



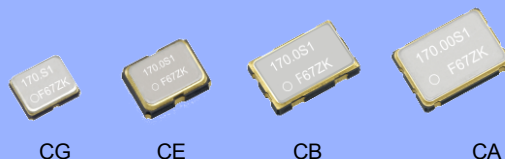
# CRYSTAL OSCILLATOR (Programmable) SPREAD SPECTRUM OUTPUT: CMOS

## SG-9101 series

- Frequency range : 0.67 MHz to 170 MHz (1 ppm Step)
- Supply voltage : 1.62 V to 3.63 V
- Function : Output enable (OE) or Standby ( $\overline{ST}$ )
- Down or Center spread modulation
- Configurable spreading
  - 3 modulation profile (Hershey-kiss, Sine-wave, Triangle),
  - 4 modulation frequency, 6 spread percentage
- Package : 2.5 x 2.0, 3.2 x 2.5, 5.0 x 3.2, 7.0 x 5.0 (mm)
- PLL technology to enable short lead time
- Available field oscillator programmer "SG-Writer II"



Product Number (please contact us)  
 SG-9101CA: X1G005301xxxx00  
 SG-9101CB: X1G005311xxxx00  
 SG-9101CE: X1G005321xxxx00  
 SG-9101CG: X1G005291xxxx00



### Specifications (characteristics)

| Item                                   |         | Symbol            | Specifications            |                  |                  |                                      | Conditions/Remarks                                                             |                                                            |                 |      |      |      |      |
|----------------------------------------|---------|-------------------|---------------------------|------------------|------------------|--------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------|-----------------|------|------|------|------|
| Supply voltage                         |         | V <sub>CC</sub>   | 1.80 V Typ.               |                  | 2.50 V Typ.      | 3.30 V Typ.                          | -                                                                              |                                                            |                 |      |      |      |      |
|                                        |         |                   | 1.62 V to 1.98 V          | 1.98 V to 2.20 V | 2.20 V to 2.80 V | 2.70 V to 3.63 V                     |                                                                                |                                                            |                 |      |      |      |      |
| Output frequency range                 |         | f <sub>o</sub>    | 0.67 MHz to 170 MHz       |                  |                  |                                      |                                                                                |                                                            |                 |      |      |      |      |
| Storage temperature                    |         | T <sub>stg</sub>  | -40 °C to +125 °C         |                  |                  |                                      | Storage as single product.                                                     |                                                            |                 |      |      |      |      |
| Operating temperature                  |         | T <sub>use</sub>  | -40 °C to +85 °C          |                  |                  |                                      |                                                                                |                                                            |                 |      |      |      |      |
|                                        |         |                   | -40 °C to +105 °C         |                  |                  |                                      |                                                                                |                                                            |                 |      |      |      |      |
| Frequency tolerance <sup>*1</sup>      |         | f <sub>tol</sub>  | ±50 × 10 <sup>-6</sup>    |                  |                  |                                      | Average frequency of 1s gate time.                                             |                                                            |                 |      |      |      |      |
| Current consumption                    |         | I <sub>CC</sub>   | 3.4 mA Max.               | 3.5 mA Max.      | 3.6 mA Max.      | 3.7 mA Max.                          | T <sub>use</sub> = +105 °C                                                     | No load, f <sub>o</sub> = 20 MHz                           |                 |      |      |      |      |
|                                        |         |                   | 2.9 mA Typ.               |                  | 3.0 mA Typ.      | 3.2 mA Typ.                          | T <sub>use</sub> = +25 °C                                                      |                                                            |                 |      |      |      |      |
|                                        |         |                   | 5.7 mA Max.               | 6.0 mA Max.      | 6.9 mA Max.      | 8.3 mA Max.                          | T <sub>use</sub> = +105 °C                                                     | No load, f <sub>o</sub> = 170 MHz                          |                 |      |      |      |      |
|                                        |         |                   | 4.9 mA Typ.               |                  | 5.9 mA Typ.      | 7.0 mA Typ.                          | T <sub>use</sub> = +25 °C                                                      |                                                            |                 |      |      |      |      |
| Output disable current                 |         | I <sub>dis</sub>  | 3.4 mA Max.               | 3.4 mA Max.      | 3.5 mA Max.      | 3.7 mA Max.                          | OE = GND, f <sub>o</sub> = 170 MHz                                             |                                                            |                 |      |      |      |      |
| Standby current                        |         | I <sub>std</sub>  | 0.9 µA Max.               | 1.0 µA Max.      | 1.5 µA Max.      | 2.5 µA Max.                          | T <sub>use</sub> = +105 °C                                                     | ST = GND                                                   |                 |      |      |      |      |
|                                        |         |                   | 0.3 µA Typ.               | 0.4 µA Typ.      | 0.5 µA Typ.      | 1.1 µA Typ.                          | T <sub>use</sub> = +25 °C                                                      |                                                            |                 |      |      |      |      |
| Symmetry                               |         | SYM               | 45 % to 55 %              |                  |                  |                                      | 50 % V <sub>CC</sub> Level                                                     |                                                            |                 |      |      |      |      |
| Output voltage<br>(DC characteristics) |         | V <sub>OH</sub>   | 90 % V <sub>CC</sub> Min. |                  |                  |                                      | I <sub>OH</sub> /I <sub>OL</sub> Conditions [mA]                               |                                                            |                 |      |      |      |      |
|                                        |         |                   |                           |                  |                  |                                      | Rise/Fall time                                                                 |                                                            | V <sub>CC</sub> | *A   | *B   | *C   | *D   |
|                                        |         |                   |                           |                  |                  |                                      |                                                                                |                                                            |                 |      |      |      |      |
|                                        |         |                   |                           |                  |                  |                                      | Default (f <sub>o</sub> > 40 MHz),<br>Fast                                     |                                                            | I <sub>OH</sub> | -2.5 | -3.5 | -4.0 | -5.0 |
|                                        |         | I <sub>OL</sub>   | 2.5                       | 3.5              | 4.0              | 5.0                                  |                                                                                |                                                            |                 |      |      |      |      |
|                                        |         | V <sub>OL</sub>   | 10 % V <sub>CC</sub> Max. |                  |                  |                                      | Default (f <sub>o</sub> ≤ 40 MHz)                                              |                                                            | I <sub>OH</sub> | -1.5 | -2.0 | -2.5 | -3.0 |
|                                        |         |                   |                           |                  |                  |                                      |                                                                                |                                                            | I <sub>OL</sub> | 1.5  | 2.0  | 2.5  | 3.0  |
|                                        |         |                   |                           |                  |                  |                                      | Slow                                                                           |                                                            | I <sub>OH</sub> | -1.0 | -1.5 | -2.0 | -2.5 |
| I <sub>OL</sub>                        | 1.0     |                   |                           |                  |                  |                                      |                                                                                |                                                            | 1.5             | 2.0  | 2.5  |      |      |
| Output load condition                  |         | L <sub>CMOS</sub> | 15 pF Max.                |                  |                  |                                      | -                                                                              |                                                            |                 |      |      |      |      |
| Input voltage                          |         | V <sub>IH</sub>   | 70 % V <sub>CC</sub> Min. |                  |                  |                                      |                                                                                |                                                            |                 |      |      |      |      |
|                                        |         | V <sub>IL</sub>   | 30 % V <sub>CC</sub> Max. |                  |                  |                                      | OE or ST                                                                       |                                                            |                 |      |      |      |      |
| Rise and Fall<br>time                  | Default | tr/ff             | 3.0 ns Max.               |                  |                  | f <sub>o</sub> > 40 MHz              |                                                                                | 20 % - 80 % V <sub>CC</sub> ,<br>L <sub>CMOS</sub> = 15 pF |                 |      |      |      |      |
|                                        |         |                   | 6.0 ns Max.               |                  |                  | f <sub>o</sub> ≤ 40 MHz              |                                                                                |                                                            |                 |      |      |      |      |
|                                        | Fast    |                   | 3.0 ns Max.               |                  |                  | f <sub>o</sub> = 0.67 MHz to 170 MHz |                                                                                |                                                            |                 |      |      |      |      |
|                                        |         |                   | 10.0 ns Max.              |                  |                  | f <sub>o</sub> = 0.67 MHz to 20 MHz  |                                                                                |                                                            |                 |      |      |      |      |
| Disable Time                           |         | t <sub>stp</sub>  | 1 µs Max.                 |                  |                  |                                      | Measured from the time OE or ST pin crosses 30 % V <sub>CC</sub>               |                                                            |                 |      |      |      |      |
| Enable Time                            |         | t <sub>sta</sub>  | 1 µs Max.                 |                  |                  |                                      | Measured from the time OE pin crosses 70 % V <sub>CC</sub>                     |                                                            |                 |      |      |      |      |
| Resume Time                            |         | t <sub>res</sub>  | 3 ms Max.                 |                  |                  |                                      | Measured from the time ST pin crosses 70 % V <sub>CC</sub>                     |                                                            |                 |      |      |      |      |
| Start-up time                          |         | t <sub>str</sub>  | 3 ms Max.                 |                  |                  |                                      | Measured from the time V <sub>CC</sub> reaches its rated minimum value, 1.62 V |                                                            |                 |      |      |      |      |

\*1 Frequency tolerance includes initial frequency tolerance, temperature variation, supply voltage variation, reflow drift, load drift and aging (+25 °C, 1 year).

### Spread spectrum configuration

|   |                             |                   |         |        |         |        |        |        |
|---|-----------------------------|-------------------|---------|--------|---------|--------|--------|--------|
| ④ | C: Center spread modulation | ③Code             | 02      | 05     | 07      | 10     | 15     | 20     |
|   |                             | Spread percentage | ±0.25 % | ±0.5 % | ±0.75 % | ±1.0 % | ±1.5 % | ±2.0 % |
|   | D: Down spread modulation   | ③Code             | 05      | 10     | 15      | 20     | 30     | 40     |
|   |                             | Spread percentage | -0.5 %  | -1.0 % | -1.5 %  | -2.0 % | -3.0 % | -4.0 % |

Modulation frequency: 25.4 kHz (default), 6.3 kHz, 8.5 kHz, 12.7 kHz

Modulation profile: Hershey-kiss (default), Sine-wave, Triangle

### Product Name

SG-9101CG 170.000000MHz C 20 P H A A A

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

|                     |
|---------------------|
| ②Package Type       |
| CA: 7.0 mm x 5.0 mm |
| CB: 5.0 mm x 3.2 mm |
| CE: 3.2 mm x 2.5 mm |
| CG: 2.5 mm x 2.0 mm |

|                  |
|------------------|
| ④Spread type     |
| C: Center spread |
| D: Down spread   |

|                        |
|------------------------|
| ⑦Operating temperature |
| G: -40 °C to +85 °C    |
| H: -40 °C to +105 °C   |

|                           |
|---------------------------|
| ⑨Modulation profile       |
| A: Hershey-kiss (default) |
| B: Sine-wave              |
| C: Triangle               |

|                  |
|------------------|
| ⑥Function        |
| P: Output enable |
| S: Standby       |

|                       |
|-----------------------|
| ⑧Modulation frequency |
| A: 25.4 kHz (default) |
| B: 12.7 kHz           |
| C: 8.5 kHz            |
| D: 6.3 kHz            |

|                 |
|-----------------|
| ⑩Rise/Fall time |
| A: Default      |
| B: Fast         |
| C: Slow         |

- ①Model, ②Package type, ③Frequency,  
 ④Spread type, ⑤Spread percentage code,  
 ⑥Function, ⑦Operating temperature,  
 ⑧Modulation frequency, ⑨Modulation profile, ⑩Rise/Fall time



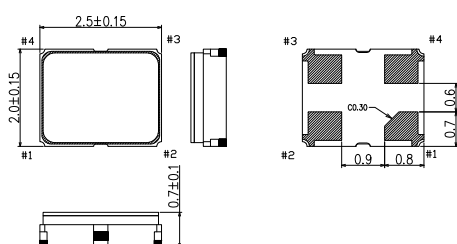
## Pin description

| Pin | Name                   | I/O type | Function                                                                                                                                                                         |
|-----|------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | OE                     | Input    | Output enable                                                                                                                                                                    |
|     |                        |          | High: Specified frequency output from OUT pin<br>Low: Out pin is low (weak pull down), only output driver is disabled.                                                           |
|     | $\overline{\text{ST}}$ | Input    | Standby                                                                                                                                                                          |
|     |                        |          | High: Specified frequency output from OUT pin<br>Low: Out pin is low (weak pull down),<br>Device goes to standby mode. Supply current reduces to the least as $I_{\text{std}}$ . |
| 2   | GND                    | Power    | Ground                                                                                                                                                                           |
| 3   | OUT                    | Output   | Clock output                                                                                                                                                                     |
| 4   | $V_{\text{CC}}$        | Power    | Power supply                                                                                                                                                                     |

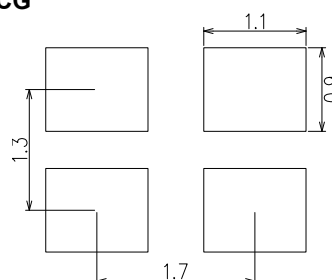
## External dimensions

(Unit: mm)

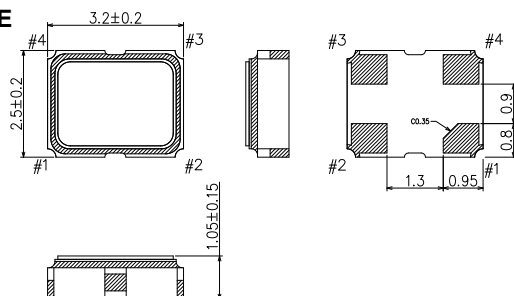
## SG-9101CG



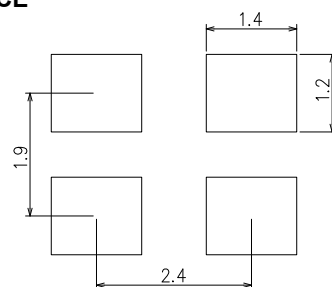
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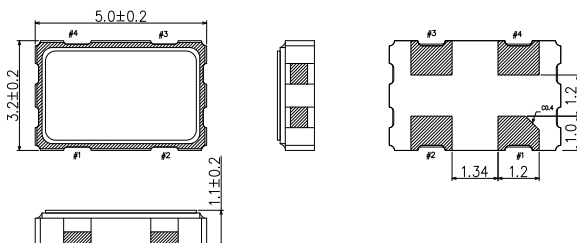
## SG-9101CE



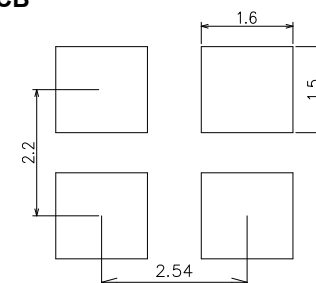
## SG-9101CE



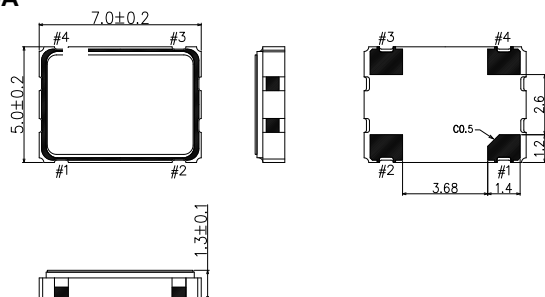
## SG-9101CB



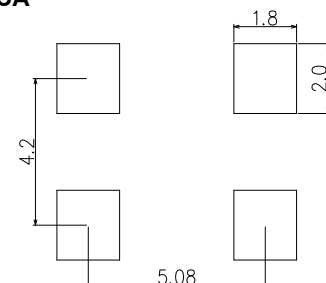
## SG-9101CB



## SG-9101CA



## SG-9101CA



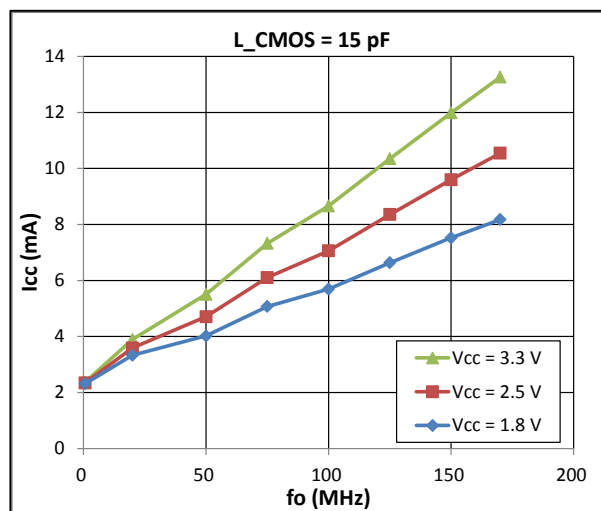
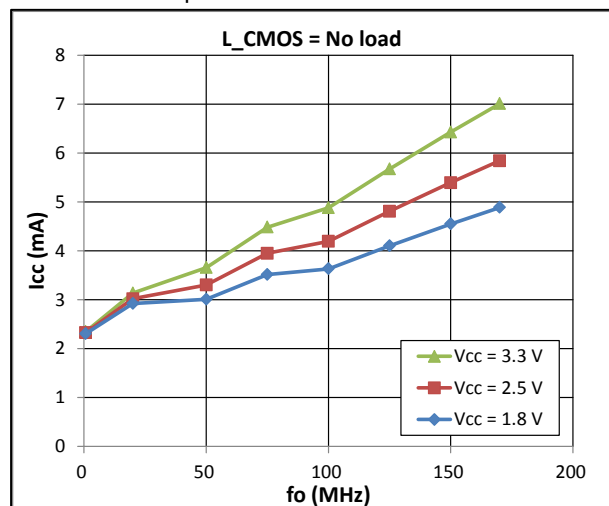
## ■ Notes:

In order to achieve optimum jitter performance, the 0.1  $\mu\text{F}$  capacitor between  $V_{\text{CC}}$  and GND should be placed. It is also recommended that the capacitors are placed on the device side of the PCB, as close to the device as possible and connected together with short wiring pattern.

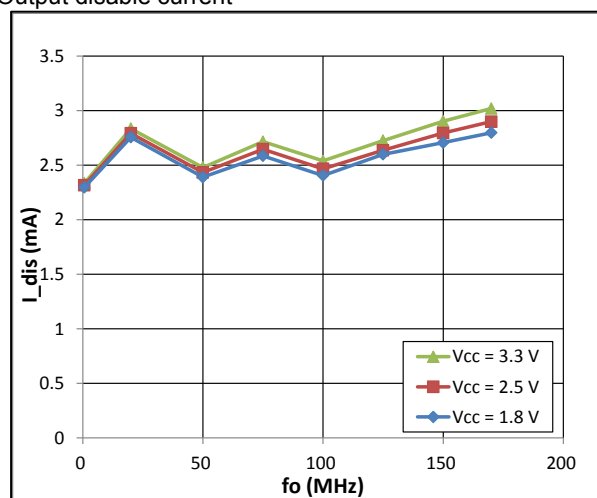


Specification Graph (Typical supplemental specification. Unless otherwise specified  $T_{\text{use}} = 25^\circ\text{C}$ ,  $L_{\text{CMOS}} = 15\text{pF}$ )

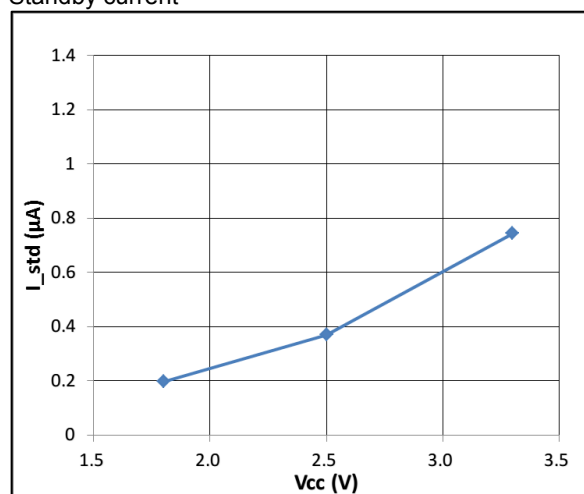
## Current Consumption



## Output disable current



## Standby current

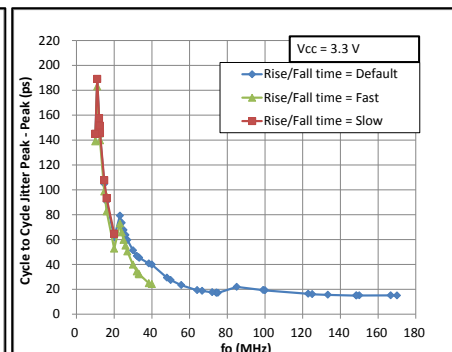
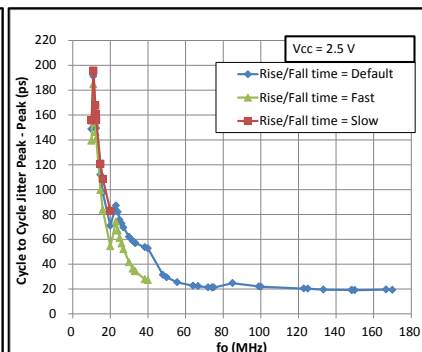
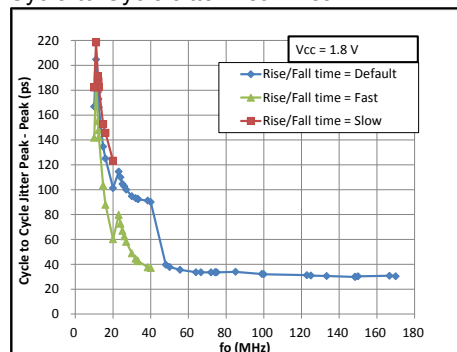


## ■ Notes:

Spread percentage :  $\pm 2.0\%$ , Modulation frequency : 25.4 kHz, Modulation profile : Hershey-kiss

Specification Graph (Typical supplemental specification. Unless otherwise specified  $T_{\text{use}} = 25^\circ\text{C}$ ,  $L_{\text{CMOS}} = 15\text{pF}$ )

## Cycle-to-Cycle Jitter Peak-Peak



## ■ Notes:

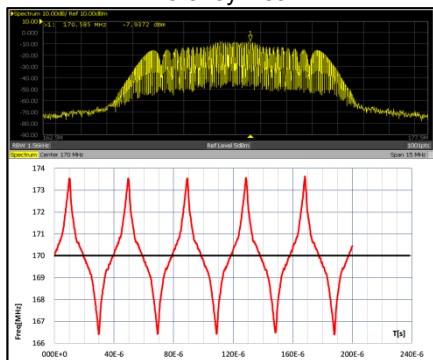
Spread percentage :  $\pm 2.0\%$ , Modulation frequency : 25.4 kHz, Modulation profile : Hershey-kiss



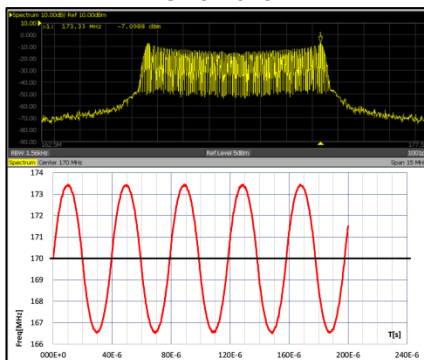
## Spread Spectrum Specification Graph

Spread Spectrum Profile  $f_o = 170 \text{ MHz}$  / Spread spectrum :  $\pm 2.0 \%$  / Modulation frequency :  $25.4 \text{ kHz}$ 

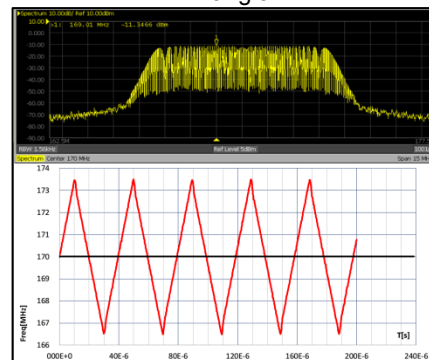
Hershey-kiss



Sine-wave



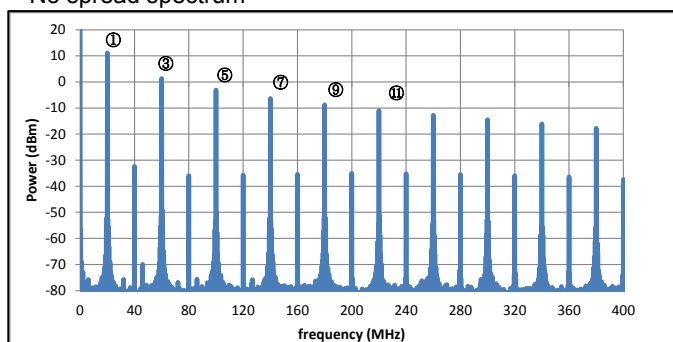
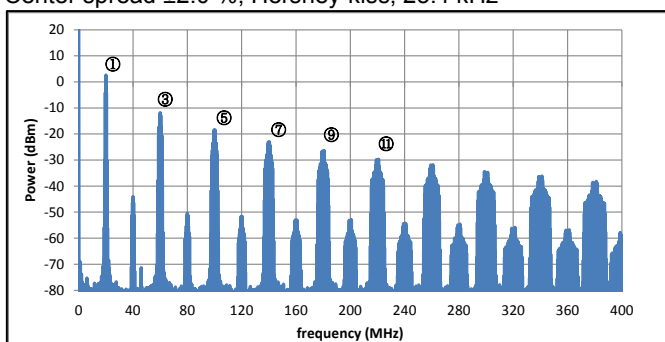
Triangle



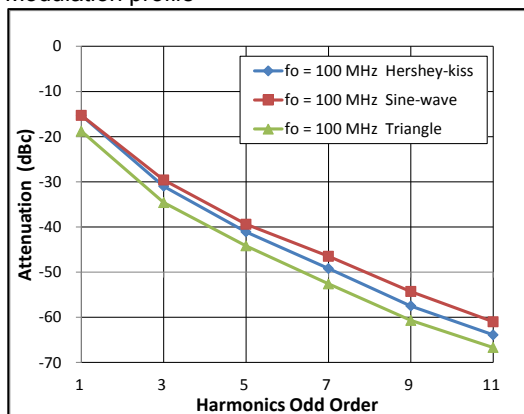
## Harmonics Specification Graph

(Typical supplemental specification. Unless otherwise specified  $T_{\text{use}} = 25^\circ\text{C}$ ,  $L_{\text{CMOS}} = 15 \text{ pF}$ ,  $V_{\text{CC}} = 3.3 \text{ V}$ )Harmonics spectrum ( $f_o = 20 \text{ MHz}$ )

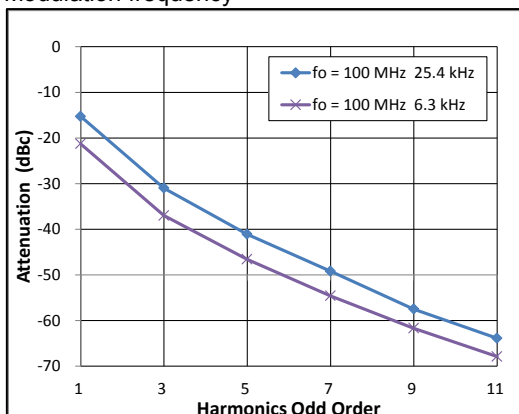
No spread spectrum

Center spread  $\pm 2.0 \%$ , Hershey-kiss,  $25.4 \text{ kHz}$ 

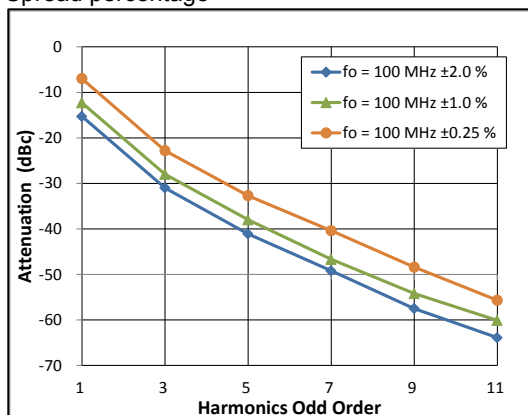
## Modulation profile



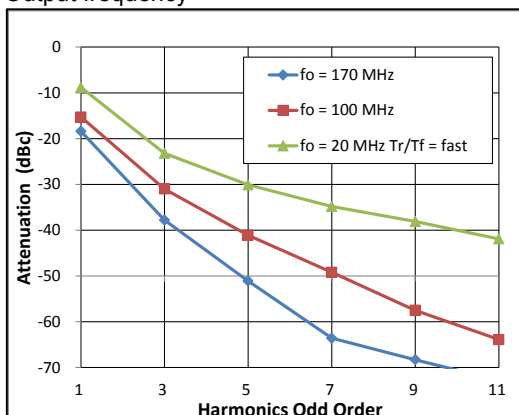
## Modulation frequency



## Spread percentage



## Output frequency

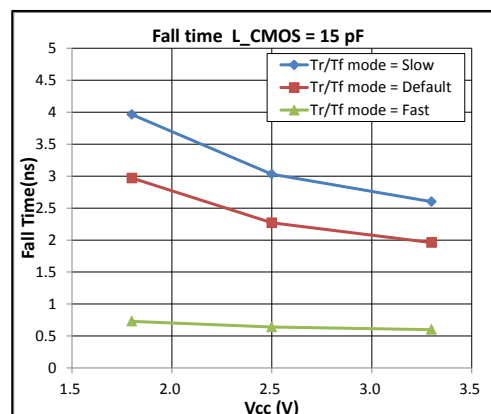
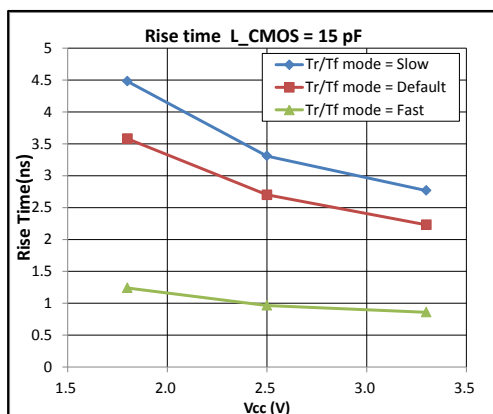
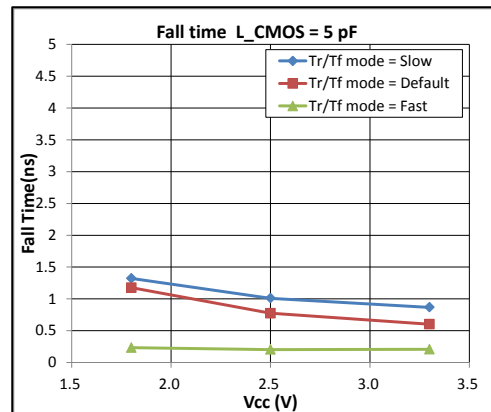
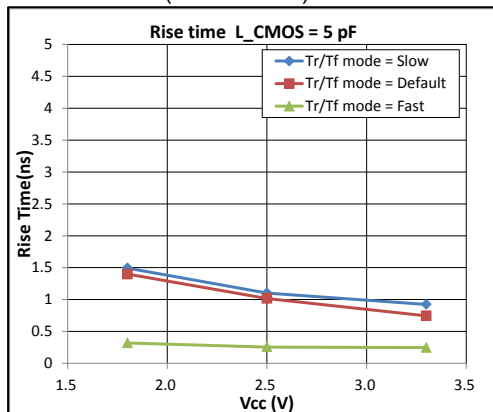


## Notes:

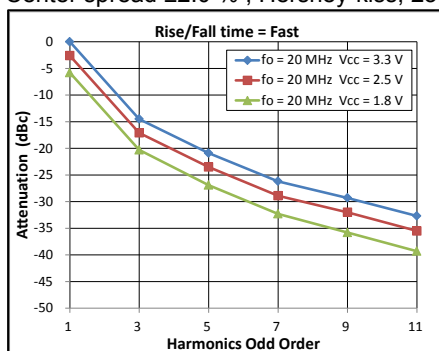
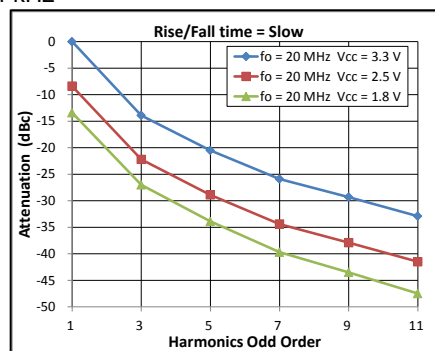
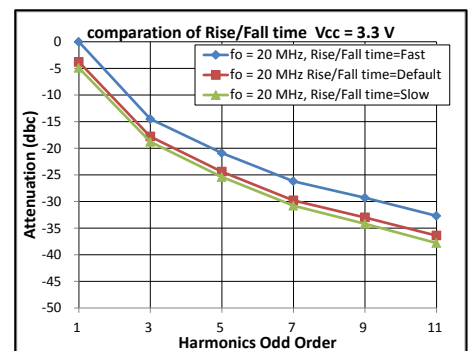
Harmonics order attenuation is normalizing to no-spread spectrum mode.



## Specification Graph

(Typical supplemental specification. Unless otherwise specified  $T_{\text{use}} = 25^{\circ}\text{C}$ ,  $L_{\text{CMOS}} = 15\text{ pF}$ ,  $V_{\text{CC}} = 3.3\text{ V}$ )Rise/Fall Time ( $f_o = 20\text{ MHz}$ )

## Harmonics comparison

Center spread  $\pm 2.0\%$ , Hershey-kiss, 25.4 kHzNormalize to  $V_{\text{CC}} = 3.3\text{ V}$ .Normalize to  $V_{\text{CC}} = 3.3\text{ V}$ .

Normalize to Rise/Fall time = "Fast".

## Notes:

| frequency       | slow     | default     | fast     |
|-----------------|----------|-------------|----------|
| 0.67 M – 20 MHz | See Slow | See Default | See Fast |
| 20 M – 40 MHz   | -        | See Default | See Fast |
| 40 M – 170 MHz  | -        | See Fast    | See Fast |



## Simulation Model

- IBIS Model is available upon request. Please contact us.  
Information Required: Oscillator operating condition (i.e. Power Supply, Rise/Fall Time, Temperature)

## ESD Rating

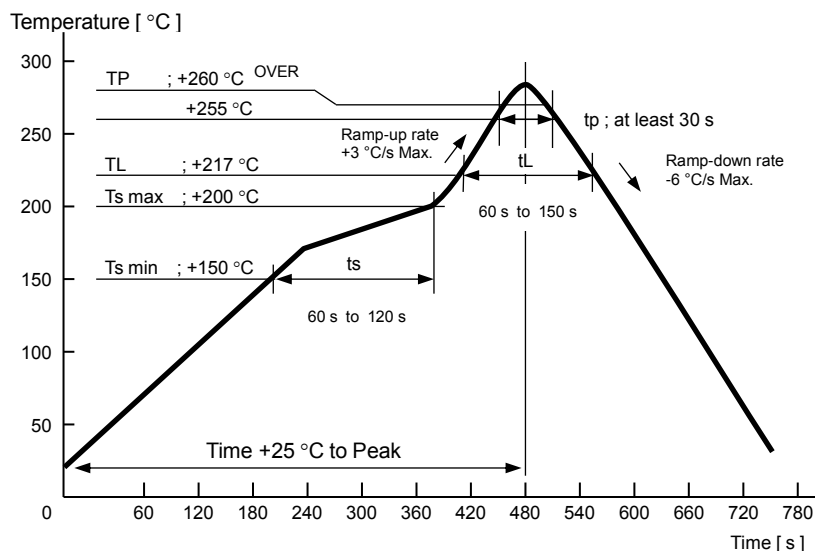
| Test items                 | Breakdown voltage |
|----------------------------|-------------------|
| Human Body Model (HBM)     | 2 000 V           |
| Machine Model (MM)         | 250 V             |
| Charged Device Model (CDM) | 750 V             |

## Device Material &amp; Environmental Information

| Model     | Package Dimensions | # of Pins | Reference Weight (Typ.) | Terminal Material | Terminal Plating | Complies With EU RoHS | Pb Free | MSL Rating | Peak Temp. (Max) |
|-----------|--------------------|-----------|-------------------------|-------------------|------------------|-----------------------|---------|------------|------------------|
| SG-9101CG | 2.5x2.0x0.7 mm     | 4         | 13 mg                   | W                 | Au               | Yes                   | Yes     | 1          | 260 °C           |
| SG-9101CE | 3.2x2.5x1.0 mm     | 4         | 25 mg                   | W                 | Au               | Yes                   | Yes     | 1          | 260 °C           |
| SG-9101CB | 5.0x3.2x1.1 mm     | 4         | 51 mg                   | W                 | Au               | Yes                   | Yes     | 1          | 260 °C           |
| SG-9101CA | 7.0x5.0x1.3 mm     | 4         | 143 mg                  | W                 | Au               | Yes                   | Yes     | 1          | 260 °C           |

## SMD products Reflow profile(example)

The availability of the heat resistance for reflow conditions of JEDEC-STD-020D.01 is judged individually. Please inquire.



|  |                                                                                                                                                                                                                                                                                                                            |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"><li>Pb free.</li></ul>                                                                                                                                                                                                                                                                   |
|  | <ul style="list-style-type: none"><li>Complies with EU RoHS directive.<ul style="list-style-type: none"><li>About the products without the Pb-free mark.<br/>Contains Pb in products exempted by EU RoHS directive.<br/>(Contains Pb in sealing glass, high melting temperature type solder or other.)</li></ul></li></ul> |

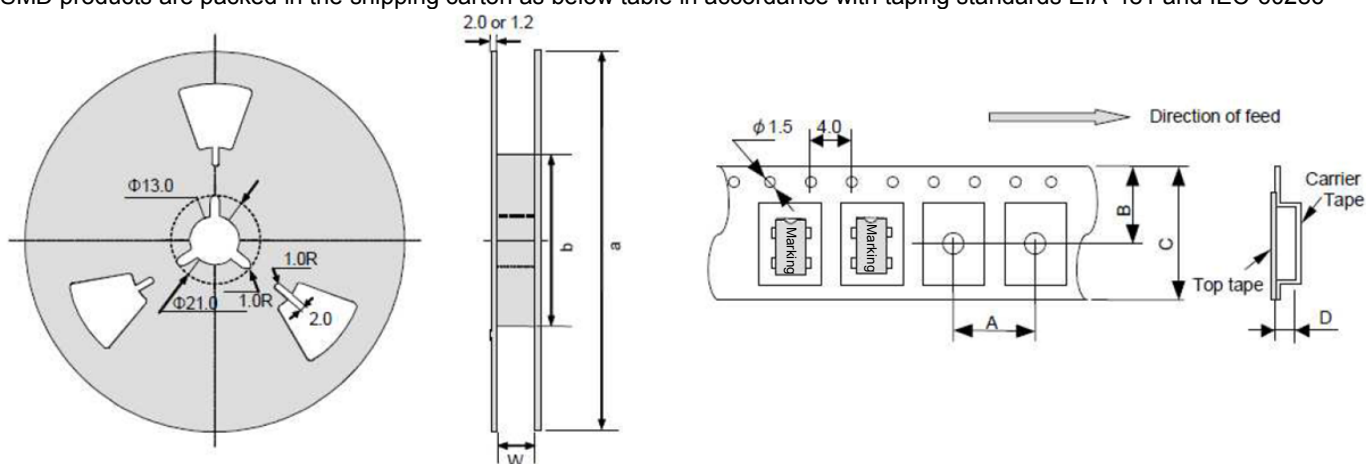


## Device Marking

| Model     | Factory Programmed Part Marking | Field Programmable Part Marking<br>(Blank Samples) |
|-----------|---------------------------------|----------------------------------------------------|
| SG-9101CG |                                 |                                                    |
| SG-9101CE |                                 |                                                    |
| SG-9101CB |                                 |                                                    |
| SG-9101CA |                                 |                                                    |

## Standard Packing Specification

SMD products are packed in the shipping carton as below table in accordance with taping standards EIA-481 and IEC-60286



## Standard Packing Quantity &amp; Dimension (Unit mm)

| Model     | Quantity<br>(pcs/Reel) | Reel Dimension |      |      | Career Tape Dimension |      |    |      | Direction of<br>Feed (L= Left<br>Direction) |
|-----------|------------------------|----------------|------|------|-----------------------|------|----|------|---------------------------------------------|
|           |                        | a              | b    | W    | A                     | B    | C  | D    |                                             |
| SG-9101CG | 3000                   | Φ180           | Φ60  | 9    | 4                     | 5.25 | 8  | 1.15 | L                                           |
| SG-9101CE | 2000                   | Φ180           | Φ60  | 9    | 4                     | 5.25 | 8  | 1.4  | L                                           |
| SG-9101CB | 1000                   | Φ180           | Φ60  | 13   | 8                     | 7.25 | 12 | 1.4  | L                                           |
| SG-9101CA | 1000                   | Φ254           | Φ100 | 17.5 | 8                     | 9.25 | 16 | 2.3  | L                                           |

## 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 ISO/TS 16949 certification that is requested strongly by major automotive manufacturers as standard.

ISO/TS16949 is the international standard that added the sector-specific supplemental requirements for automotive industry based on ISO9001.

### ► Explanation of the mark that are using it for the catalog

|                                                                                     |                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | ► Pb free.                                                                                                                                                                                                                      |
|  | ► Complies with EU RoHS directive.<br>*About the products without the Pb-free mark.<br>Contains Pb in products exempted by EU RoHS directive.<br>(Contains Pb in sealing glass, high melting temperature type solder or other.) |
|  | ► Designed for automotive applications such as Car Multimedia, Body Electronics, Remote Keyless Entry etc.                                                                                                                      |
|  | ► Designed for automotive applications related to driving safety (Engine Control Unit, Air Bag, ESC etc ).                                                                                                                      |

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