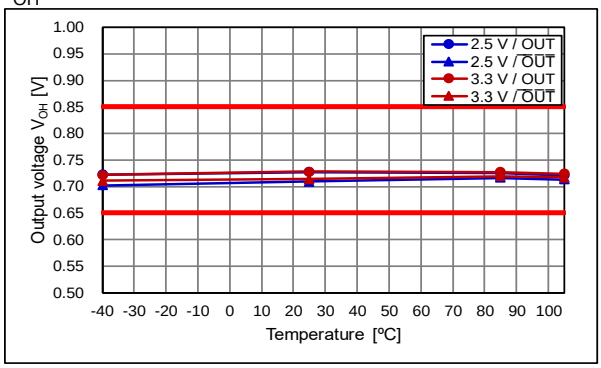


fo = 322.265625 MHz

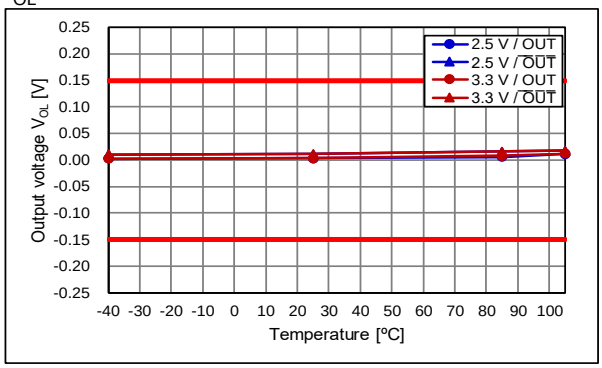


(7-5) Output Voltage Temperature Characteristic

V_{OH}

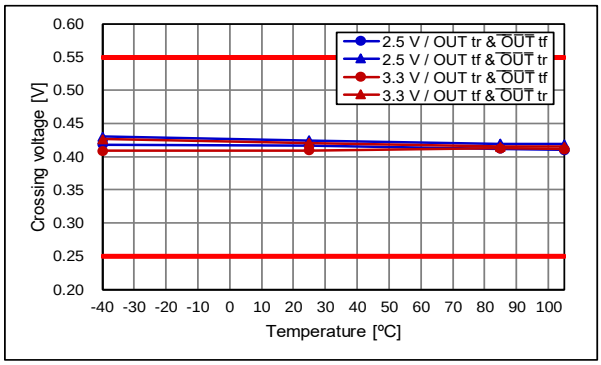


V_{OL}

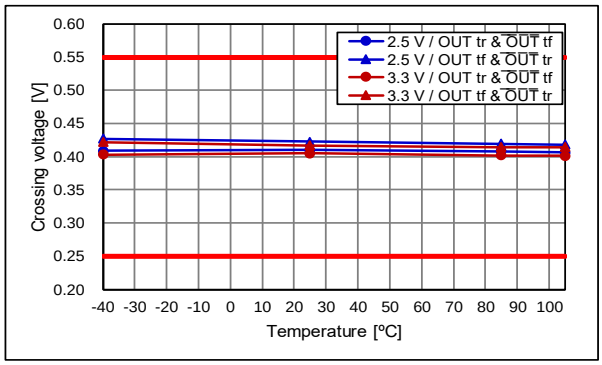


(7-6) Crossing Voltage Temperature Characteristic

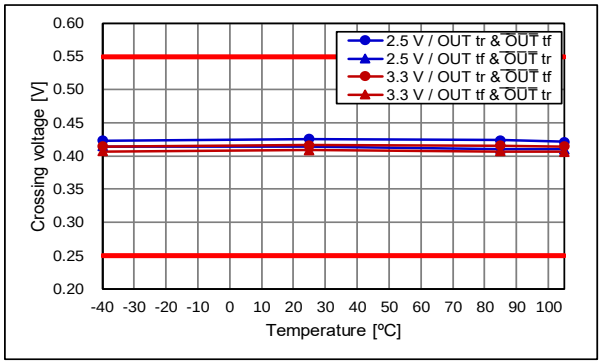
fo = 100 MHz



fo = 200 MHz

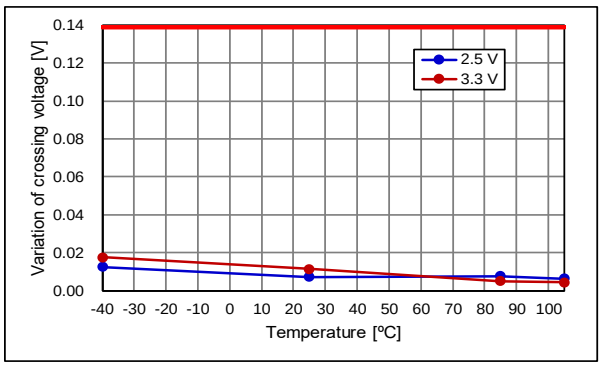


fo = 322.265625 MHz

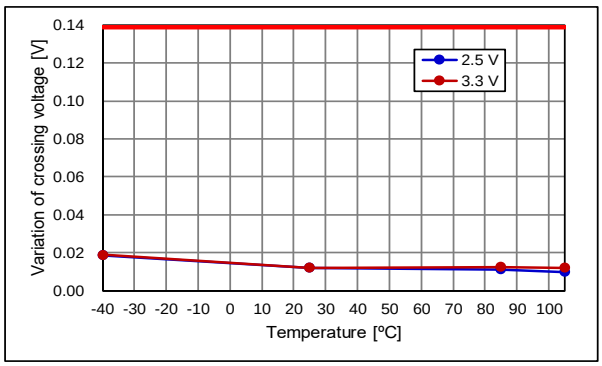


(7-7) Crossing Voltage Variation Temperature Characteristic

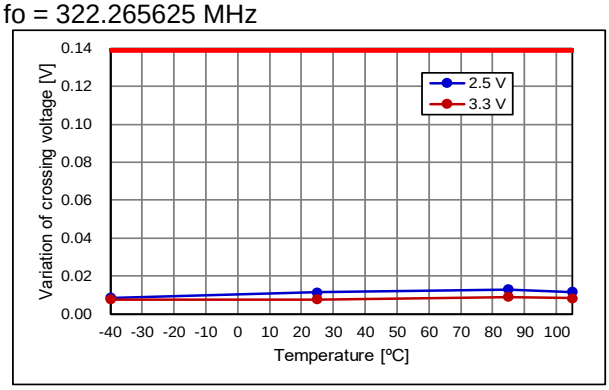
fo = 100 MHz



fo = 200 MHz

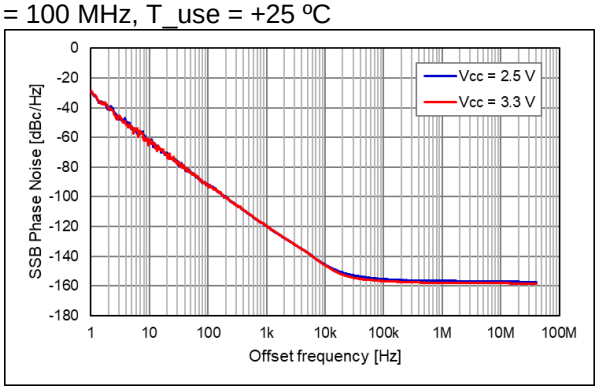


fo = 322.265625 MHz



(7-8) Phase Noise and Phase Jitter

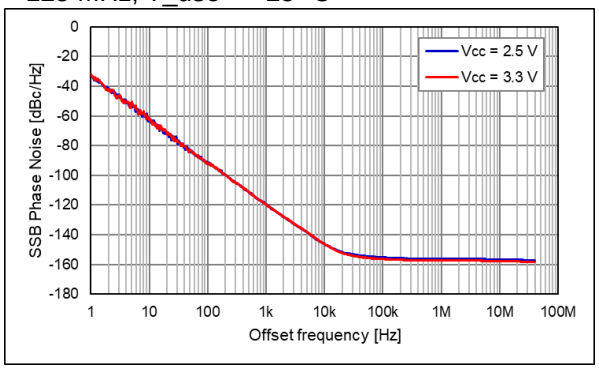
fo = 100 MHz, T_use = +25 ºC



V_{CC}	Phase Jitter*
2.5 V	126 fs
3.3 V	145 fs

* Offset frequency: 12 kHz to 20 MHz

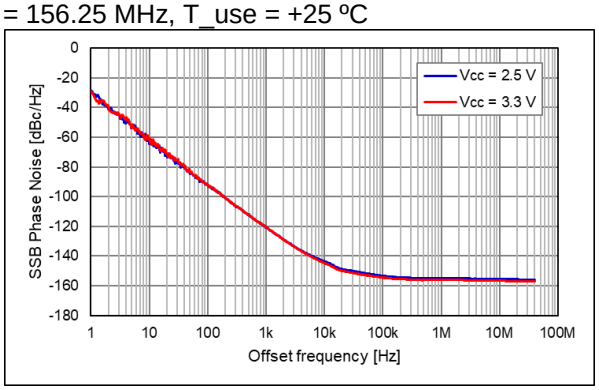
fo = 125 MHz, T_use = +25 ºC



V_{CC}	Phase Jitter*
2.5 V	121 fs
3.3 V	107 fs

* Offset frequency: 12 kHz to 20 MHz

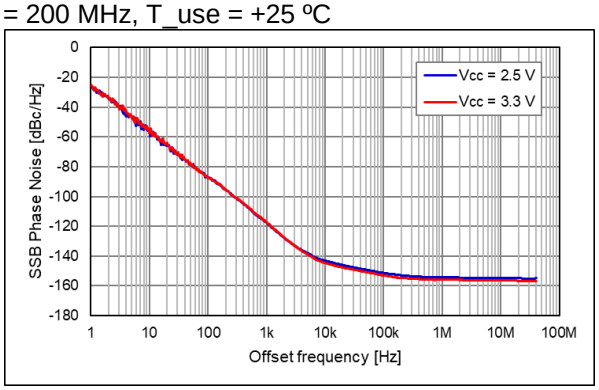
fo = 156.25 MHz, T_use = +25 ºC



V_{CC}	Phase Jitter*
2.5 V	110 fs
3.3 V	96 fs

* Offset frequency: 12 kHz to 20 MHz

fo = 200 MHz, T_use = +25 ºC

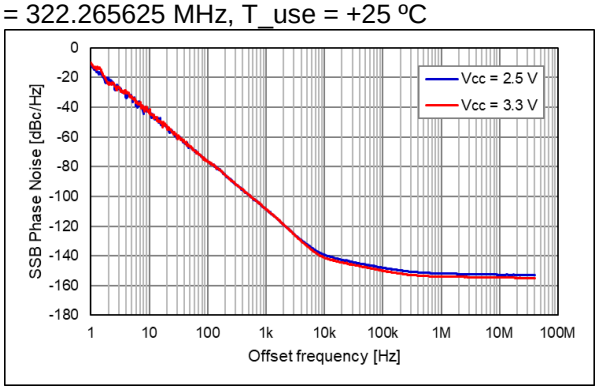


V_{CC}	Phase Jitter*
2.5 V	94 fs
3.3 V	78 fs

* Offset frequency: 12 kHz to 20 MHz

(7-8) Phase Noise and Phase Jitter [cont'd]

fo = 322.265625 MHz, T_use = +25 ºC

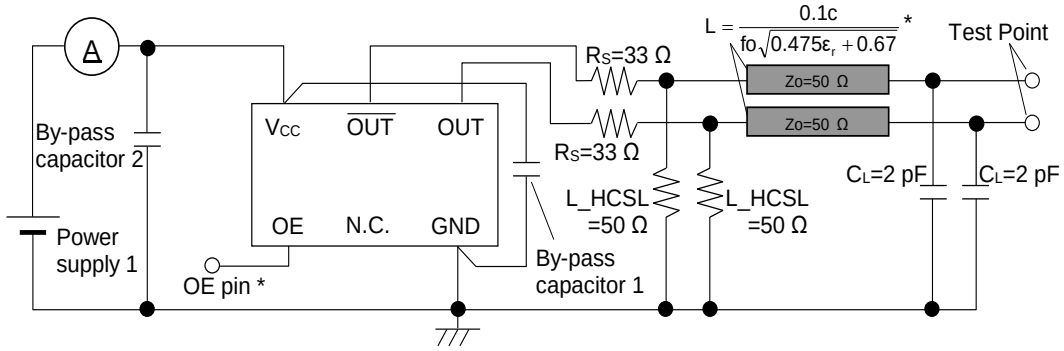


V_{CC}	Phase Jitter*
2.5 V	75 fs
3.3 V	60 fs

* Offset frequency: 12 kHz to 20 MHz

[8] Test Circuit

(8-1) Waveform Observation and Current Consumption Test Setup



* Each output trace should be same length

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

(8-2) Conditions

(1) Oscilloscope

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

The probe ground should be placed closely to the test point and the lead length should be as short as possible

(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

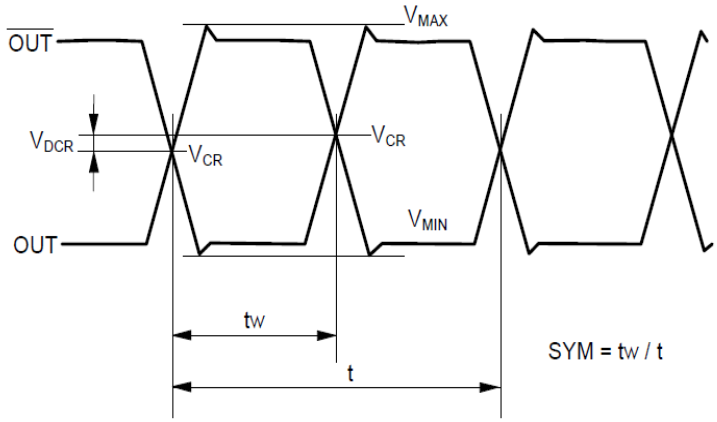
Power supply startup time (0 %V_{CC}→90 %V_{CC}) should be more than 150 µs

Power supply impedance should be as low as possible

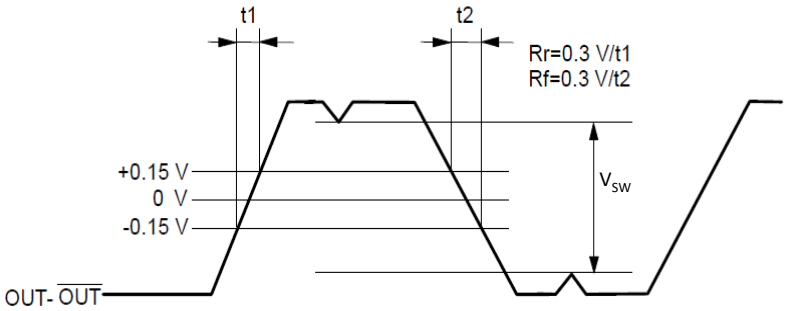
(8-3) Timing Chart

(1) Output Waveform and Level

OUT, $\overline{OUT}$ Output Waveform

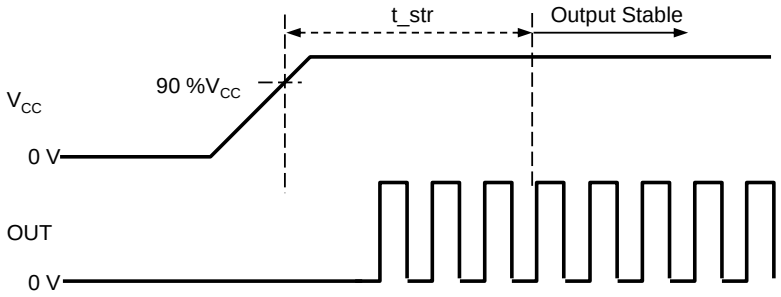


Differential Output Waveform



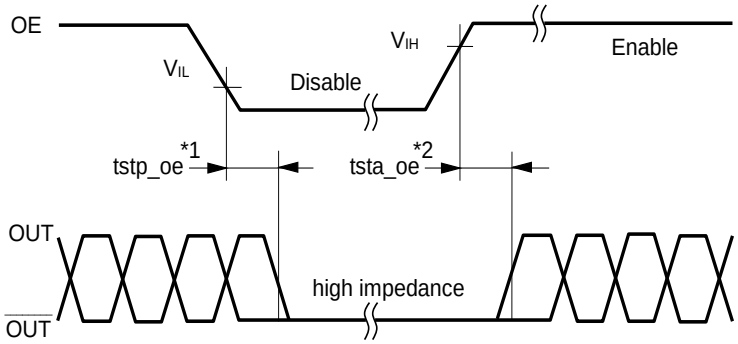
(8-3) Timing Chart (cont'd)

(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



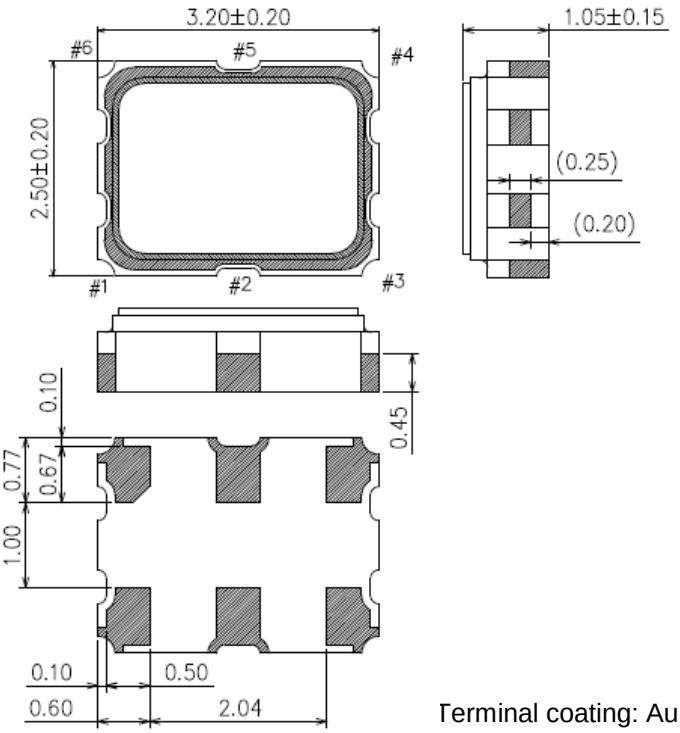
*1 The time from OE=V_{IL} to output = disable (high impedance)

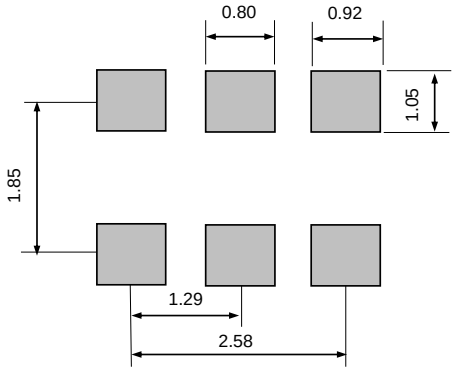
*2 The time from OE=V_{IH} to starting output

* OE level should not exceed supply voltage when using the OE function
Please note that during startup the OE votlage level should not exceed the supply voltage

[9] Outline Drawing and Recommended Footprint

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.

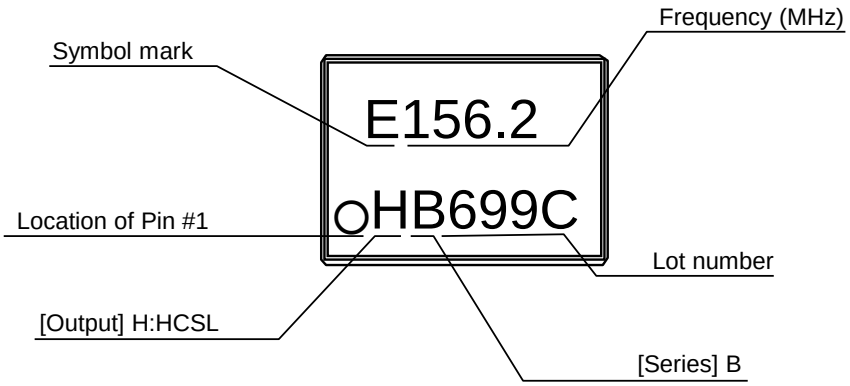
Terminal coating: Au plating

Reference weight Typ.: 25.6 mg

Terminal Assignment

Pin #	Connection	Function	
#1	OE	OE terminal / active high	
		OE function	Output
		"H" or OPEN	Specified frequency is output: Enable
		"L"	Output becomes 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)

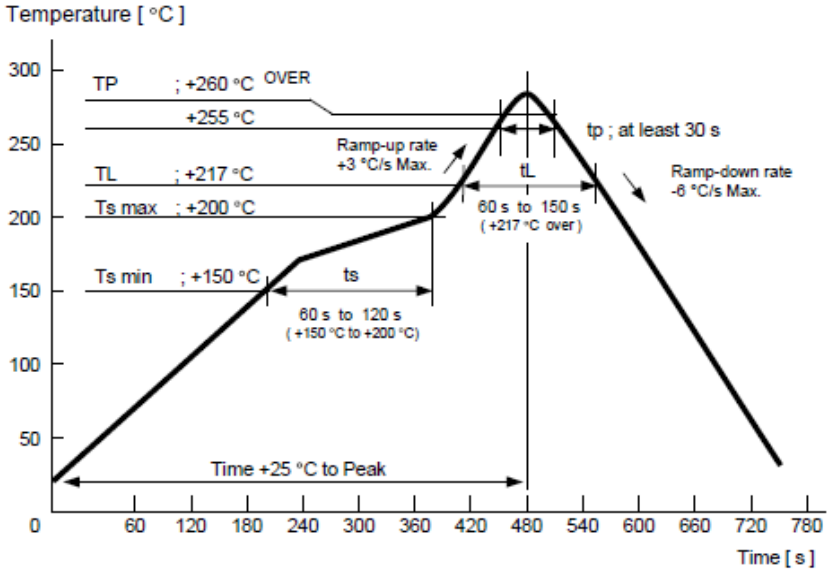
Parameter	Specification	Conditions
MSL	LEVEL 1	IPC/JEDEC J-STD-020D.1

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

Parameter	Specification	Conditions
HBM	2 000 V Min.	EIAJ ED-4701-1 C111A, 100 pF, 1.5 kΩ, 3 times
MM	200 V Min.	EIAJ ED-4701-1 C111, 200 pF, 0 Ω, 1 time

[11] Reflow Profile

IPC/JEDEC J-STD-020D.1



[12] Packing Information

(12-1) Packing Quantity

The last two digits of the Product Number (X1G005141xxxx**xx**) are a code that defines the packing quantity. The standard is "00" for a 2 000 pcs/Reel.

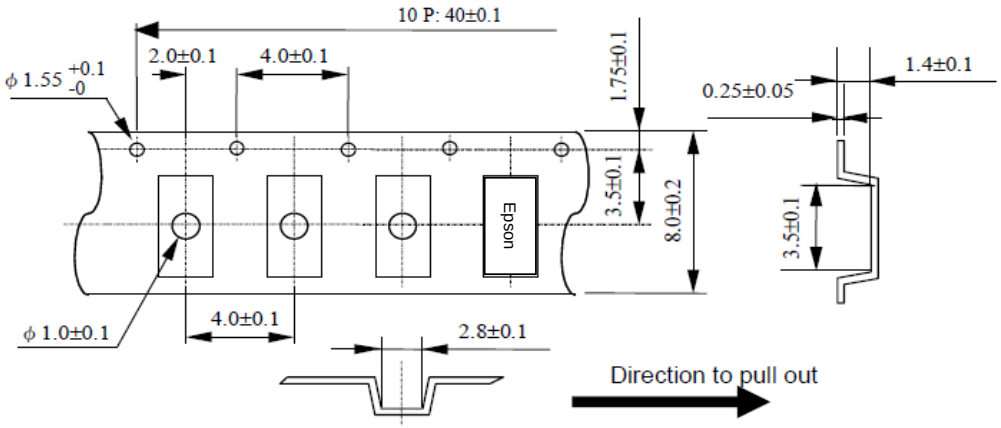
(12-2) Taping Specification

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

(1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene)

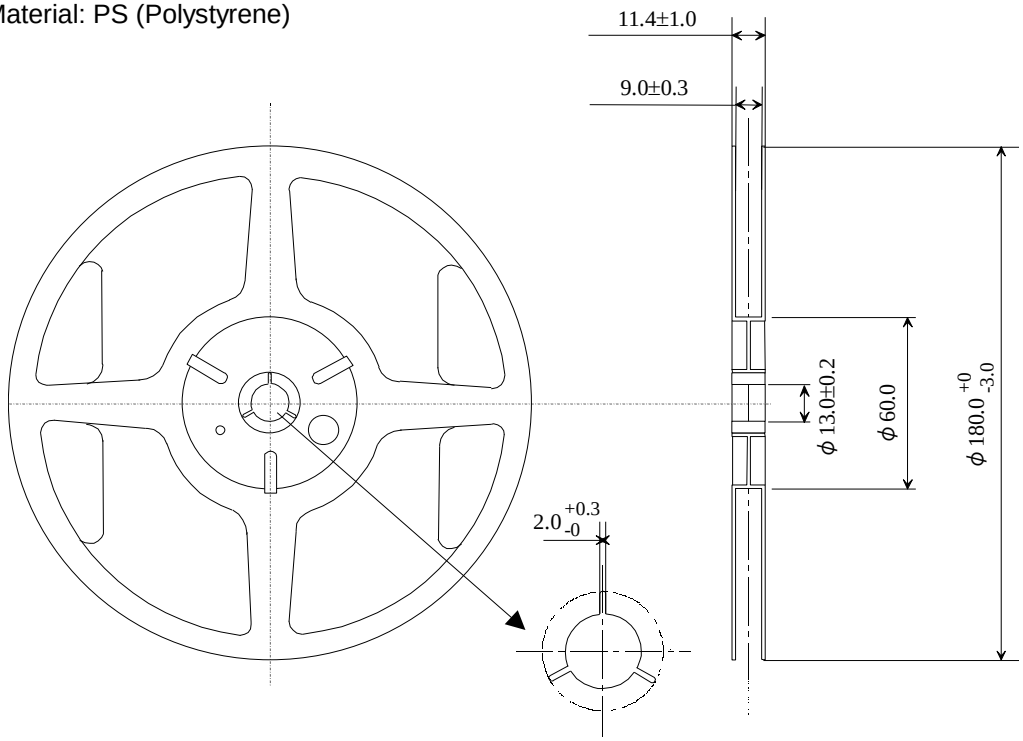
Top Tape Material: PET (Polyethylene Terephthalate) +PE (Polyethylene) Units: mm



(2) Reel Dimensions

Center Material: PS (Polystyrene) Units: mm

Reel Material: PS (Polystyrene)



(12-3) Storage Environment

We recommend to keep less than +30 ºC and 85 %RH of humidity in a packed condition, and to use it less than 6 months after delivery.

[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)