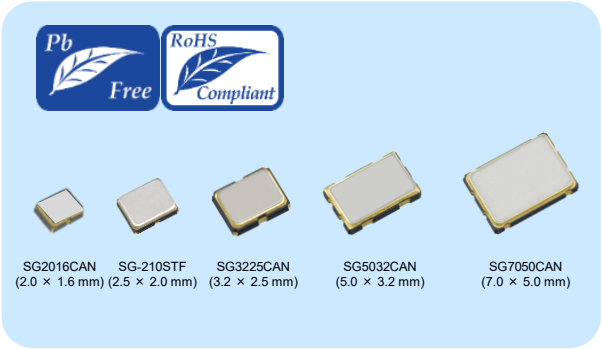
# Crystal oscillator: SG2016 / 3225 / 5032 / 7050CAN & SG-210STF

## Features

- Crystal oscillator (SPXO)
- Frequency: 20 standard frequencies (4 MHz to 72 MHz)
- Output: CMOS
- Supply voltage: 1.6 V to 3.63 V
- Operating temperature: -20 ºC to +70 ºC
  -40 ºC to +105 ºC




## Applications

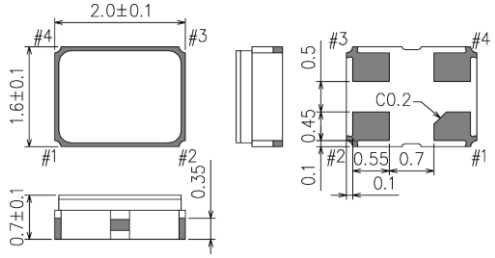
- IoT, Wearable device
- Data center, Storage
- Medical, Industrial automation

## Description

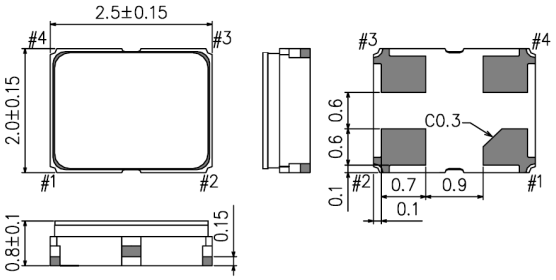
Epson's SGxxxxCAN & SG-210STF are Simple Packaged Crystal Oscillator (SPXO) series with CMOS output. These SPXO's are ideal for variety of applications from IoT, wearables, medical, industrial automation, etc. These SPXO have low current consumption, wide operating voltage from 1.6 V to 3.63 V and wide operating temperature range from -40 ºC to 85 ºC, in addition operation up to 105 ºC is available.
These SPXO's are available in five different package size from 2.0 × 1.6 mm to 7.0 × 5.0 mm and available in standard pin out's.

## Outline Drawing and Terminal Assignment

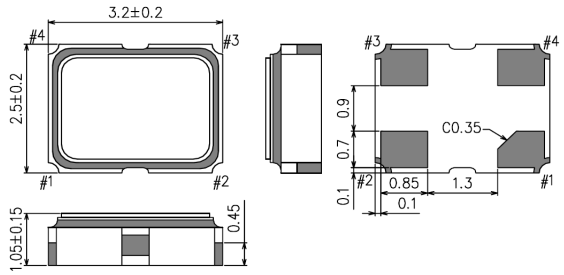
SG2016CAN



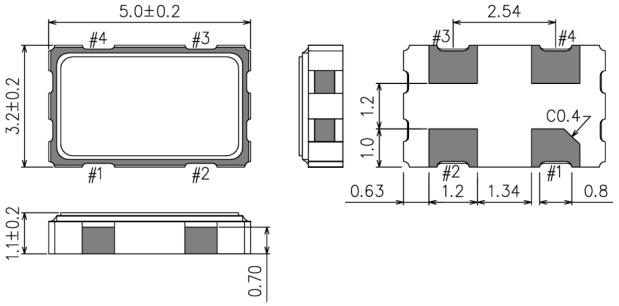

SG-210STF



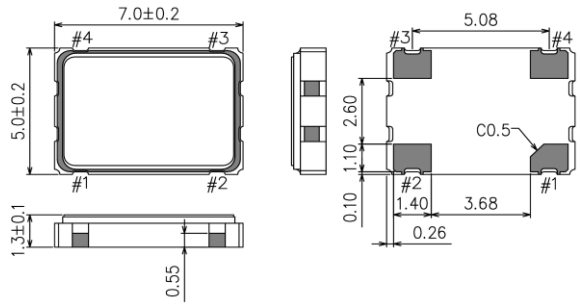

SG3225CAN




SG5032CAN




SG7050CAN




Terminal Assignment

| Pin # | Connection | Function | | |
|---|---|---|---|---|
| #1 | $\overline{ST}$ | $\overline{ST}$ terminal | | |
| | | $\overline{ST}$ function | Osc. Circuit | Output |
| | | "H" or OPEN | Oscillation | Specified frequency : Enable |
| | | "L" | Oscillation stop | High impedance : Disable |
| #2 | GND | GND terminal | | |
| #3 | OUT | Output terminal | | |
| #4 | $V_{CC}$ | $V_{CC}$ terminal | | |

[ 1 ] Product Name / Product Number

(1-1) SG2016CAN

(1) Product Name (Standard Form)

SG2016 C AN 25.000000MHz T J H A
① ② ③ ④⑤⑥⑦

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

| ④Supply voltage Refer to Figure 1 | |
|---|---|
| T | 1.8 V to 3.3 V Typ. |
| K | 2.5 V to 3.3 V Typ. |

*Figure 1 is on the next page

| ⑤Frequency tolerance / ⑥Operating temperature | |
|---|---|
| DB | ±25 × $10^{-6}$ / -20 ºC to +70 ºC |
| JG | ±50 × $10^{-6}$ / -40 ºC to +85 ºC |
| JH | ±50 × $10^{-6}$ / -40 ºC to +105 ºC |

(2) Product Number / Ordering Code

| Frequency [MHz] | Frequency tolerance / Operating temperature | | |
|---|---|---|---|
| | DB | JG | JH |
| | ±25 × $10^{-6}$ -20 ºC to +70 ºC | ±50 × $10^{-6}$ -40 ºC to +85 ºC | ±50 × $10^{-6}$ -40 ºC to +105 ºC |
| 4 | - | X1G004801003000 | X1G004801004900 |
| 8 | - | X1G004801004500 | X1G004801004600 |
| 10 | - | X1G004801002900 | X1G004801002700 |
| 12 | X1G004801005000 | X1G004801000700 | X1G004801005100 |
| 12.288 | X1G004801005200 | X1G004801004400 | X1G004801005300 |
| 14.7456 | - | X1G004801005400 | X1G004801005500 |
| 16 | - | X1G004801001400 | X1G004801005600 |
| 20 | X1G004801005700 | X1G004801005800 | X1G004801001800 |
| 24 | X1G004801005900 | X1G004801000200 | X1G004801004000 |
| 24.576 | - | X1G004801006000 | X1G004801003100 |
| 25 | X1G004801002400 | X1G004801001200 | X1G004801003500 |
| 26 | - | X1G004801000300 | X1G004801003900 |
| 27 | - | X1G004801006100 | X1G004801002100 |
| 32 | - | X1G004801006200 | X1G004801006300 |
| 33.33 | - | X1G004801006400 | X1G004801006500 |
| 33.3333 | - | X1G004801002600 | X1G004801006600 |
| 40 | - | X1G004801006700 | X1G004801003600 |
| 48 | X1G004801006800 | X1G004801002000 | X1G004801006900 |
| 50 | X1G004801007000 | X1G004801001300 | X1G004801002800 |
| 72 | X1G004801007100 | X1G004801007200 | X1G004801007300 |

(1-2) SG-210STF

(1) Product Name (Standard Form)

SG-210 S T F 25.000000MHz Y

① ②③ ④ ⑤

①Model ②Function (S:Standby) ③Supply voltage

④Frequency ⑤Frequency tolerance / Operating temperature

| ③Supply voltage Refer to Figure 1 | |
|---|---|
| T | 1.8 V to 3.3 V Typ. |

*Figure 1 is on the next page

| ⑤Frequency tolerance / Operating temperature | |
|---|---|
| S | ±25 × $10^{-6}$ / -20 ºC to +70 ºC |
| L | ±50 × $10^{-6}$ / -40 ºC to +85 ºC |
| Y | ±50 × $10^{-6}$ / -40 ºC to +105 ºC |

(2) Product Number / Ordering Code

| Frequency [MHz] | Frequency tolerance / Operating temperature | | |
|---|---|---|---|
| | S | L | Y |
| | ±25 × $10^{-6}$ -20 ºC to +70 ºC | ±50 × $10^{-6}$ -40 ºC to +85 ºC | ±50 × $10^{-6}$ -40 ºC to +105 ºC |
| 4 | - | X1G004171000900 | X1G004171029900 |
| 8 | - | X1G004171001500 | X1G004171006900 |
| 10 | - | X1G004171001600 | X1G004171036500 |
| 12 | X1G004171016300 | X1G004171001800 | X1G004171028000 |
| 12.288 | X1G004171006100 | X1G004171001900 | X1G004171036600 |
| 14.7456 | - | X1G004171002500 | X1G004171036700 |
| 16 | - | X1G004171002700 | X1G004171015400 |
| 20 | X1G004171021800 | X1G004171002900 | X1G004171023800 |
| 24 | X1G004171015600 | X1G004171003100 | X1G004171019700 |
| 24.576 | - | X1G004171003200 | X1G004171036800 |
| 25 | X1G004171007700 | X1G004171003300 | X1G004171005900 |
| 26 | - | X1G004171003400 | X1G004171024400 |
| 27 | - | X1G004171003500 | X1G004171025000 |
| 32 | - | X1G004171004000 | X1G004171012700 |
| 33.33 | - | X1G004171011900 | X1G004171030000 |
| 33.3333 | - | X1G004171012000 | X1G004171007500 |
| 40 | - | X1G004171004500 | X1G004171020600 |
| 48 | X1G004171007800 | X1G004171004600 | X1G004171036900 |
| 50 | X1G004171007900 | X1G004171004700 | X1G004171012600 |
| 72 | X1G004171037000 | X1G004171012400 | X1G004171037100 |

(1-3) SG3225CAN

(1) Product Name (Standard Form)

SG3225 C AN 25.000000MHz T J H A

① ② ③ ④⑤⑥⑦

①Model ②Output (C:CMOS) ③Frequency ④Supply voltage

⑤Frequency tolerance ⑥Operating temperature ⑦Internal identification code ("A" is default)

| ④Supply voltage Refer to Figure 1 | |
|---|---|
| T | 1.8 V to 3.3 V Typ. |
| K | 2.5 V to 3.3 V Typ. |

*Figure 1 is on the next page

| ⑤Frequency tolerance / ⑥Operating temperature | |
|---|---|
| DB | ±25 × $10^{-6}$ / -20 ºC to +70 ºC |
| JG | ±50 × $10^{-6}$ / -40 ºC to +85 ºC |
| JH | ±50 × $10^{-6}$ / -40 ºC to +105 ºC |

(2) Product Number / Ordering Code

| Frequency [MHz] | Frequency tolerance / Operating temperature | | |
|---|---|---|---|
| | DB | JG | JH |
| | ±25 × $10^{-6}$ -20 ºC to +70 ºC | ±50 × $10^{-6}$ -40 ºC to +85 ºC | ±50 × $10^{-6}$ -40 ºC to +105 ºC |
| 4 | - | X1G005961001115 | X1G005961001215 |
| 8 | - | X1G005961000415 | X1G005961001315 |
| 10 | - | X1G005961000515 | X1G005961001415 |
| 12 | X1G005961001515 | X1G005961000615 | X1G005961001615 |
| 12.288 | X1G005961001715 | X1G005961001815 | X1G005961001915 |
| 14.7456 | - | X1G005961002015 | X1G005961002115 |
| 16 | - | X1G005961002215 | X1G005961002315 |
| 20 | X1G005961002415 | X1G005961000715 | X1G005961002515 |
| 24 | X1G005961002615 | X1G005961000115 | X1G005961002715 |
| 24.576 | - | X1G005961000815 | X1G005961002815 |
| 25 | X1G005961002915 | X1G005961000215 | X1G005961003015 |
| 26 | - | X1G005961003115 | X1G005961003215 |
| 27 | - | X1G005961003315 | X1G005961003415 |
| 32 | - | X1G005961003515 | X1G005961003615 |
| 33.33 | - | X1G005961003715 | X1G005961003815 |
| 33.3333 | - | X1G005961003915 | X1G005961004015 |
| 40 | - | X1G005961000915 | X1G005961004115 |
| 48 | X1G005961004215 | X1G005961000315 | X1G005961004315 |
| 50 | X1G005961004415 | X1G005961001015 | X1G005961004515 |
| 72 | X1G005961004615 | X1G005961004715 | X1G005961004815 |

(1-4) SG5032CAN

(1) Product Name (Standard Form)

SG5032 C AN 25.000000MHz T J H A
① ② ③ ④⑤⑥⑦

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

| ④Supply voltage Refer to Figure 1 | |
|---|---|
| T | 1.8 V to 3.3 V Typ. |
| K | 2.5 V to 3.3 V Typ. |

*Figure 1 is on the next page

| ⑤Frequency tolerance / ⑥Operating temperature | |
|---|---|
| DB | ±25 × $10^{-6}$ / -20 ºC to +70 ºC |
| JG | ±50 × $10^{-6}$ / -40 ºC to +85 ºC |
| JH | ±50 × $10^{-6}$ / -40 ºC to +105 ºC |

(2) Product Number / Ordering Code

| Frequency [MHz] | Frequency tolerance / Operating temperature | | |
|---|---|---|---|
| | DB | JG | JH |
| | ±25 × $10^{-6}$ -20 ºC to +70 ºC | ±50 × $10^{-6}$ -40 ºC to +85 ºC | ±50 × $10^{-6}$ -40 ºC to +105 ºC |
| 4 | - | X1G004451003400 | X1G004451019600 |
| 8 | - | X1G004451002100 | X1G004451019700 |
| 10 | - | X1G004451001300 | X1G004451017800 |
| 12 | X1G004451019800 | X1G004451002800 | X1G004451019900 |
| 12.288 | X1G004451020000 | X1G004451000100 | X1G004451020100 |
| 14.7456 | - | X1G004451001900 | X1G004451020200 |
| 16 | - | X1G004451000200 | X1G004451020300 |
| 20 | X1G004451020400 | X1G004451001100 | X1G004451020500 |
| 24 | X1G004451017200 | X1G004451000300 | X1G004451020600 |
| 24.576 | - | X1G004451002900 | X1G004451020700 |
| 25 | X1G004451009700 | X1G004451000400 | X1G004451020800 |
| 26 | - | X1G004451008200 | X1G004451020900 |
| 27 | - | X1G004451000500 | X1G004451021000 |
| 32 | - | X1G004451001400 | X1G004451021100 |
| 33.33 | - | X1G004451021200 | X1G004451021300 |
| 33.3333 | - | X1G004451016700 | X1G004451021400 |
| 40 | - | X1G004451001200 | X1G004451021500 |
| 48 | X1G004451014900 | X1G004451000700 | X1G004451011200 |
| 50 | X1G004451011500 | X1G004451000800 | X1G004451003600 |
| 72 | X1G004451021600 | X1G004451021700 | X1G004451021800 |

(1-5) SG7050CAN

(1) Product Name (Standard Form)

SG7050 C AN 25.000000MHz T J H A
① ② ③ ④⑤⑥⑦

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

| ④Supply voltage Refer to Figure 1 | |
|---|---|
| T | 1.8 V to 3.3 V Typ. |
| K | 2.5 V to 3.3 V Typ. |

*Figure 1 is on the next page

| ⑤Frequency tolerance / ⑥Operating temperature | |
|---|---|
| DB | ±25 × $10^{-6}$ / -20 ºC to +70 ºC |
| JG | ±50 × $10^{-6}$ / -40 ºC to +85 ºC |
| JH | ±50 × $10^{-6}$ / -40 ºC to +105 ºC |

(2) Product Number / Ordering Code

| Frequency [MHz] | Frequency tolerance / Operating temperature | | |
|---|---|---|---|
| | DB | JG | JH |
| | ±25 × $10^{-6}$ -20 ºC to +70 ºC | ±50 × $10^{-6}$ -40 ºC to +85 ºC | ±50 × $10^{-6}$ -40 ºC to +105 ºC |
| 4 | - | X1G004481005100 | X1G004481025200 |
| 8 | - | X1G004481001400 | X1G004481025300 |
| 10 | - | X1G004481000500 | X1G004481025400 |
| 12 | X1G004481025500 | X1G004481000600 | X1G004481025600 |
| 12.288 | X1G004481025700 | X1G004481000100 | X1G004481025800 |
| 14.7456 | - | X1G004481002500 | X1G004481025900 |
| 16 | - | X1G004481000700 | X1G004481026000 |
| 20 | X1G004481012800 | X1G004481000800 | X1G004481026100 |
| 24 | X1G004481002200 | X1G004481000200 | X1G004481026200 |
| 24.576 | - | X1G004481001600 | X1G004481026300 |
| 25 | X1G004481011600 | X1G004481000300 | X1G004481026400 |
| 26 | - | X1G004481003500 | X1G004481026500 |
| 27 | - | X1G004481000400 | X1G004481026600 |
| 32 | - | X1G004481000900 | X1G004481026700 |
| 33.33 | - | X1G004481017900 | X1G004481026800 |
| 33.3333 | - | X1G004481003300 | X1G004481026900 |
| 40 | - | X1G004481001500 | X1G004481027000 |
| 48 | X1G004481022600 | X1G004481001100 | X1G004481027100 |
| 50 | X1G004481011200 | X1G004481001200 | X1G004481016000 |
| 72 | X1G004481027200 | X1G004481018300 | X1G004481027300 |

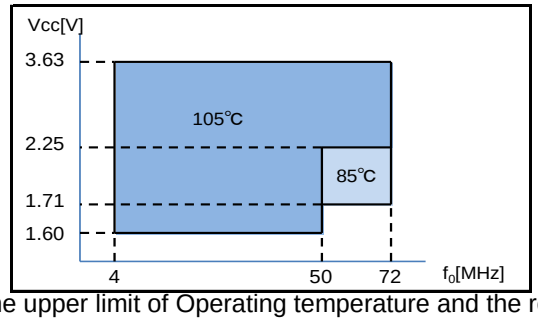
## [ 2 ] Absolute Maximum Ratings

| Parameter | Symbol | Specification | | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Maximum supply voltage | $V_{CC}$ | -0.3 | - | 4 | V | |
| Input voltage | Vin | -0.3 | - | $V_{CC}$ + 0.3 | V | $\overline{ST}$ terminal |
| Storage temperature range | T_stg | -55 | - | +125 | ºC | SG2016CAN |
| | | -40 | - | +125 | ºC | All other |

## [ 3 ] Operating Range

| Parameter | Symbol | Specification | | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Supply voltage | $V_{CC}$ | 1.6 | - | 3.63 | V | fo ≤ 50 MHz,<br>T_use = +105 °C Max. |
| | | 1.71 | - | 3.63 | V | fo = 72 MHz,<br>T_use = +85 °C Max. |
| | | 2.25 | - | 3.63 | V | fo = 72 MHz,<br>T_use = +105 °C Max. |
| Supply voltage | GND | 0.0 | 0.0 | 0.0 | V | |
| Operating temperature range (Refer to Figure 1) | T_use | -20 | +25 | +70 | ºC | |
| | | -40 | +25 | +85 | ºC | |
| | | -40 | +25 | +105 | ºC | |
| CMOS load condition | L_CMOS | - | - | 15 | pF | |

* Power supply startup time (0 %$V_{CC}$ → 90 %$V_{CC}$) should be more than 150 µs
* A 0.01 µF to a 0.1 µF bypass capacitor should be connected between $V_{CC}$ and GND pins located close to the device




Please note that Supply voltage range ($V_{CC}$) depends on Output frequency(fo) and upper limit of Operating temperature(T_use Max.).

Figure 1: The upper limit of Operating temperature and the related conditions

## [ 4 ] Frequency Characteristics

(Unless stated otherwise [ 3 ] Operating Range)

| Parameter | Symbol | Specification | | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Output frequency | fo | 4, 8, 10, 12, 12.288, 14.7456, 16, 20, 24, 24.576, 25, 26, 27, 32, 33.33, 33.3333, 40, 48, 50, 72 | | | MHz | |
| Frequency tolerance *1 | f_tol | -50 | - | +50 | $\times 10^{-6}$ | T_use = -20 ºC to +70 ºC |
| | | -100 | | +100 | $\times 10^{-6}$ | T_use = -40 ºC to +105 ºC<br>T_use = -40 ºC to +85 ºC *2 |
| Frequency aging | f_age | -3 | | +3 | $\times 10^{-6}$ | +25 ºC, First year |

*1 Frequency tolerance includes initial frequency tolerance, temperature variation, supply voltage change and load drift.
*2 This temperature range is only for fo = 75 MHz

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

| Parameter | Symbol | Specification | | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Start-up time | t_str | - | - | 3 | ms | t = 0 at 90 %$V_{CC}$ |
| Current consumption (No load) $V_{CC}$ = 1.8 V ± 10 % | $I_{CC}$ | - | - | 1.5 | mA | 1 MHz ≤ fo ≤ 20 MHz |
| | | - | - | 1.8 | mA | 20 MHz < fo ≤ 40 MHz |
| | | - | - | 2.1 | mA | 40 MHz < fo ≤ 50 MHz |
| $V_{CC}$ = 1.8 V ± 5 % | | - | - | 2.4 | mA | fo = 72 MHz |
| Current consumption (No load) $V_{CC}$ = 2.5 V ± 10 % | | - | - | 1.6 | mA | 1 MHz ≤ fo ≤ 20 MHz |
| | | - | - | 2.0 | mA | 20 MHz < fo ≤ 40 MHz |
| | | - | - | 2.4 | mA | 40 MHz < fo ≤ 50 MHz |
| | | - | - | 2.8 | mA | fo = 72 MHz |
| Current consumption (No load) $V_{CC}$ = 3.3 V ± 10 % | | - | - | 1.8 | mA | 1 MHz ≤ fo ≤ 20 MHz |
| | | - | - | 2.2 | mA | 20 MHz < fo ≤ 40 MHz |
| | | - | - | 2.6 | mA | 40 MHz < fo ≤ 50 MHz |
| | | - | - | 3.0 | mA | fo = 72 MHz |
| Stand-by current | I_std | - | - | 2.1 | µA | $V_{CC}$ = 1.8 V ± 10 % or ± 5 %, $\overline{ST}$ = GND |
| | | - | - | 2.5 | µA | $V_{CC}$ = 2.5 V ± 10 %, $\overline{ST}$ = GND |
| | | - | - | 2.7 | µA | $V_{CC}$ = 3.3 V ± 10 %, $\overline{ST}$ = GND |
| Output voltage | $V_{OH}$ | 90 % $V_{CC}$ | - | - | V | Load current condition<br>1.8 V ± 10 % / 2.5 V ± 10 % / 3.3 V ± 10 %<br>$I_{OH}$ -1.5 mA / -3 mA / -4 mA<br>$I_{OL}$ 1.5 mA / 3 mA / 4 mA |
| | $V_{OL}$ | - | - | 10 % $V_{CC}$ | V | |
| | $V_{OH}$ | $V_{CC}$ - 0.4 | - | - | V | Load current condition<br>1.8 V ± 10 % / 2.5 V ± 10 % / 3.3 V ± 10 %<br>$I_{OH}$ -1.5 mA / -3 mA / -4 mA<br>$I_{OL}$ 1.5 mA / 3 mA / 4 mA |
| | $V_{OL}$ | - | - | 0.4 | V | |
| Symmetry | SYM | 45 | 50 | 55 | % | 50 % $V_{CC}$ level, L_CMOS ≤ 15 pF |
| Rise time / Fall time | tr / tf | - | - | 3 | ns | $V_{CC}$ = 2.5 V or 3.3 V ± 10 %, 20 % $V_{CC}$ to 80 % $V_{CC}$ Level, L_CMOS = 15 pF |
| | | - | - | 3.5 | ns | $V_{CC}$ = 1.8 V ± 10 % or ± 5 %, 20 % $V_{CC}$ to 80 % $V_{CC}$ Level, L_CMOS = 15 pF |
| Input voltage | $V_{IH}$ | 80 % Vcc | - | - | V | $\overline{ST}$ terminal |
| | $V_{IL}$ | - | - | 20 % Vcc | V | |
| Output disable time (ST) | tstp_st | - | - | 100 | ns | $\overline{ST}$ terminal HIGH → LOW |
| Output enable time (ST) | tsta_st | - | - | 3 | ms | $\overline{ST}$ terminal LOW → HIGH |

[ 6 ] Thermal resistance (For reference only)

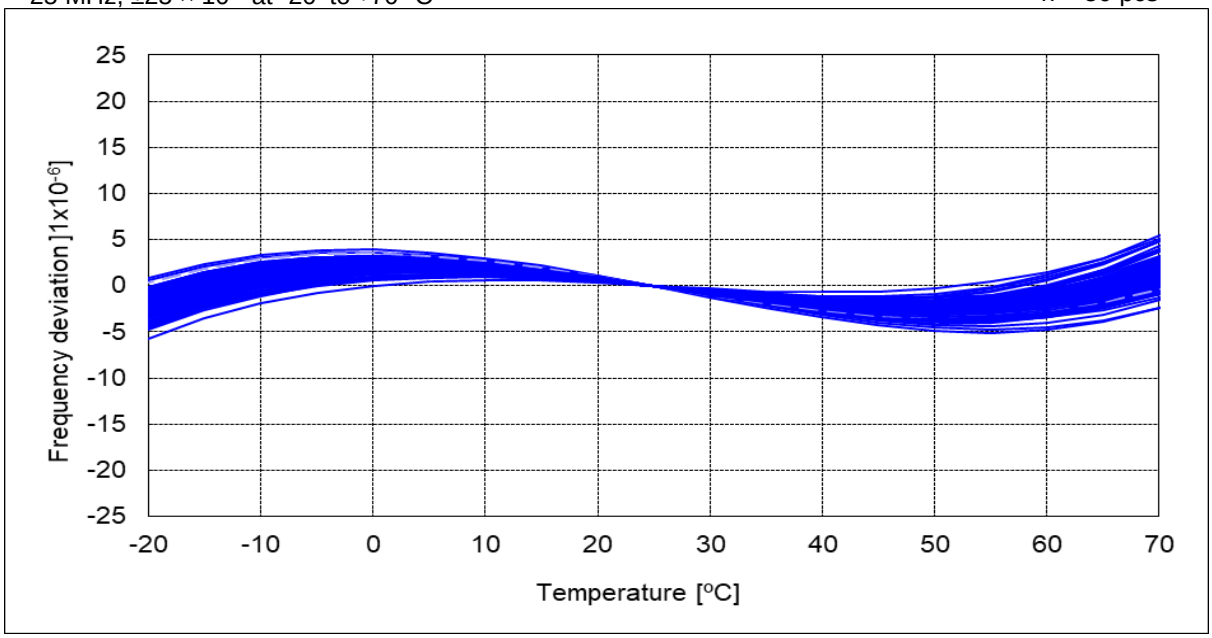
| Parameter | Symbol | Specification | | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Junction temperature | Tj | - | - | +125 | ºC | |
| Junction to case | θjc | - | 136 | - | ºC/W | SG2016CAN |
| | | - | 166 | - | ºC/W | SG-210STF |
| | | - | 70 | - | ºC/W | SG3225CAN |
| | | - | 60 | - | ºC/W | SG5032CAN |
| | | - | 72 | - | ºC/W | SG7050CAN |
| Junction to ambient | θja | - | 162 | - | ºC/W | SG2016CAN |
| | | - | 210 | - | ºC/W | SG-210STF |
| | | - | 135 | - | ºC/W | SG3225CAN |
| | | - | 119 | - | ºC/W | SG5032CAN |
| | | - | 98 | - | ºC/W | SG7050CAN |

[ 7 ] Typical Performance Characteristics (For reference only)

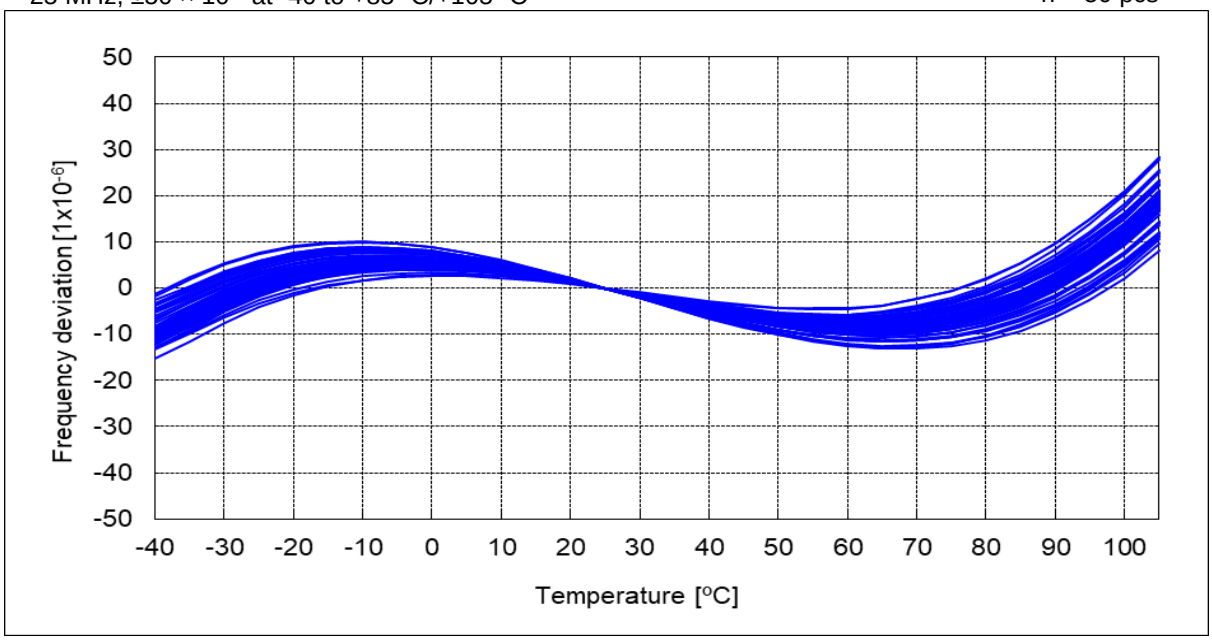
The following data shows typical performance characteristics

(7-1) Frequency / Temperature Characteristics

fo = 25 MHz, ±25 × $10^{-6}$ at -20 to +70 ºC n = 50 pcs

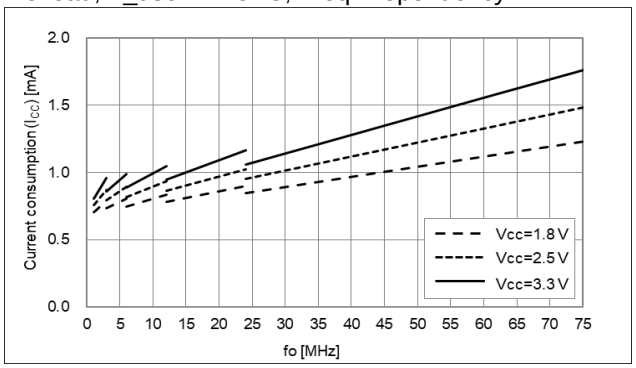



fo = 25 MHz, ±50 × $10^{-6}$ at -40 to +85 ºC/+105 ºC n = 50 pcs

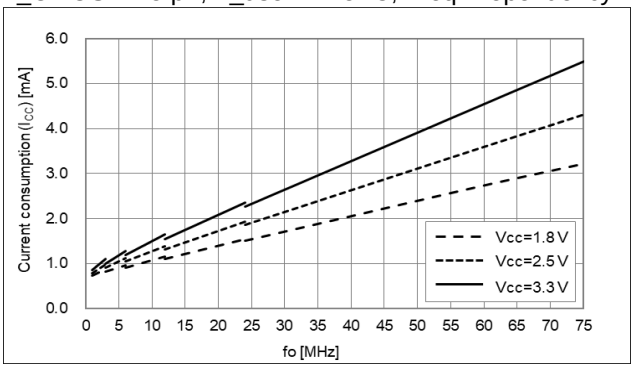


(7-2) Current Consumption

No load, T_use = +25 ºC, Freq. Dependency

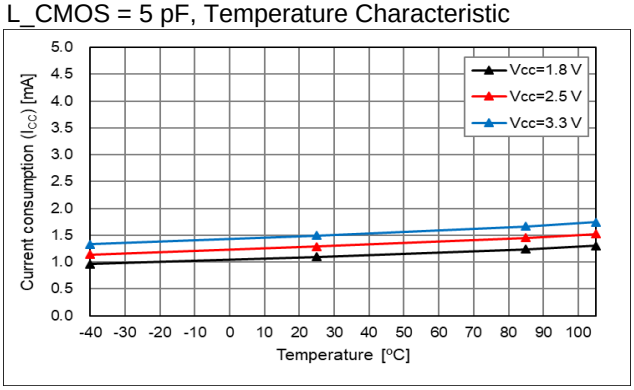



L_CMOS = 15 pF, T_use = +25 ºC, Freq. Dependency

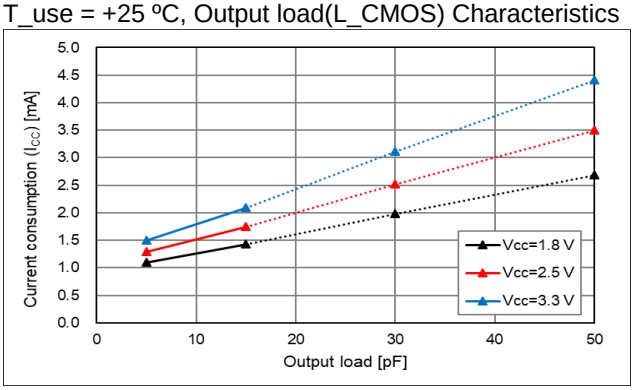



fo = 20 MHz

L_CMOS = 5 pF, Temperature Characteristic

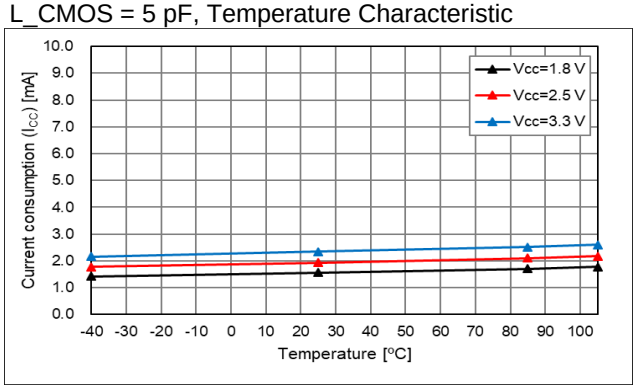



T_use = +25 ºC, Output load(L_CMOS) Characteristics

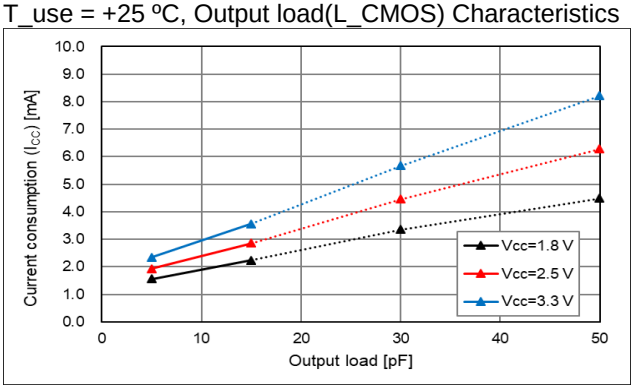



fo = 40 MHz

L_CMOS = 5 pF, Temperature Characteristic

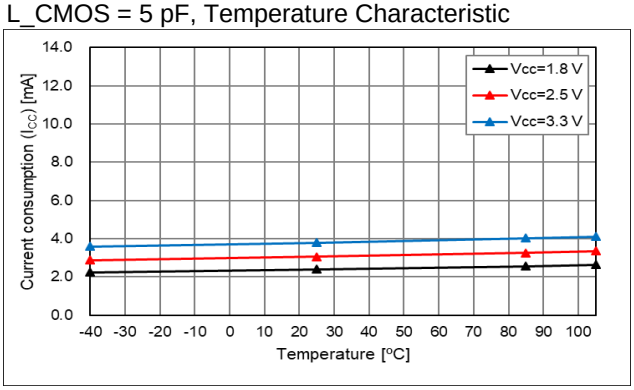



T_use = +25 ºC, Output load(L_CMOS) Characteristics

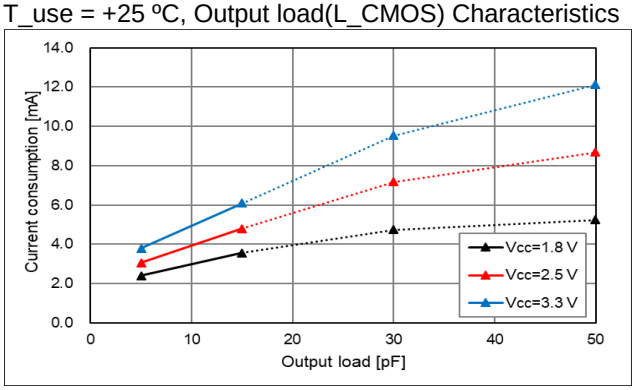



fo = 72 MHz

L_CMOS = 5 pF, Temperature Characteristic




T_use = +25 ºC, Output load(L_CMOS) Characteristics



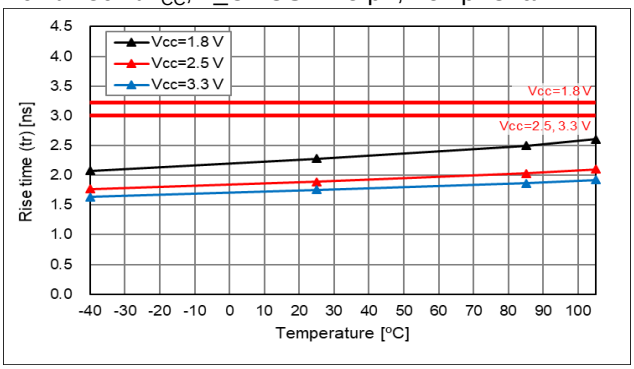

* Output load condition under L_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.

The actual current consumption is the total of the current under the condition of no load and the current to drive the output load (fo × L_CMOS × $V_{CC}$). To reduce the current consumption, it is effective to use lower frequency, lower supply voltage and lower output load.

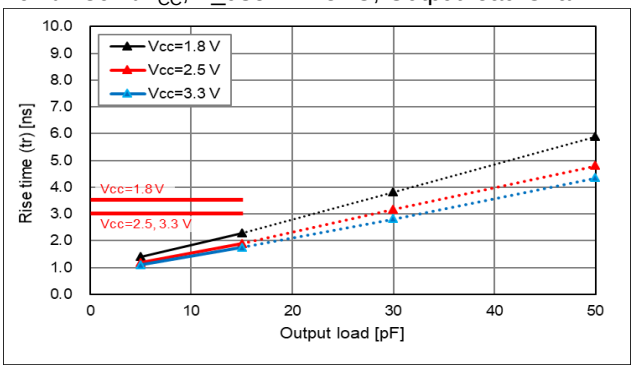
(7-3) Rise Time / Fall Time

fo = 20 MHz, Rise Time

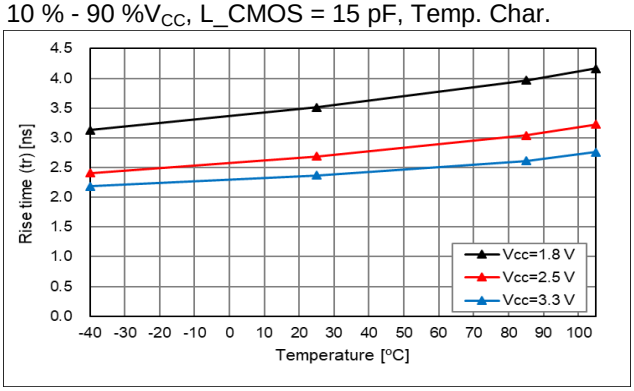
20 % - 80 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.



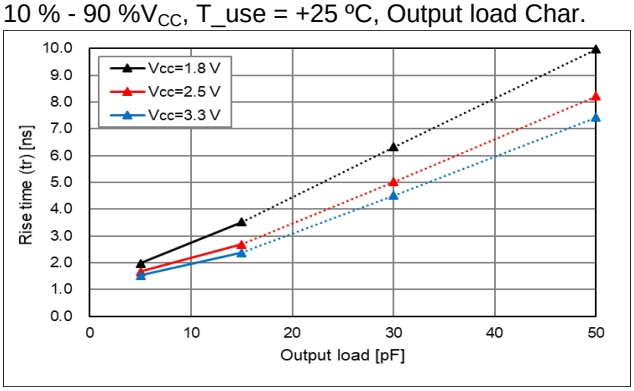

20 % - 80 %$V_{CC}$, T_use = +25 ºC, Output load Char.




10 % - 90 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.



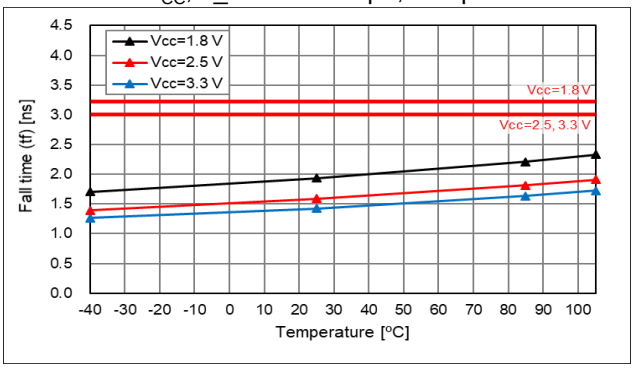

10 % - 90 %$V_{CC}$, T_use = +25 ºC, Output load Char.



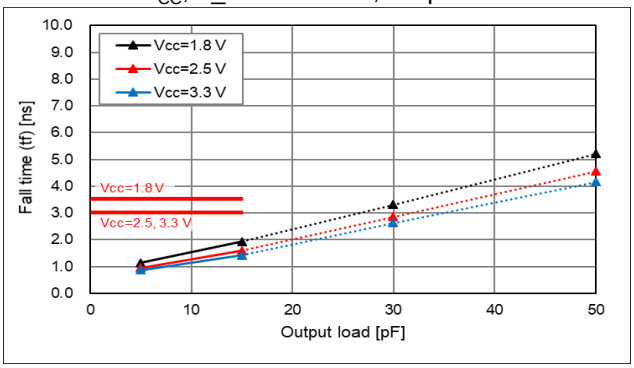

* Output load condition under L_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.

fo = 20 MHz, Fall Time

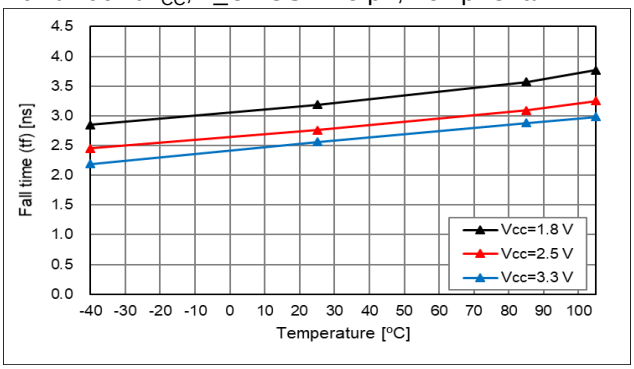
20 % - 80 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.



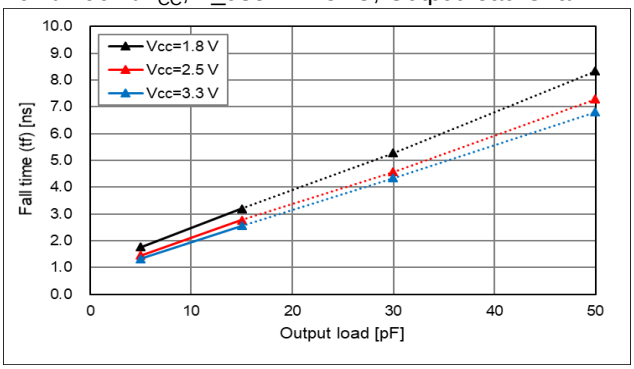

20 % - 80 %$V_{CC}$, T_use = +25 ºC, Output load Char.




10 % - 90 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.




10 % - 90 %$V_{CC}$, T_use = +25 ºC, Output load Char.

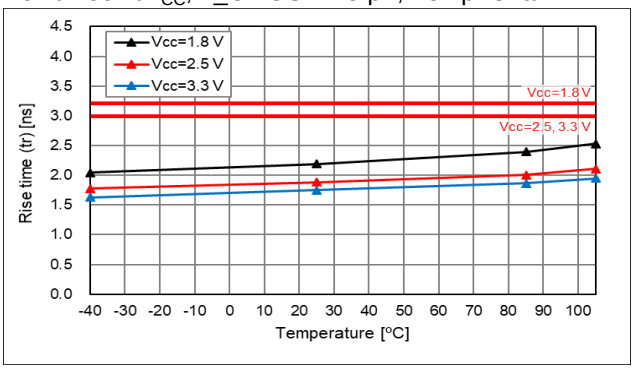



* Output load condition under L_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.

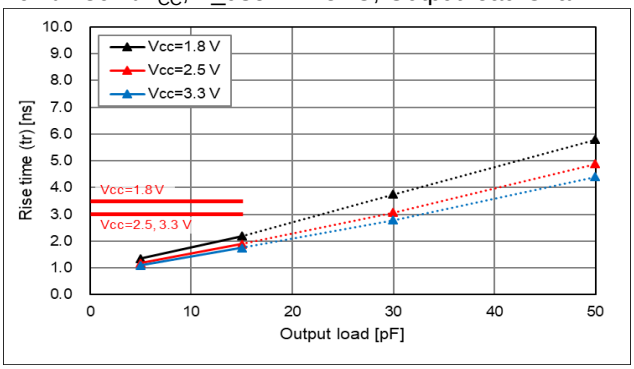
(7-3) Rise Time / Fall Time [cont'd]

fo = 40 MHz, Rise Time

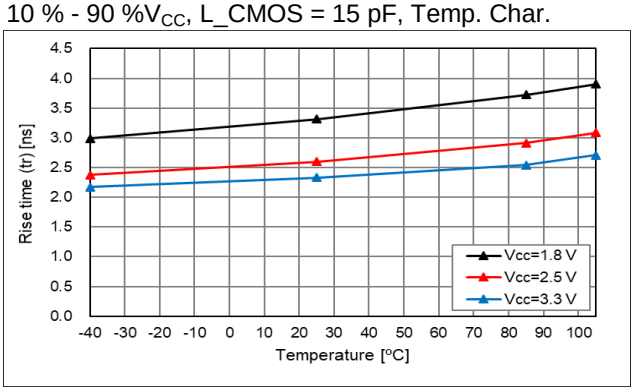
20 % - 80 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.



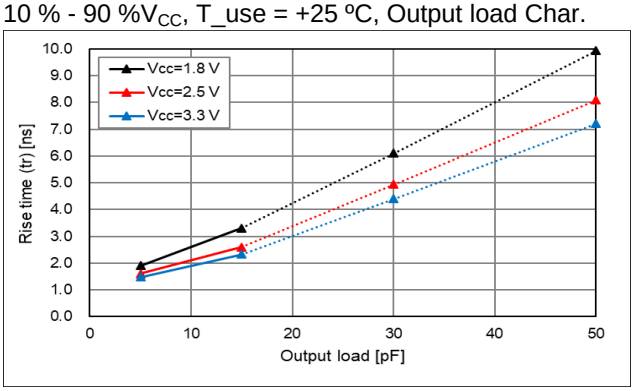

20 % - 80 %$V_{CC}$, T_use = +25 ºC, Output load Char.




10 % - 90 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.



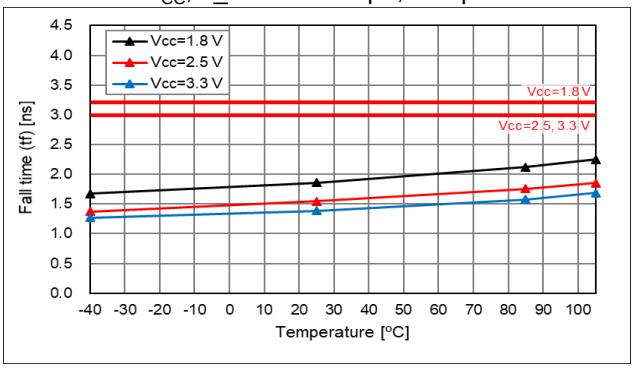

10 % - 90 %$V_{CC}$, T_use = +25 ºC, Output load Char.



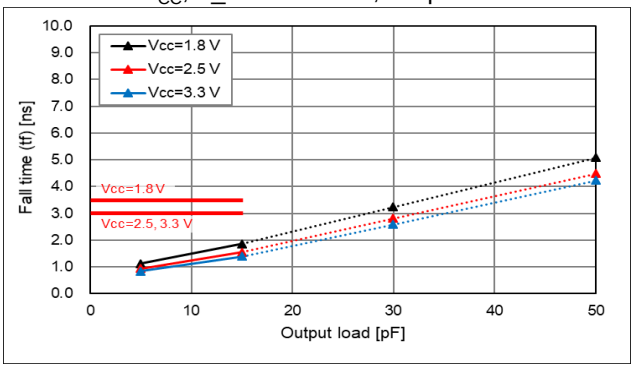

* Output load condition under L_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.

fo = 40 MHz, Fall Time

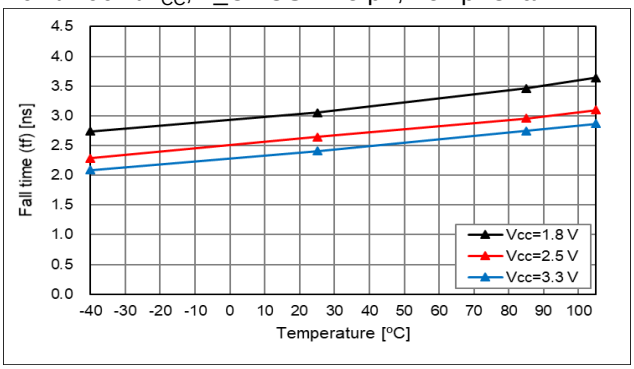
20 % - 80 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.



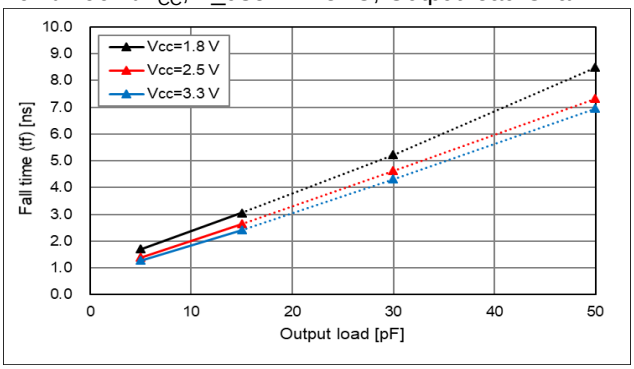

20 % - 80 %$V_{CC}$, T_use = +25 ºC, Output load Char.




10 % - 90 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.




10 % - 90 %$V_{CC}$, T_use = +25 ºC, Output load Char.

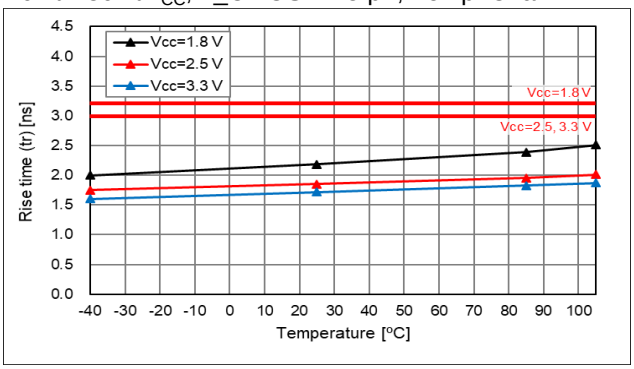



* Output load condition under L_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.

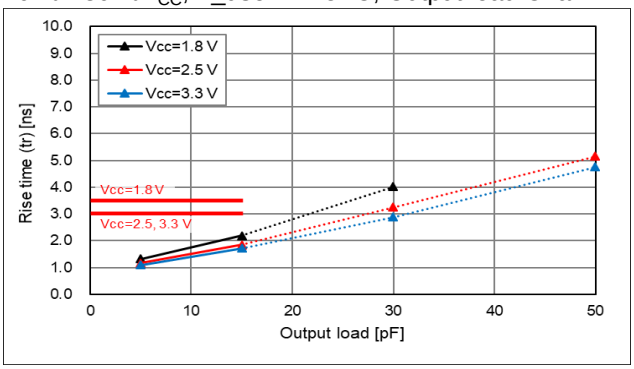
(7-3) Rise Time / Fall Time [cont'd]

fo = 72 MHz, Rise Time

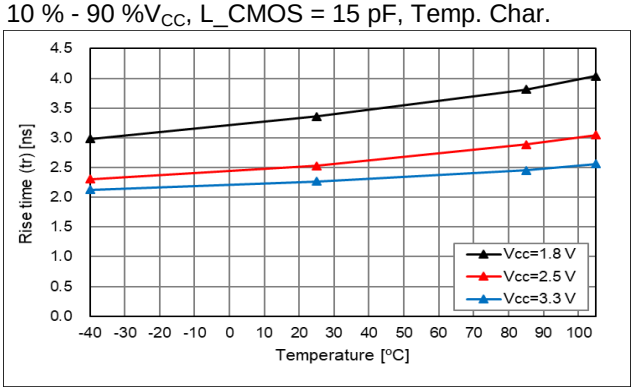
20 % - 80 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.



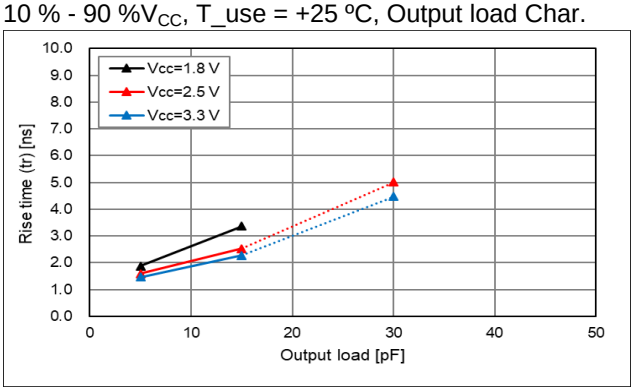

20 % - 80 %$V_{CC}$, T_use = +25 ºC, Output load Char.




10 % - 90 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.



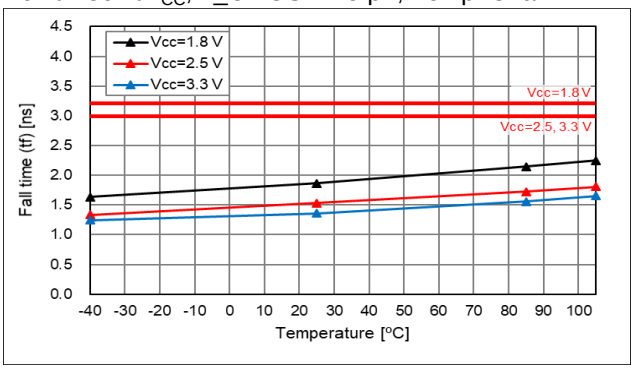

10 % - 90 %$V_{CC}$, T_use = +25 ºC, Output load Char.



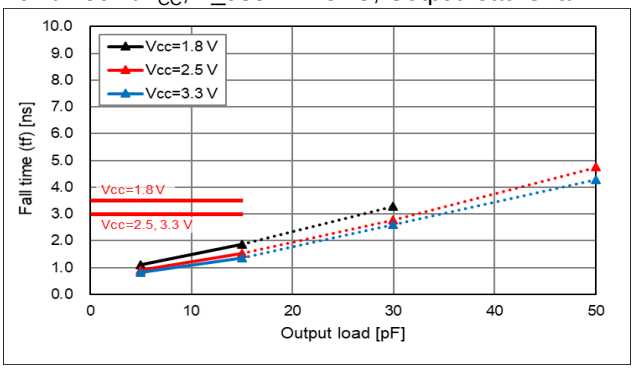

* Output load condition under L_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.
There are some missing data in the graph. It is unmeasurable because of low amplitude under the condition of L CMOS > 15 pF.

fo = 72 MHz, Fall Time

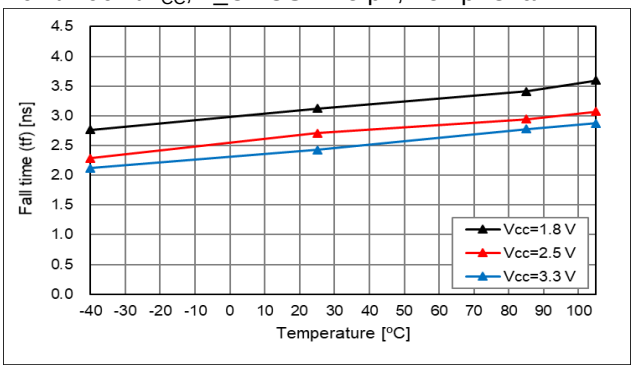
20 % - 80 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.



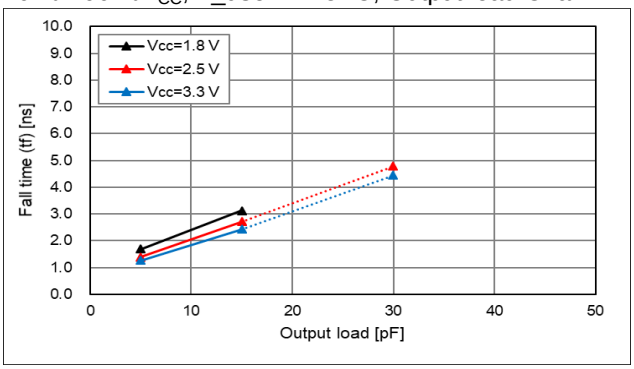

20 % - 80 %$V_{CC}$, T_use = +25 ºC, Output load Char.




10 % - 90 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.




10 % - 90 %$V_{CC}$, T_use = +25 ºC, Output load Char.

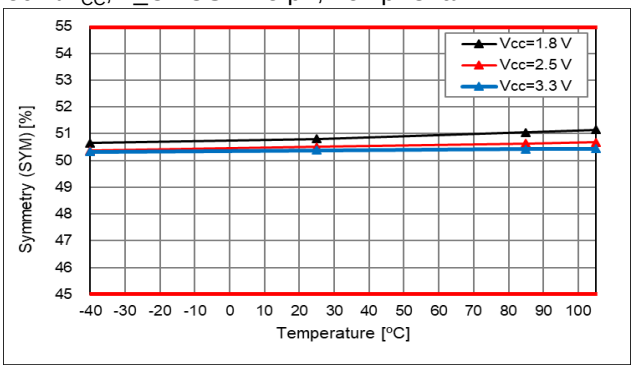



* Output load condition under L_CMOS > 15 pF (dotted line area) is not guaranteed, and the data is for reference.
There are some missing data in the graph. It is unmeasurable because of low amplitude under the condition of L CMOS > 15 pF.

(7-4) Symmetry

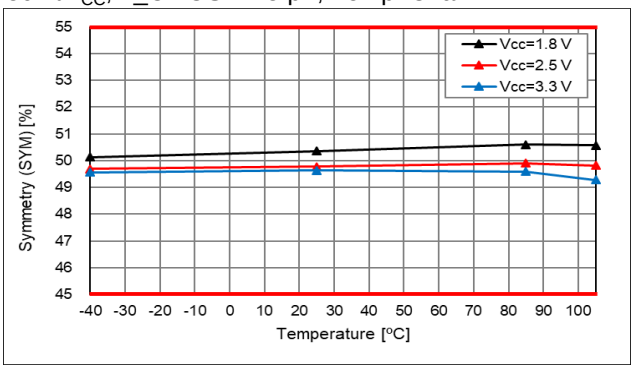
fo = 20 MHz

50 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.



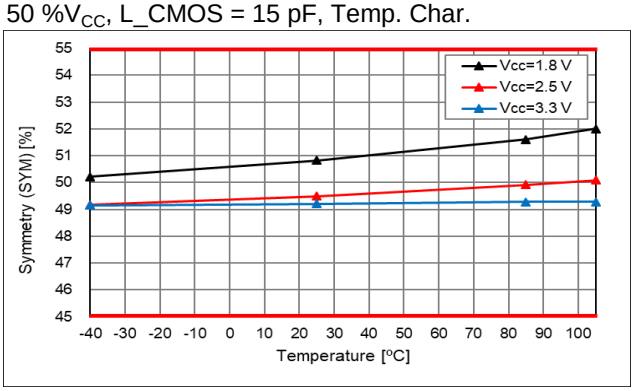

fo = 40 MHz

50 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.




fo = 72 MHz

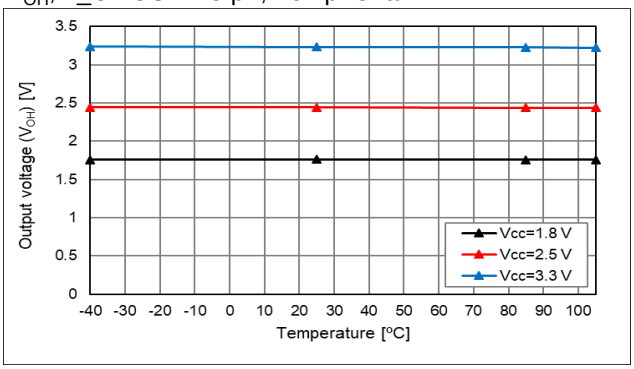
50 %$V_{CC}$, L_CMOS = 15 pF, Temp. Char.



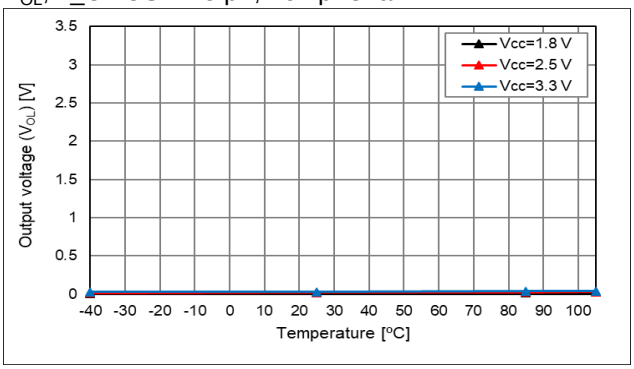
(7-5) Output Voltage

fo = 20 MHz

$V_{OH}$, L_CMOS = 15 pF, Temp. Char.

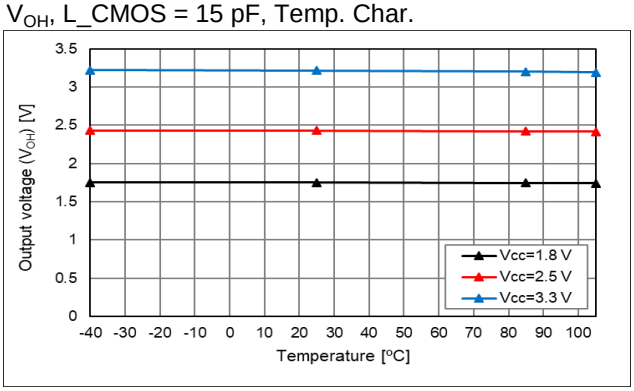



$V_{OL}$, L_CMOS = 15 pF, Temp. Char.

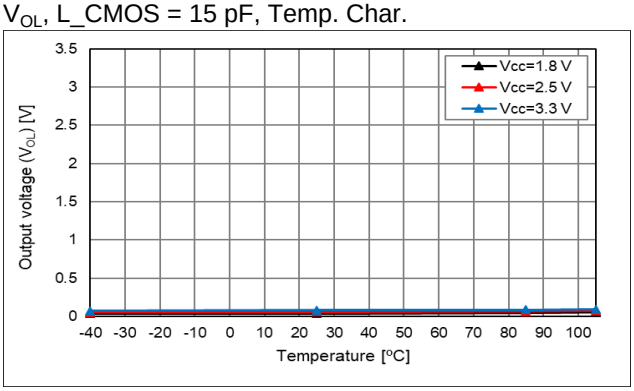



fo = 40 MHz

$V_{OH}$, L_CMOS = 15 pF, Temp. Char.

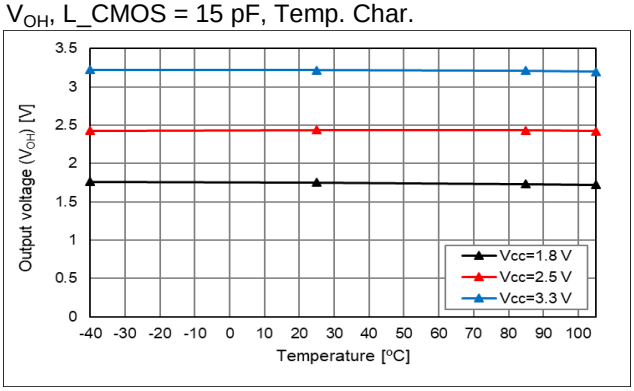



$V_{OL}$, L_CMOS = 15 pF, Temp. Char.

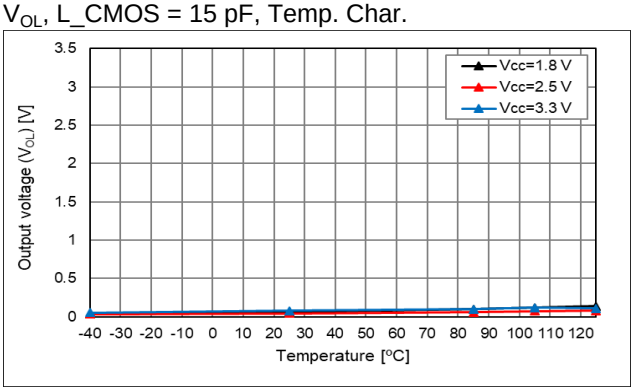



fo = 72 MHz

$V_{OH}$, L_CMOS = 15 pF, Temp. Char.



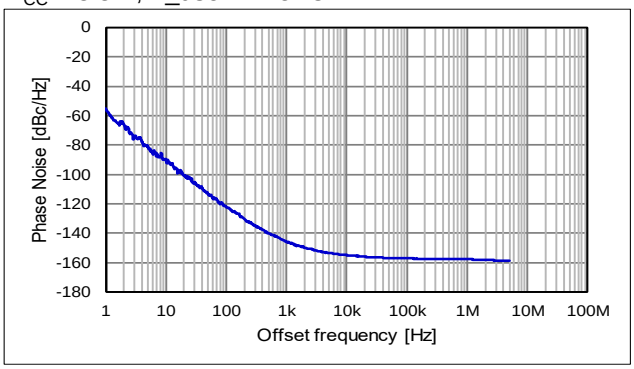

$V_{OL}$, L_CMOS = 15 pF, Temp. Char.



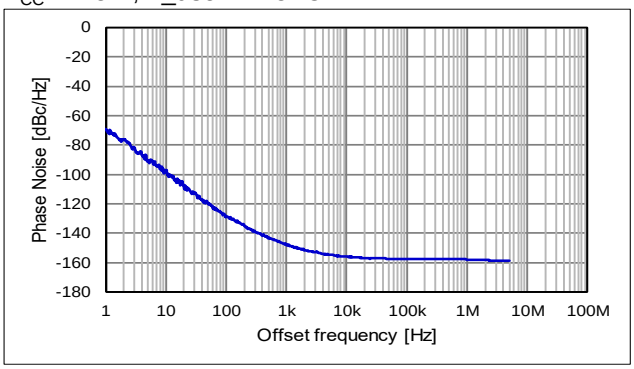
(7-6) Phase Noise, Phase Jitter, and Jitter

fo = 20 MHz

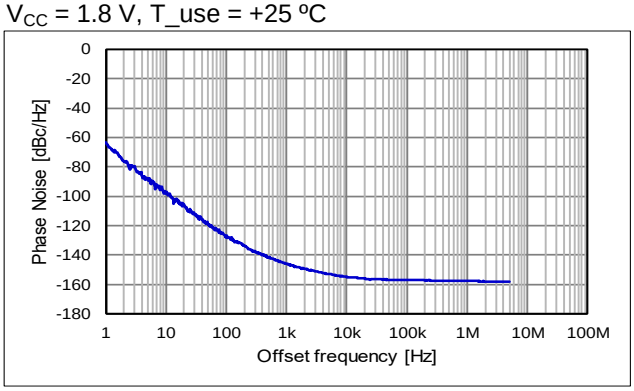
$V_{CC}$ = 3.3 V, T_use = +25 ºC




$V_{CC}$ = 2.5 V, T_use = +25 ºC




$V_{CC}$ = 1.8 V, T_use = +25 ºC




Phase Jitter (Offset frequency: 12 kHz to 5 MHz)

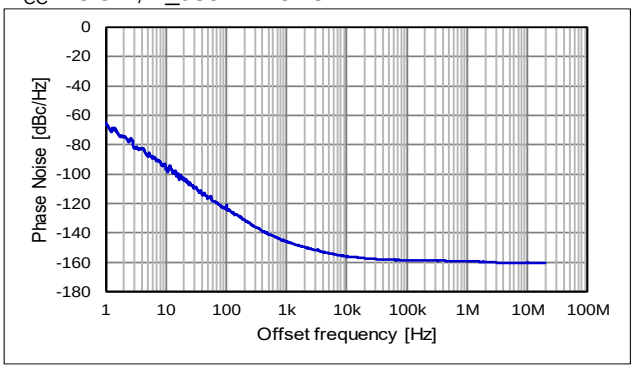
| $V_{CC}$ | Phase Jitter |
|---|---|
| 3.3 V | 0.31 ps |
| 2.5 V | 0.31 ps |
| 1.8 V | 0.32 ps |

Jitter (T_use = +25 ºC, $V_{CC}$ = 3.3 V)

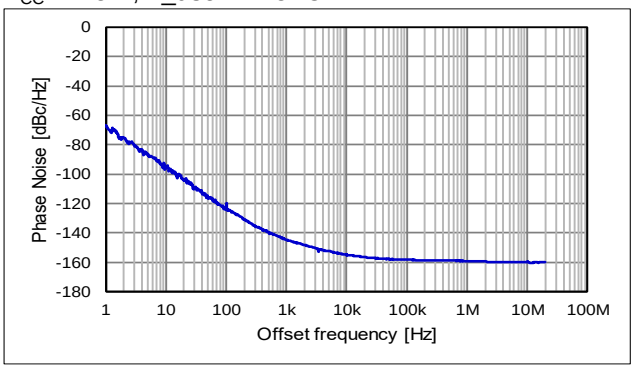
| | |
|---|---|
| Total jitter (BER = $10^{-12}$) | 31.3 ps |
| RMS jitter | 1.8 ps |
| Peak to peak jitter | 15 ps |

fo = 40 MHz

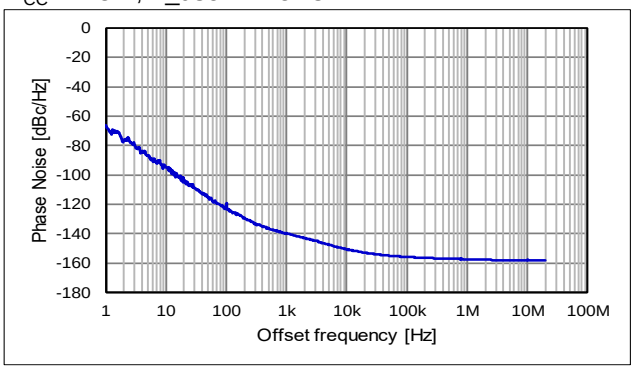
$V_{CC}$ = 3.3 V, T_use = +25 ºC




$V_{CC}$ = 2.5 V, T_use = +25 ºC




$V_{CC}$ = 1.8 V, T_use = +25 ºC




Phase Jitter (Offset frequency: 12 kHz to 20 MHz)

| $V_{CC}$ | Phase Jitter |
|---|---|
| 3.3 V | 0.24 ps |
| 2.5 V | 0.26 ps |
| 1.8 V | 0.32 ps |

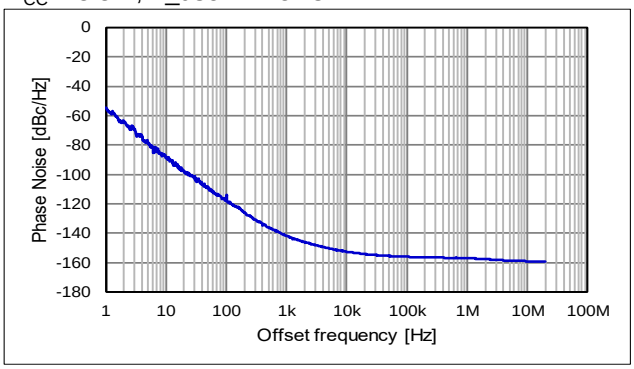
Jitter (T_use = +25 ºC, $V_{CC}$ = 3.3 V)

| | |
|---|---|
| Total jitter (BER = $10^{-12}$) | 22.3 ps |
| RMS jitter | 1.8 ps |
| Peak to peak jitter | 16 ps |

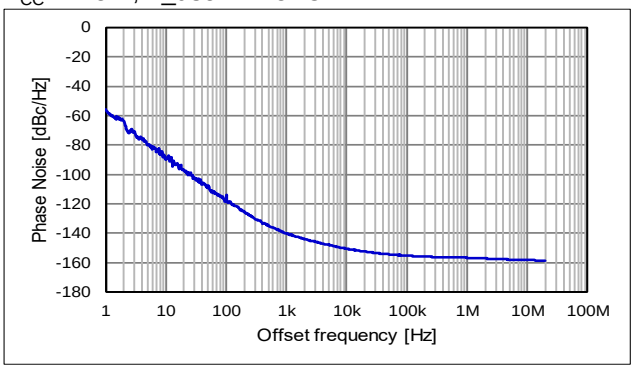
(7-6) Phase Noise and Phase Jitter [cont'd]

fo = 72 MHz

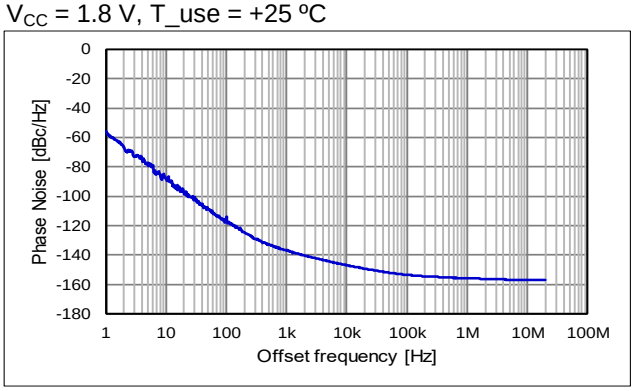
$V_{CC}$ = 3.3 V, T_use = +25 ºC




$V_{CC}$ = 2.5 V, T_use = +25 ºC




$V_{CC}$ = 1.8 V, T_use = +25 ºC




Phase Jitter (Offset frequency: 12 kHz to 20 MHz)

| $V_{CC}$ | Phase Jitter |
|---|---|
| 3.3 V | 0.16 ps |
| 2.5 V | 0.17 ps |
| 1.8 V | 0.20 ps |

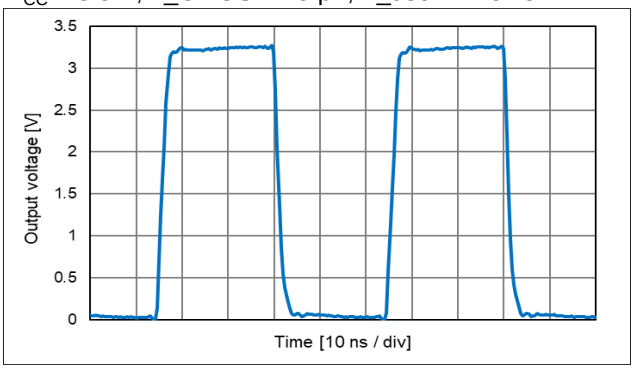
Jitter (T_use = +25 ºC, $V_{CC}$ = 3.3 V)

| | |
|---|---|
| Total jitter (BER = $10^{-12}$) | 21.8 ps |
| RMS jitter | 1.8 ps |
| Peak to peak jitter | 16 ps |

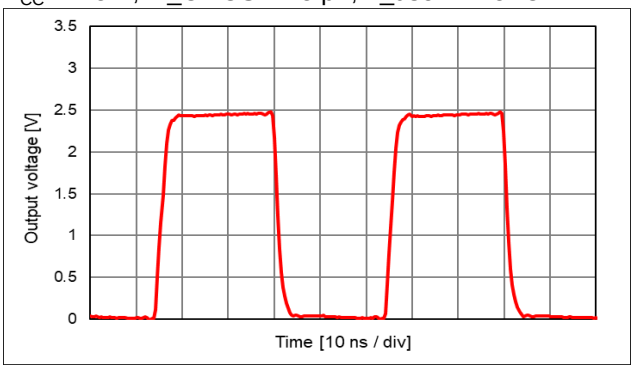
(7-7) Output Waveform

fo = 20 MHz

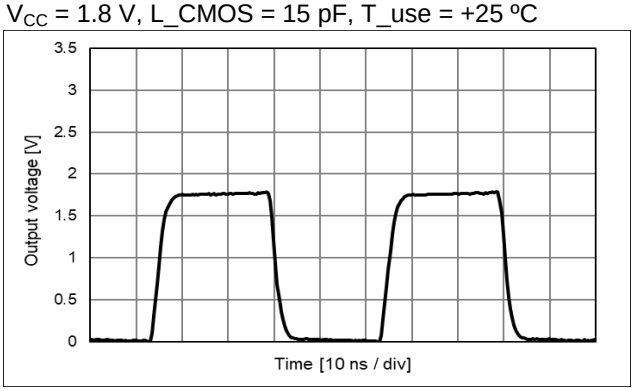
$V_{CC}$ = 3.3 V, L_CMOS = 15 pF, T_use = +25 ºC




$V_{CC}$ = 2.5 V, L_CMOS = 15 pF, T_use = +25 ºC

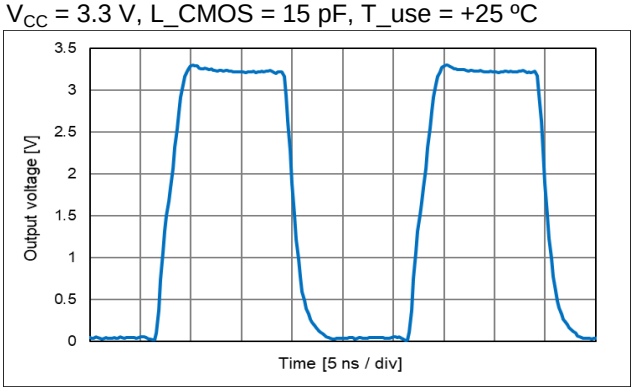



$V_{CC}$ = 1.8 V, L_CMOS = 15 pF, T_use = +25 ºC

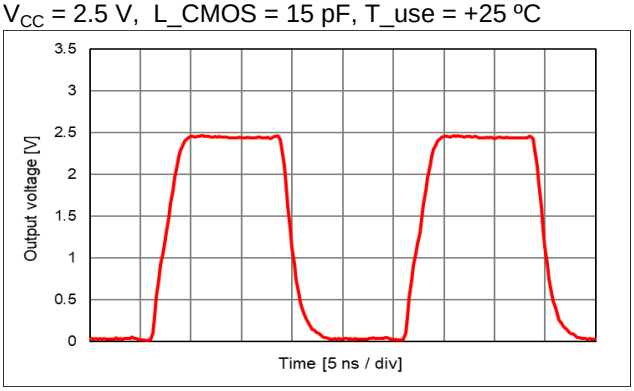



fo = 40 MHz

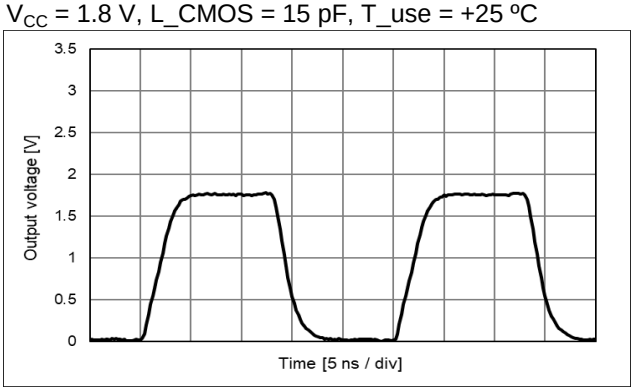
$V_{CC}$ = 3.3 V, L_CMOS = 15 pF, T_use = +25 ºC




$V_{CC}$ = 2.5 V, L_CMOS = 15 pF, T_use = +25 ºC



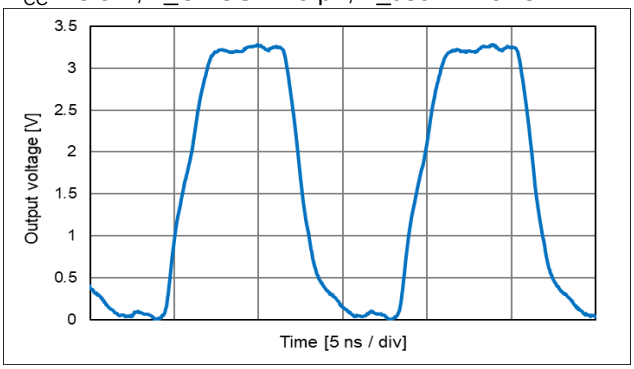

$V_{CC}$ = 1.8 V, L_CMOS = 15 pF, T_use = +25 ºC



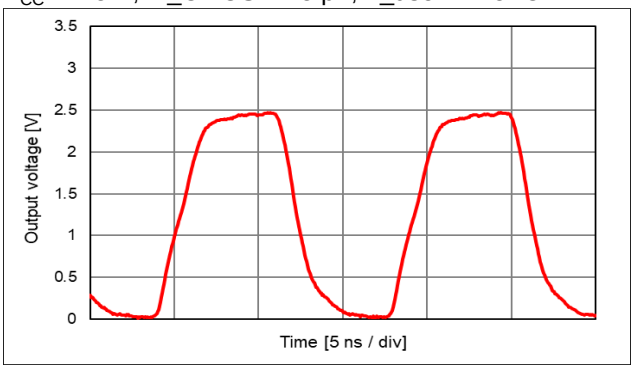
(7-7) Output Waveform [cont'd]

fo = 72 MHz

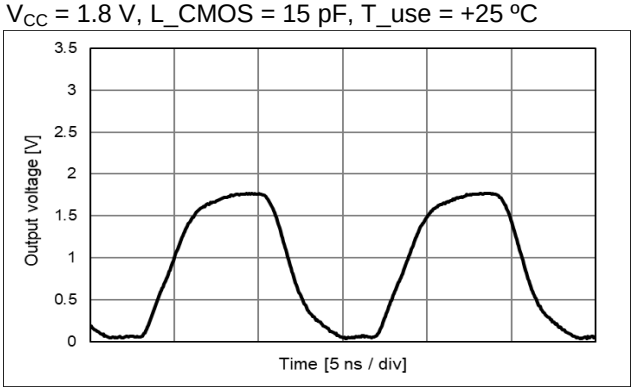
$V_{CC}$ = 3.3 V, L_CMOS = 15 pF, T_use = +25 ºC




$V_{CC}$ = 2.5 V, L_CMOS = 15 pF, T_use = +25 ºC

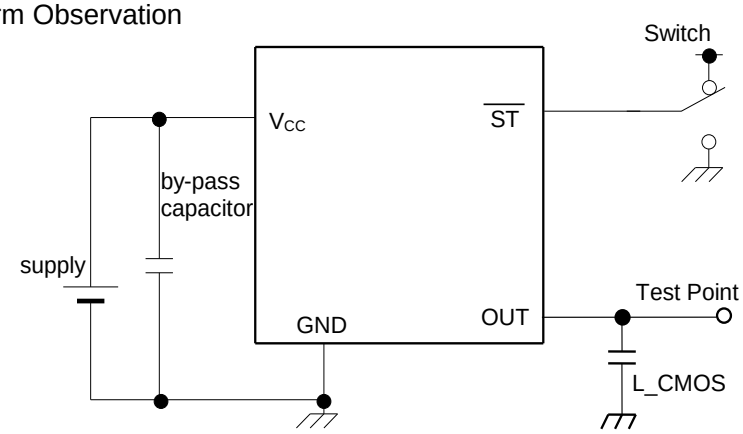



$V_{CC}$ = 1.8 V, L_CMOS = 15 pF, T_use = +25 ºC

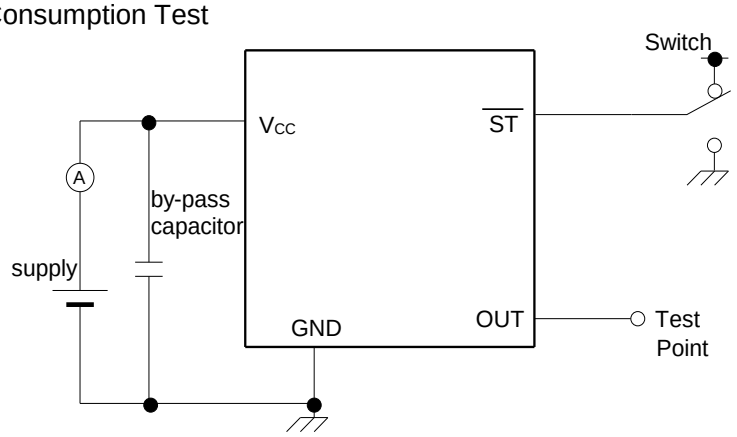


[ 8 ] Test Circuit

(8-1) Waveform Observation




(8-2) Current Consumption Test




*Standby current test should be $\overline{ST}$ = GND.

(8-3) Condition

(1) Oscilloscope

The bandwidth should be minimum 5 times wider than measurement frequency

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

* It is recommended to use miniature socket. (Don't use earth lead.)

(2) L_CMOS includes probe capacitance.

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

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

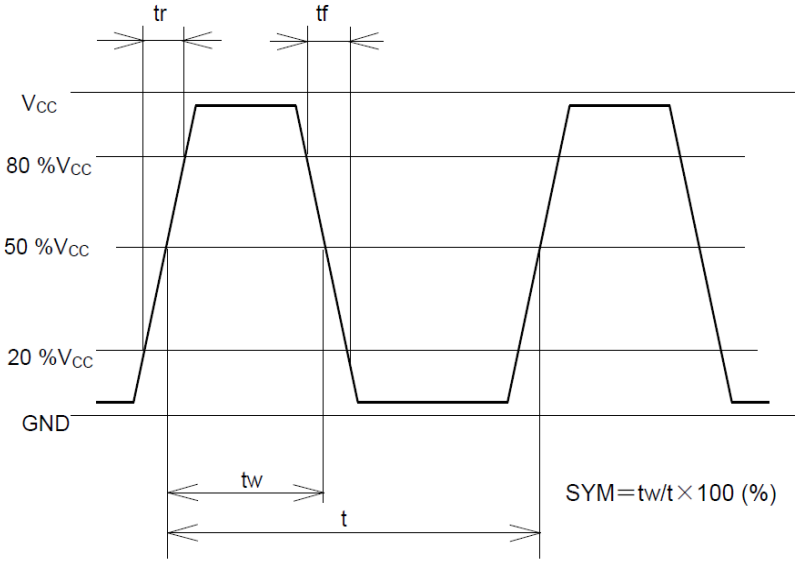
(5) Power Supply

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

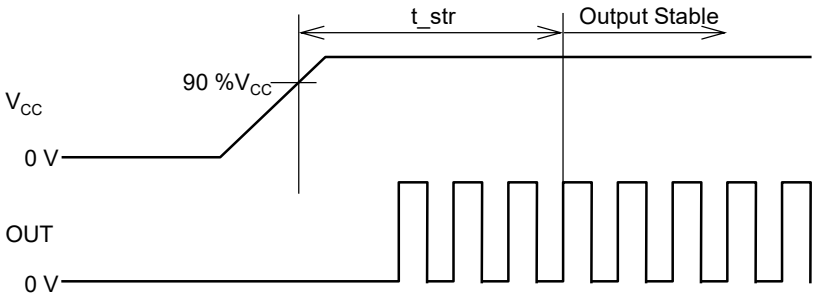
Power supply impedance should be as low as possible

(8-4) Timing Chart

(1) Output Waveform and Level

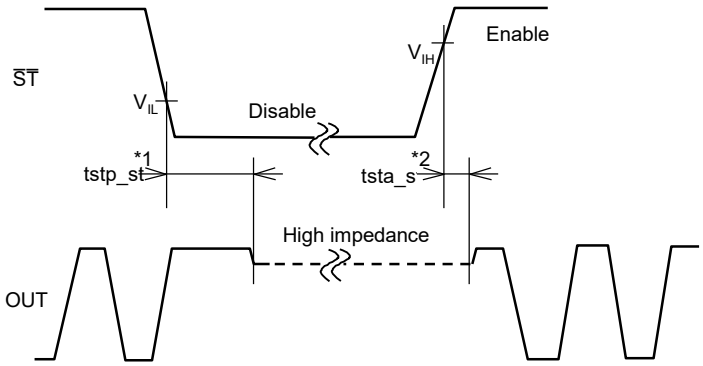



(2) Output Frequency Timing




(3) $\overline{ST}$ Function and Timing

| $\overline{ST}$ Terminal | Osc. circuit | Output status |
|---|---|---|
| "H" or OPEN | Oscillation | Specified frequency: Enable |
| "L" | Oscillation stop | High impedance: Disable |




*1 The period from $\overline{ST}$ = $V_{IL}$ to OUT = High impedance (Disable)

*2 The period from $\overline{ST}$ = $V_{IH}$ to OUT = Enable

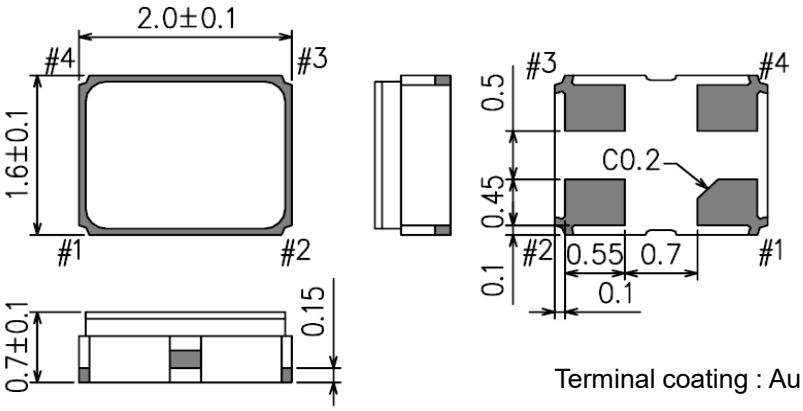
* Judge of starting output: $V_{OH} \geq 80\ \%V_{CC}$, $V_{OL} \leq 20\ \%Vcc$, fout is within fo ± 1 000 × $10^{-6}$

* $\overline{ST}$ terminal voltage level should not exceed supply voltage when using $\overline{ST}$ function.
Please note that $\overline{ST}$ rise time should not exceed supply voltage rise time at the start-up.

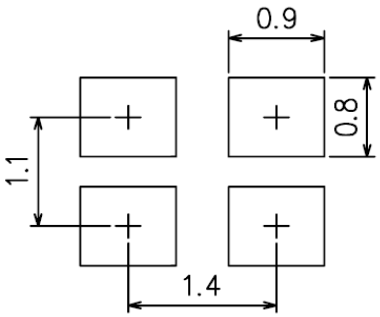
[ 9 ] Outline Drawing and Recommended Footprint

(9-1) SG2016CAN

Units: mm




Terminal coating : Au plating



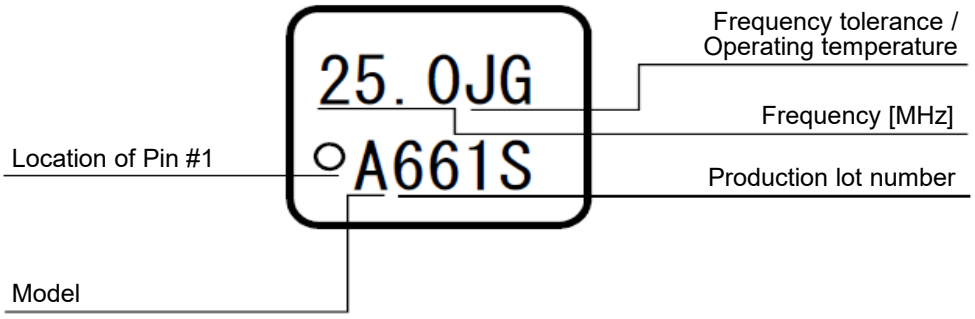

For stable operation, it is recommended that 0.01 µF to 0.1 µF bypass capacitors should be connected between $V_{CC}$ and GND and placed as close to the $V_{CC}$ pin as possible.

Reference Weight Typ.: 9.9 mg

Terminal Assignment

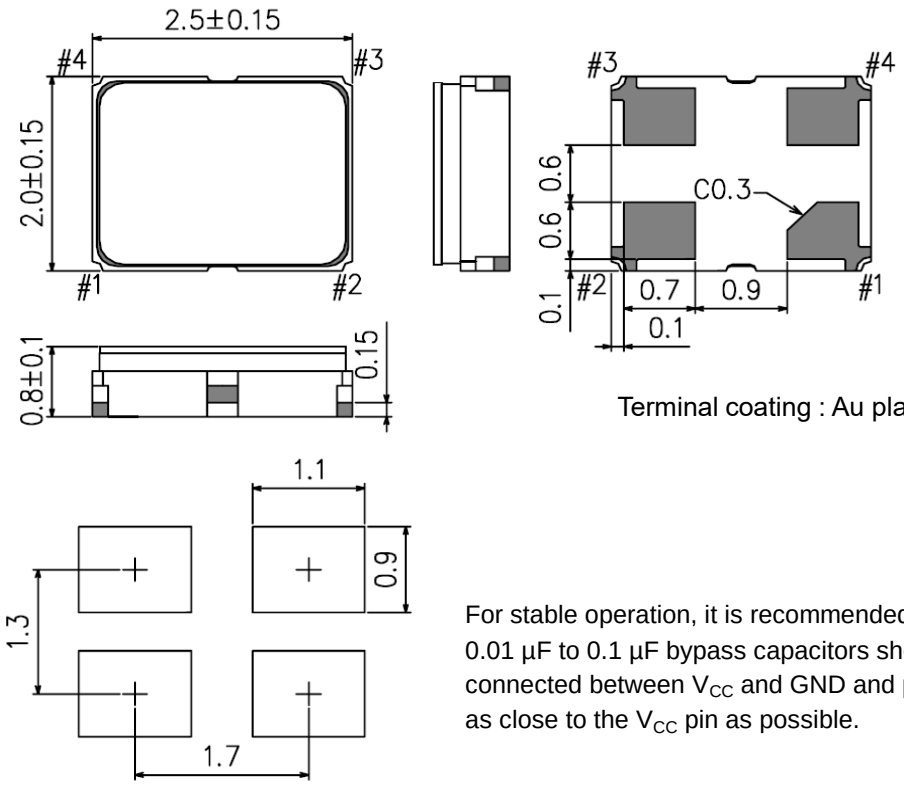
| Pin # | Connection | Function | | |
|---|---|---|---|---|
| #1 | $\overline{ST}$ | $\overline{ST}$ terminal | | |
| | | $\overline{ST}$ function | Osc. Circuit | Output |
| | | "H" or OPEN | Oscillation | Specified frequency: Enable |
| | | "L" | Oscillation stop | High impedance: Disable |
| #2 | GND | GND terminal | | |
| #3 | OUT | Output terminal | | |
| #4 | $V_{CC}$ | $V_{CC}$ terminal | | |

Marking



(9-2) SG-210STF

Units: mm




Terminal coating : Au plating

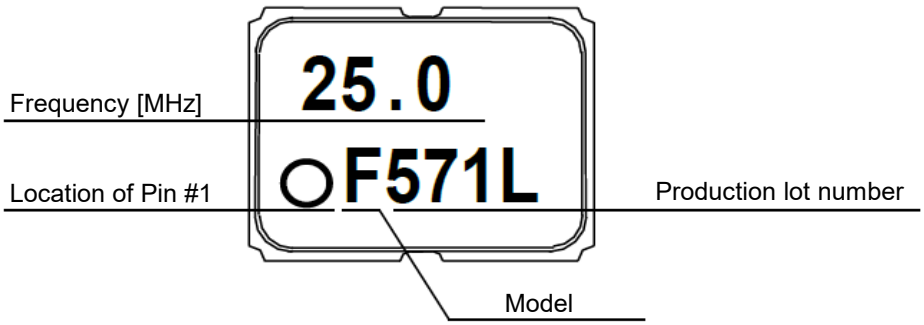
For stable operation, it is recommended that 0.01 µF to 0.1 µF bypass capacitors should be connected between $V_{CC}$ and GND and placed as close to the $V_{CC}$ pin as possible.

Reference Weight Typ.: 14 mg

Terminal Assignment

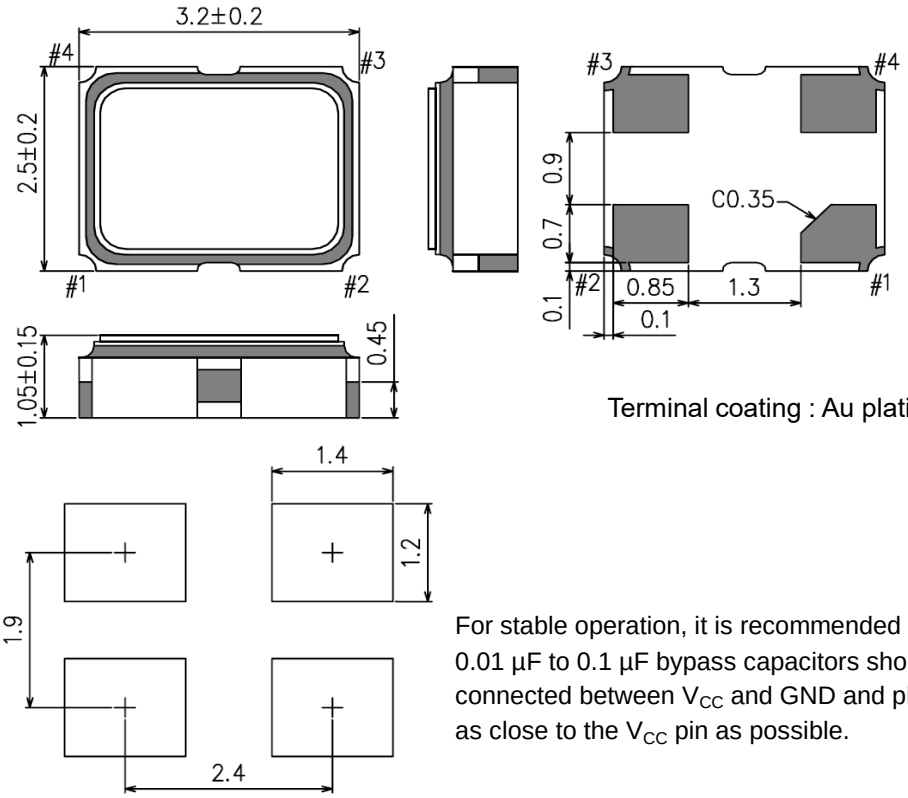
| Pin # | Connection | Function | | |
|---|---|---|---|---|
| #1 | $\overline{ST}$ | $\overline{ST}$ terminal | | |
| | | $\overline{ST}$ function | Osc. Circuit | Output |
| | | "H" or OPEN | Oscillation | Specified frequency: Enable |
| | | "L" | Oscillation stop | High impedance: Disable |
| #2 | GND | GND terminal | | |
| #3 | OUT | Output terminal | | |
| #4 | $V_{CC}$ | $V_{CC}$ terminal | | |

Marking



(9-3) SG3225CAN

Units: mm




Terminal coating : Au plating



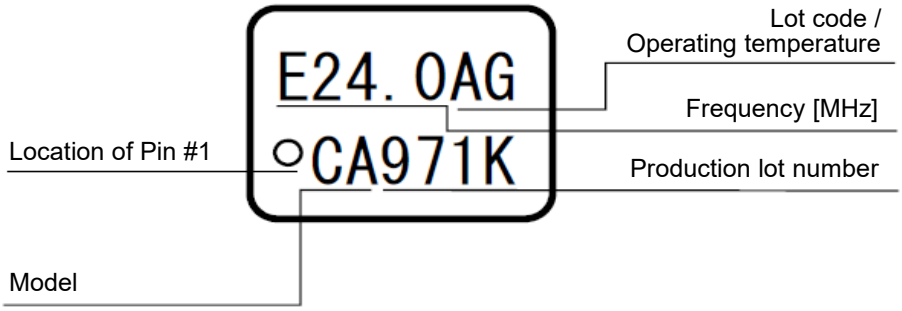

For stable operation, it is recommended that 0.01 µF to 0.1 µF bypass capacitors should be connected between $V_{CC}$ and GND and placed as close to the $V_{CC}$ pin as possible.

Reference Weight Typ.: 25 mg

Terminal Assignment

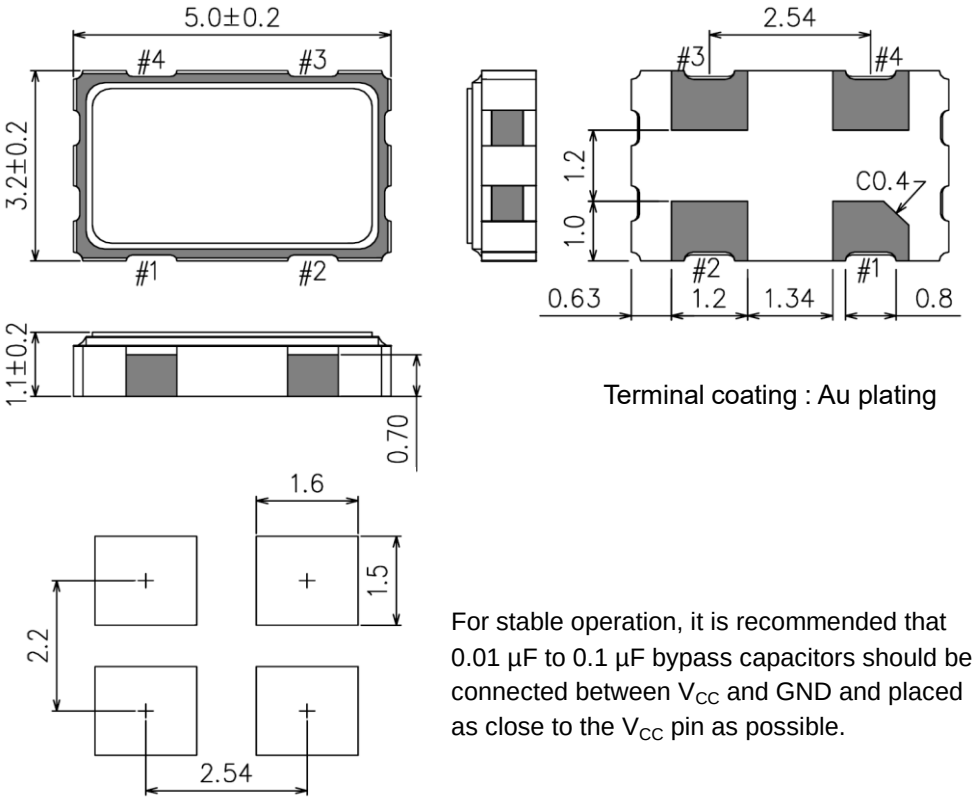
| Pin # | Connection | Function | | |
|---|---|---|---|---|
| #1 | $\overline{ST}$ | $\overline{ST}$ terminal | | |
| | | $\overline{ST}$ function | Osc. Circuit | Output |
| | | "H" or OPEN | Oscillation | Specified frequency: Enable |
| | | "L" | Oscillation stop | High impedance: Disable |
| #2 | GND | GND terminal | | |
| #3 | OUT | Output terminal | | |
| #4 | $V_{CC}$ | $V_{CC}$ terminal | | |

Marking



(9-4) SG5032CAN

Units: mm




Terminal coating : Au plating

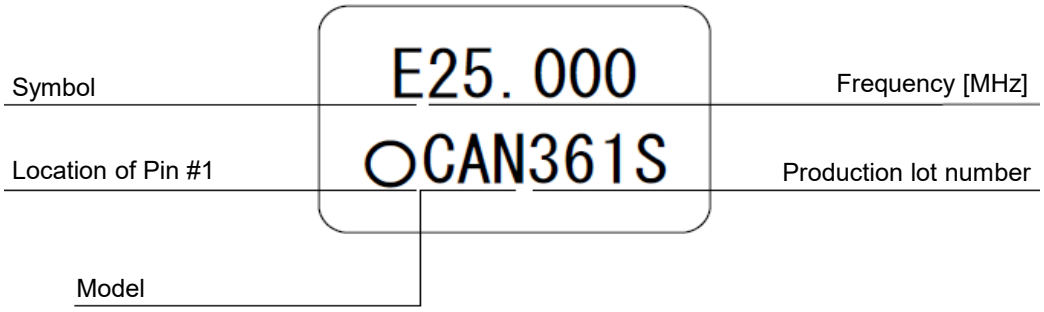
For stable operation, it is recommended that 0.01 µF to 0.1 µF bypass capacitors should be connected between $V_{CC}$ and GND and placed as close to the $V_{CC}$ pin as possible.

Reference Weight Typ.: 52 mg

Terminal Assignment

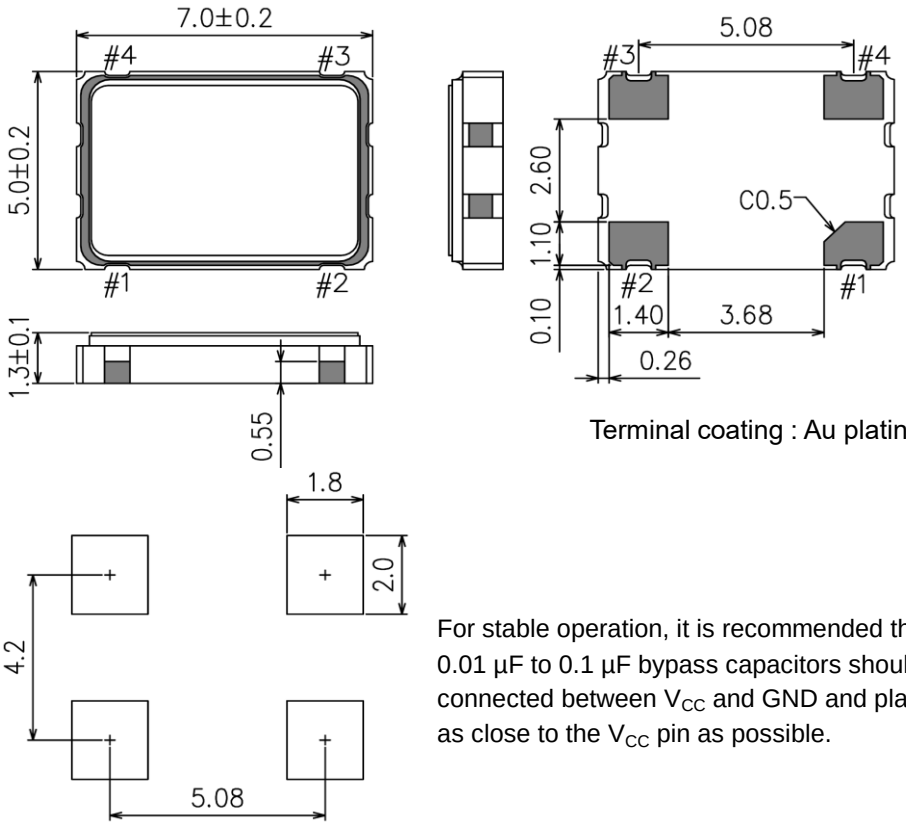
| Pin # | Connection | Function | | |
|---|---|---|---|---|
| #1 | $\overline{ST}$ | $\overline{ST}$ terminal | | |
| | | $\overline{ST}$ function | Osc. Circuit | Output |
| | | "H" or OPEN | Oscillation | Specified frequency: Enable |
| | | "L" | Oscillation stop | High impedance: Disable |
| #2 | GND | GND terminal | | |
| #3 | OUT | Output terminal | | |
| #4 | $V_{CC}$ | $V_{CC}$ terminal | | |

Marking



(9-5) SG7050CAN

Units: mm




Terminal coating : Au plating

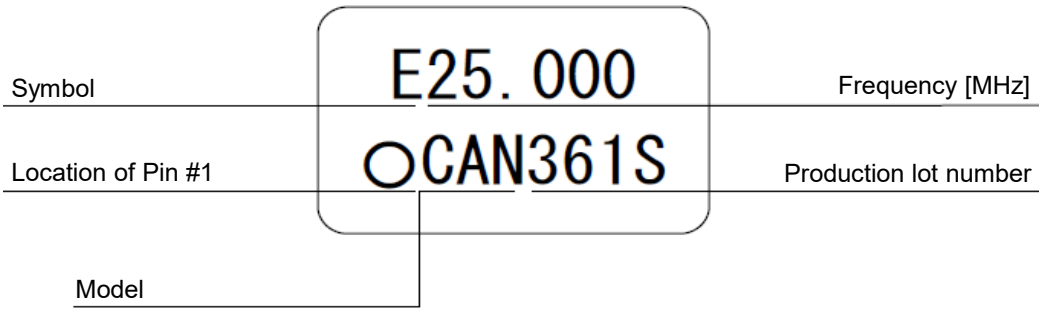
For stable operation, it is recommended that 0.01 µF to 0.1 µF bypass capacitors should be connected between $V_{CC}$ and GND and placed as close to the $V_{CC}$ pin as possible.

Reference Weight Typ.: 147 mg

Terminal Assignment

| Pin # | Connection | Function | | |
|---|---|---|---|---|
| #1 | $\overline{ST}$ | $\overline{ST}$ terminal | | |
| | | $\overline{ST}$ function | Osc. Circuit | Output |
| | | "H" or OPEN | Oscillation | Specified frequency: Enable |
| | | "L" | Oscillation stop | High impedance: Disable |
| #2 | GND | GND terminal | | |
| #3 | OUT | Output terminal | | |
| #4 | $V_{CC}$ | $V_{CC}$ 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)

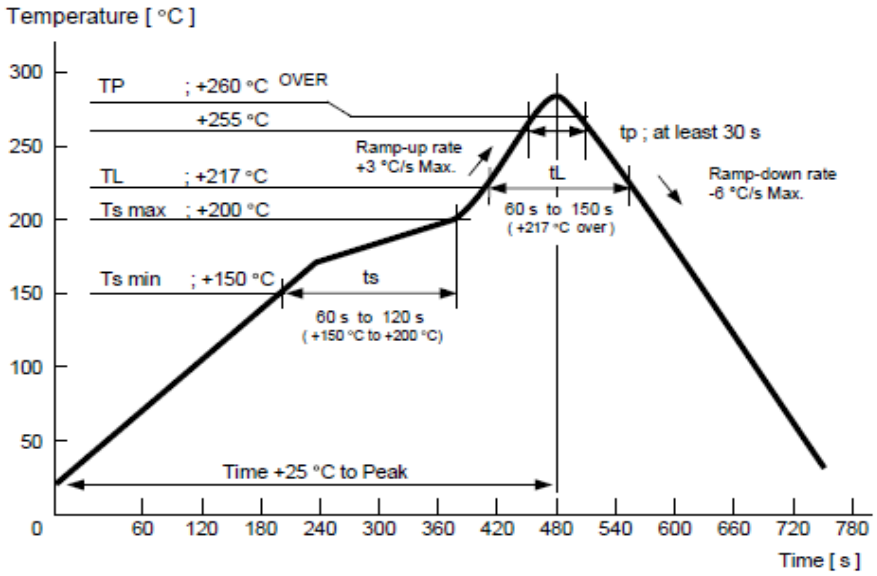
| Parameter | Specification | Conditions |
|---|---|---|
| HBM | 2 000 V Min. | EIAJ ED-4701-1 C111A, 100 pF, 1.5 kΩ, 3 times |
| MM | 200 V Min. | EIAJ ED-4701-1 C111, 200 pF, 0 Ω, 1 time |
| CDM | 750 V Min | AEC-Q100-011 (DCDM) * only for SG2016CAN |

(10-3) Latch-Up

| Parameter | Specification | Conditions |
|---|---|---|
| Latch-up | 100 mA Min. | EIAJ ED-4701-1 C113 |

[ 11 ] Reflow Profiles

IPC/JEDEC J-STD-020D.1



[ 12 ] Packing Information

(12-1) SG2016CAN

(1) Packing Quantity

The last two digits of the Product Number ( X1G004801xxxx**xx**) are a code that defines the packing quantity. The standard is "00" for a 3 000 pcs/Reel.

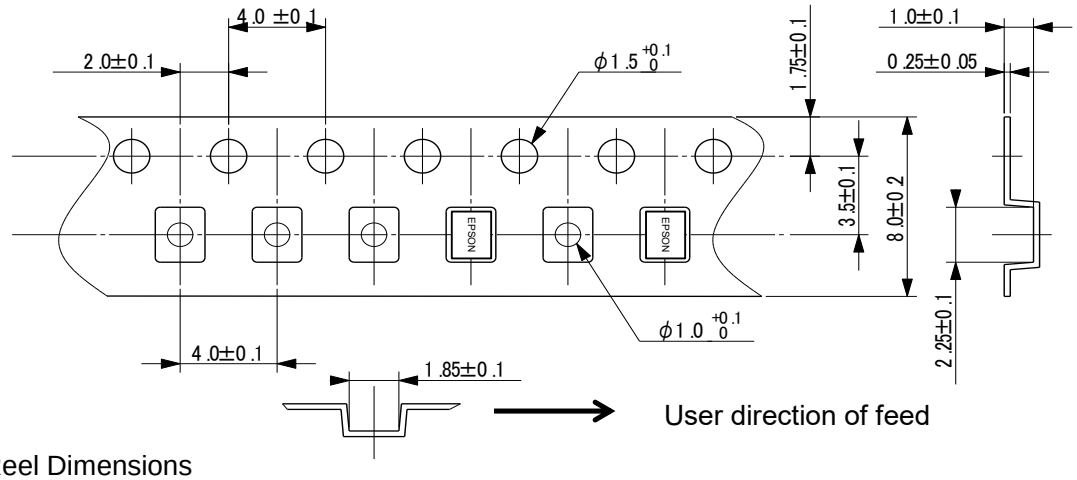
(2) Taping Specification

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

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene)

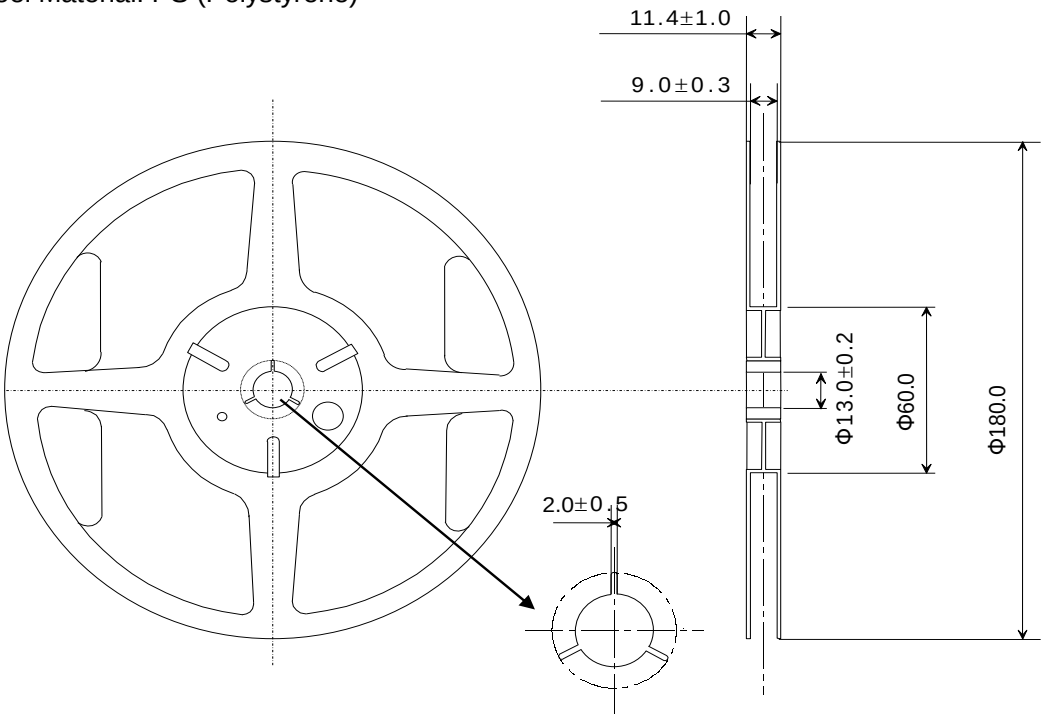
Top Tape Material: PET (Polyethylene Terephthalate) +PE (Polyethylene) Units: mm




2) Reel Dimensions

Center Material: PS (Polystyrene)

Reel Material: PS (Polystyrene) Units: mm




3) Storage Environment

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

(12-2) SG-210STF

(1) Packing Quantity

The last two digits of the Product Number ( X1G004171xxxx**xx**) are a code that defines the packing quantity. The standard is "00" for a 3 000 pcs/Reel.

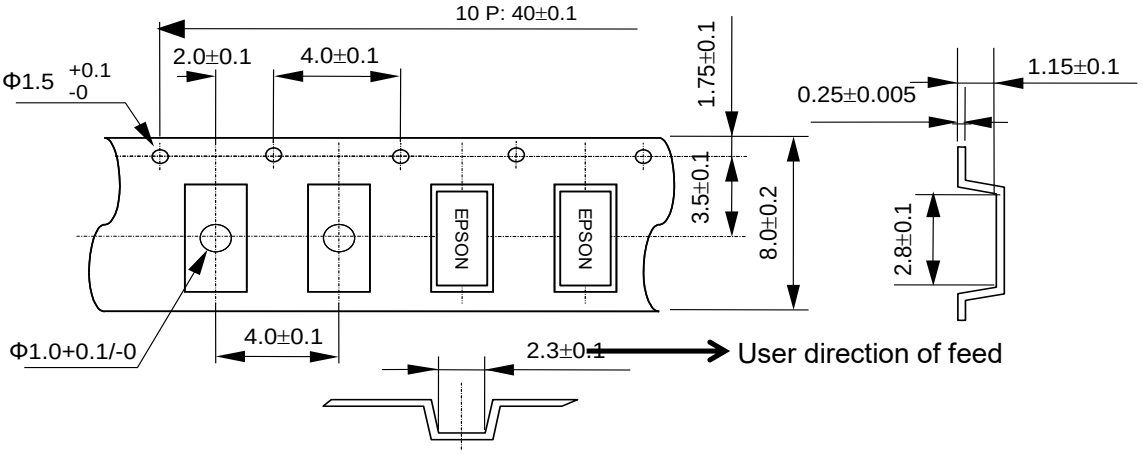
(2) Taping Specification

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

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene)

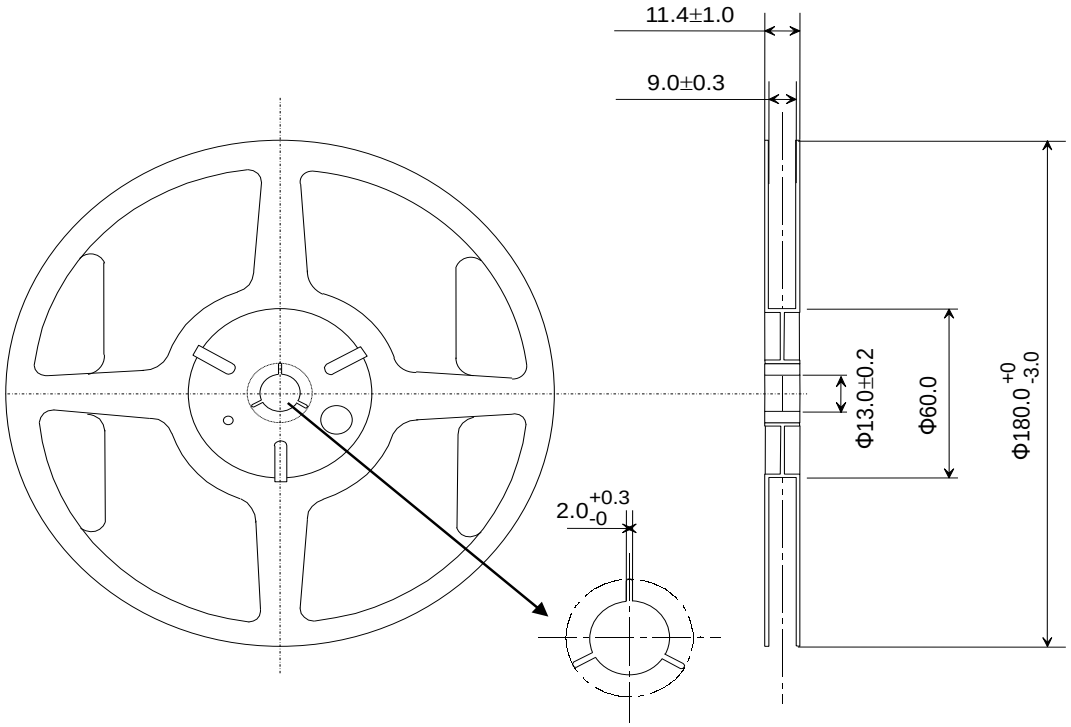
Top Tape Material: PET (Polyethylene Terephthalate) +PE (Polyethylene) Units: mm




2) Reel Dimensions

Center Material: PS (Polystyrene)

Reel Material: PS (Polystyrene) Units: mm




3) Storage Environment

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

(12-3) SG3225CAN

(1) Packing Quantity

The last two digits of the Product Number ( X1G005961xxxx**xx**) are a code that defines the packing quantity. The standard is "15" for a 2 000 pcs/Reel.

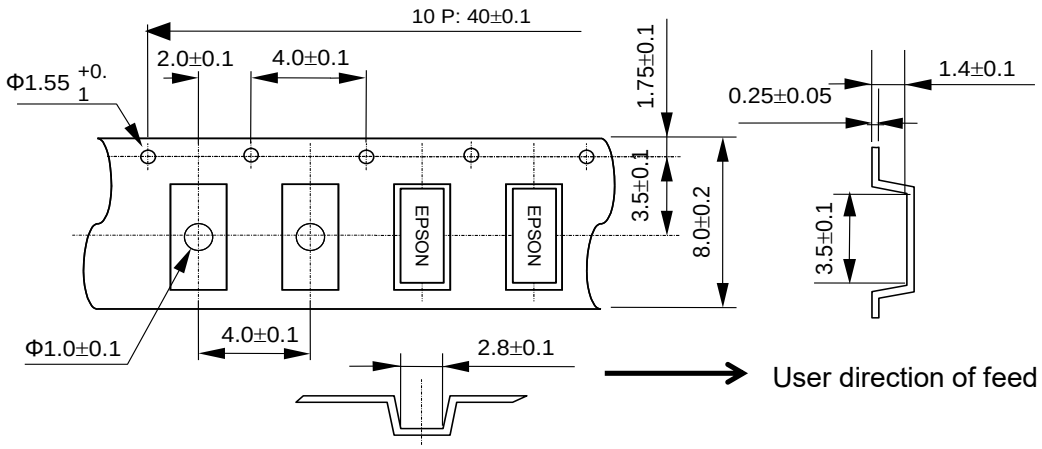
(2) Taping Specification

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

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene)

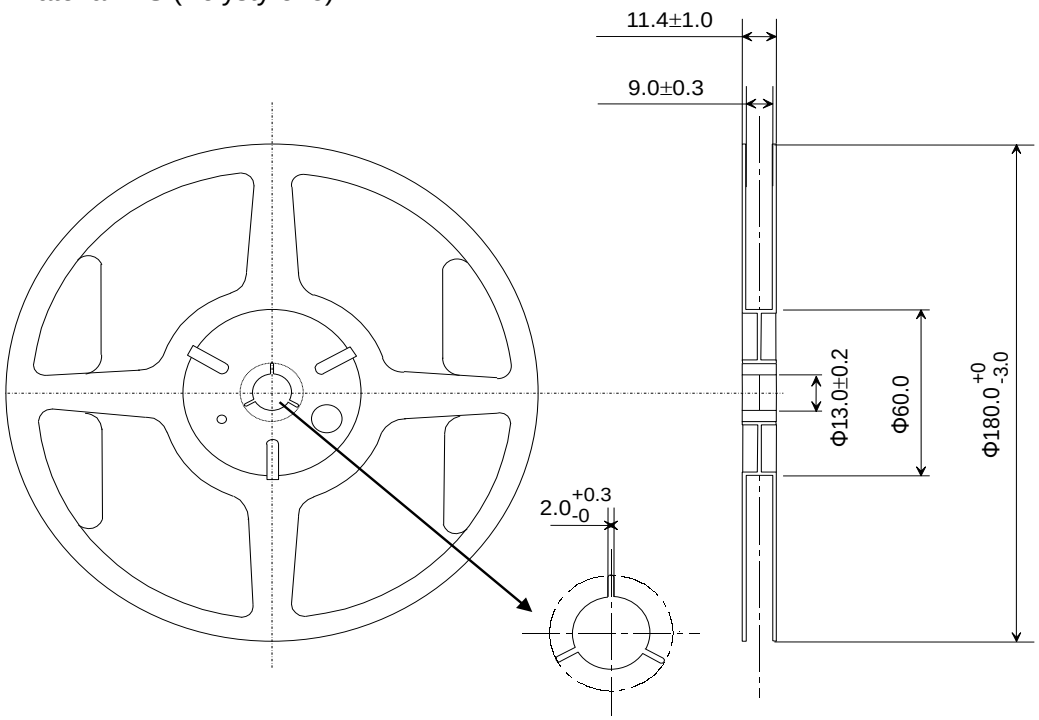
Top Tape Material: PET (Polyethylene Terephthalate) +PE (Polyethylene) Units: mm




2) Reel Dimensions

Center Material: PS (Polystyrene)

Reel Material: PS (Polystyrene) Units: mm




3) Storage Environment

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

(12-4) SG5032CAN

(1) Packing Quantity

The last two digits of the Product Number ( X1G004451xxxx**xx**) are a code that defines the packing quantity. The standard is "00" for a 1 000 pcs/Reel.

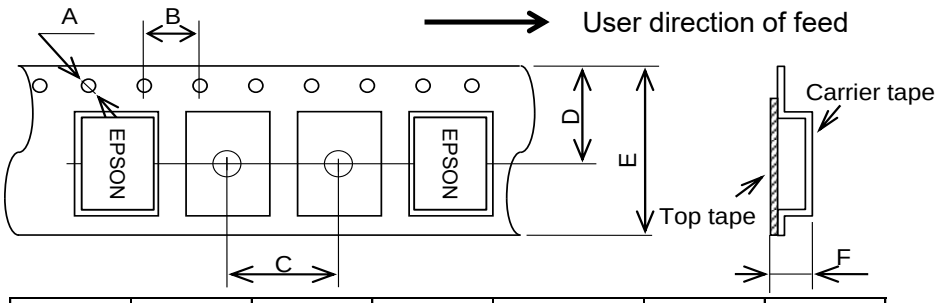
(2) Taping Specification

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

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene)

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

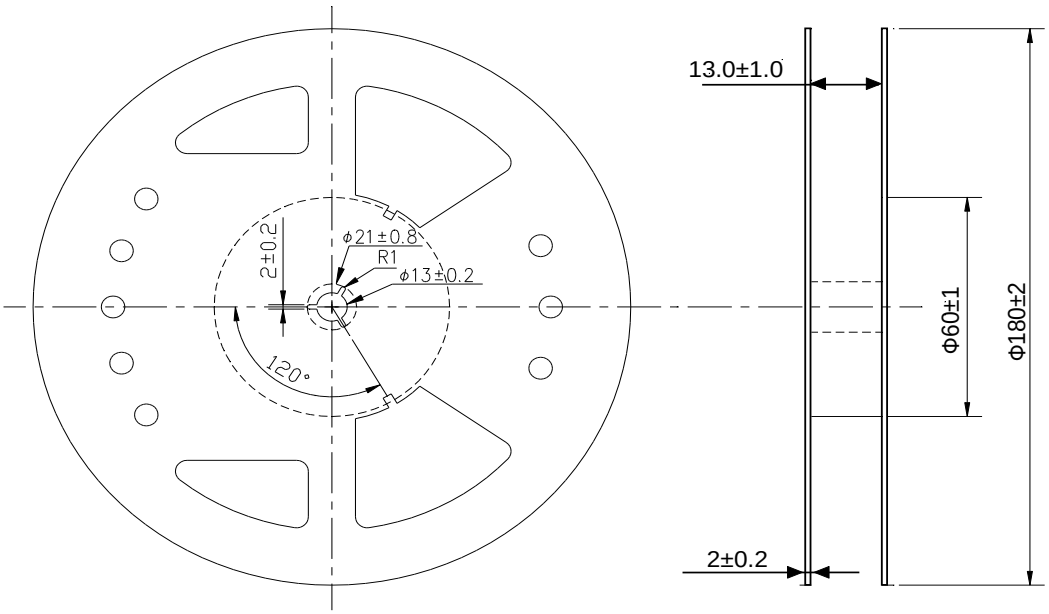



| Symbol | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Value | φ1.5 +0.1/-0 | 4.0±0.1 | 8.0±0.1 | 7.25±0.2 | 12.0±0.2 | 1.40±0.1 |

2) Reel Dimensions

Center Material: PS (Polystyrene)

Reel Material: PS (Polystyrene) Units: mm




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.

(12-5) SG7050CAN

(1) Packing Quantity

The last two digits of the Product Number ( X1G004481xxxx**xx**) are a code that defines the packing quantity. The standard is "00" for a 1 000 pcs/Reel.

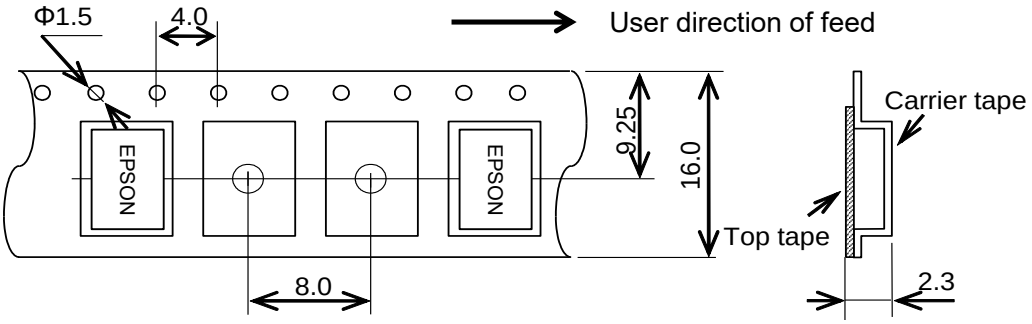
(2) Taping Specification

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

1) Tape Dimensions

Carrier Tape Material: PS (Polystyrene)

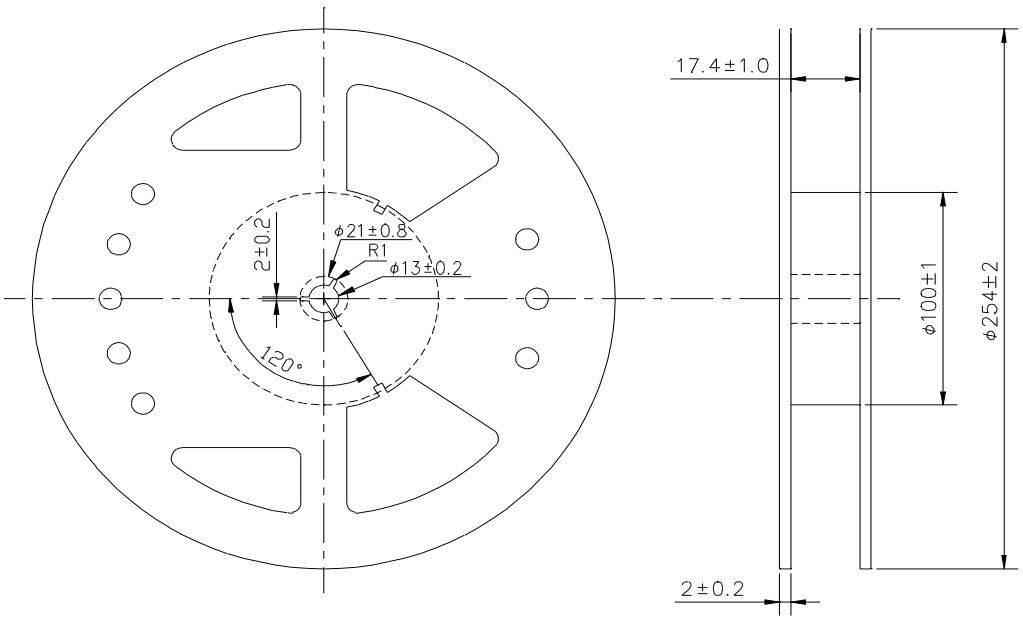
Top Tape Material: PET (Polyethylene Terephthalate) +PE (Polyethylene) Units: mm




2) Reel Dimensions

Center Material: PS (Polystyrene)

Reel Material: PS (Polystyrene) Units: mm




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 us to verify and confirm that the performanc
affected by use under such conditions.
In addition to the foregoing precautions, in order to avoid the deteriorating performance of the product, we strongly recommend that you DO NOT use the product under ANY of the following conditions:

(1) Mounting the product on a board using water-soluble solder flux and using the product without removing the residue of the flux completely from the board. The residue of such flux that is soluble in water or water-soluble cleaning agent, especially the residues which contains active halogens, will negatively affect the performance and reliability of the product.
(2) Using the product in any manner that will result in any shock or impact to the product.
(3) Using the product in places where the product is exposed to water, chemicals, organic solvent, sunlight, dust, corrosive gasses, or other materials.
(4) Using the product in places where the product is exposed to static electricity or electromagnetic waves.
(5) Applying ultrasonic cleaning without advance verification and confirmation that the product will not be affected by such a cleaning process, because it may damage the crystal,
(6) Using the product under any other conditions that may negatively affect the performance and/or reliability of the product.
(7) 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 from environmental tests results to the expectation of the amount of the frequency variation. This doesn't guarantee the product-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.**<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) |