## 1. OVERVIEW

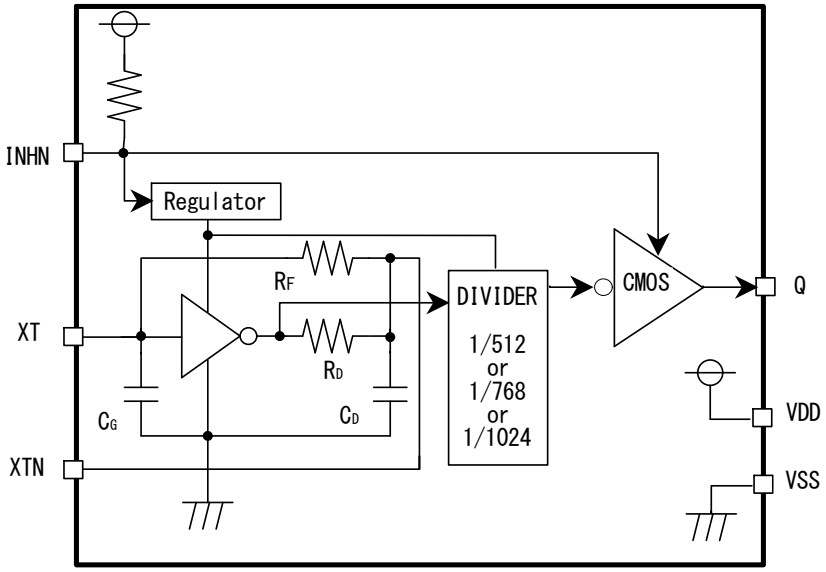
The CF/WF7202Hxxx is 32.768 kHz output and 125°C operation crystal oscillator module ICs with divide-by-512 (or divide-by-768, divide-by-1024) frequency, AT-cut crystal 16.777216MHz (or 25.165824MHz, 33.554432MHz) oscillator circuit built-in.

It is possible to generate a 32.768 kHz output crystal oscillator with excellent temperature characteristics by using AT-cut crystal.

## 2. FEATURES

- Operating supply voltage: 1.6V to 3.63V
- Recommended oscillation frequency (Fundamental-frequency)
  - 7202C1x: 16.777216MHz
  - 7202C2x: 25.165824MHz
  - 7202C3x: 33.554432MHz
- Regulated voltage drive circuit for reduced power consumption
  - 7202C1A Typical: 7μA, $V_{DD}$=3.3V, Output load is none.
- Output drive capability: ±1mA
- Output frequency: 32.768kHz
- Operation temperature: -40 to 125 °C
- Output 3-state function
- Low standby current (oscillator stopped, power saving pull-up resistor)
- Oscillation detection circuit built-in

## 3. BLOCK DIAGRAM

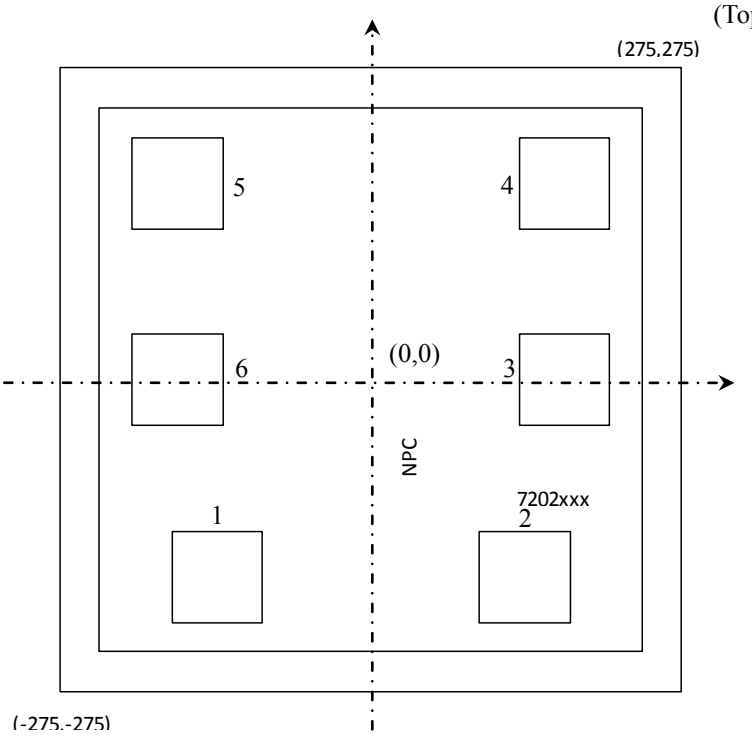


## 4. PAD DIMENSIONS

(1) Chip size[*1] : X=0.55mm,Y=0.55mm
(2) Rear surface : $V_{SS}$ potential
(3) Pad aperture size: 80um×80um
(4) Chip form

*1: The chip size is the value measured between scribe line centers.

(Top view)




Pad Dimensions (origin at chip center) Unit[μm]

| No. | X | Y | Layout type | |
|---|---|---|---|---|
| | | | A Ver. | C Ver. |
| 1 | -136 | -174 | XT | XT |
| 2 | 136 | -174 | XTN | XTN |
| 3 | 171 | 0 | VDD | VSS |
| 4 | 171 | 173 | Q | Q |
| 5 | -171 | 173 | VSS | VDD |
| 6 | -171 | 0 | INHN | INHN |

## 5. PAD DESCRIPTION

| Name | I/O | Description |
|---|---|---|
| XT | I | ・Crystal element connection pins<br>・Connect crystal between XT and XTN pins. |
| XTN | O | |
| VDD | - | ・Supply voltage |
| Q | O | ・32.768kHz frequency output<br>・High-impedance output in standby mode |
| VSS | - | ・Ground |
| INHN | I | ・Oscillator is stopped in standby mode when LOW.<br>・Pull-up resistor built-in |

I：input pin, O：output pin

## 6. 7202Hxxx SERIES CONFIGURATION

| Version Name | Fundamental Oscillation frequency | Frequency | Current consumption | Negative resistance design value (C0=1.0pF) | Standby state | |
|---|---|---|---|---|---|---|
| | | | | | Oscillator stopped | Output |
| C1A | $f_{osc}$ 16.777216MHz | 32.768kHz ($f_{osc}$/512) | Low | -300Ω | Yes | Hi-Z |
| (C1B)* | | | Middle | (-800Ω) | | |
| (C1C)* | | | High | (-1200Ω) | | |
| (C2A)* | $f_{osc}$ 25.165824MHz | 32.768kHz ($f_{osc}$/768) | Low | (-400Ω) | | |
| (C2B)* | | | Middle | (-850Ω) | | |
| (C2C)* | | | High | (-1250Ω) | | |
| C3A | $f_{osc}$ 33.554432MHz | 32.768kHz ($f_{osc}$/1024) | Low | -400Ω | | |
| (C3B)* | | | Middle | (-750Ω) | | |
| (C3C)* | | | High | (-1100Ω) | | |

Note * : Under development stage.

Please ask our sales for details of electrical characteristics in each version. (including Axx version)

### 6.1. Version Name Format

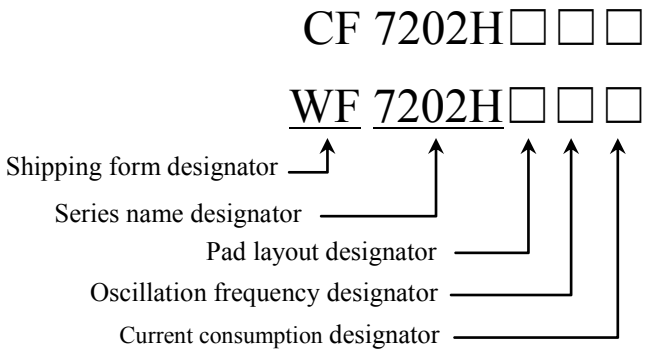
The version name comprises 3 alphanumeric characters after series name.
The meaning of **t**he product name in each figure is

(1) Shipping form designator
- CF : Chip form
- WF : Wafer form

(2) Pad layout designator
- A : Flip Chip Bonding
- C : Wire Bonding Type

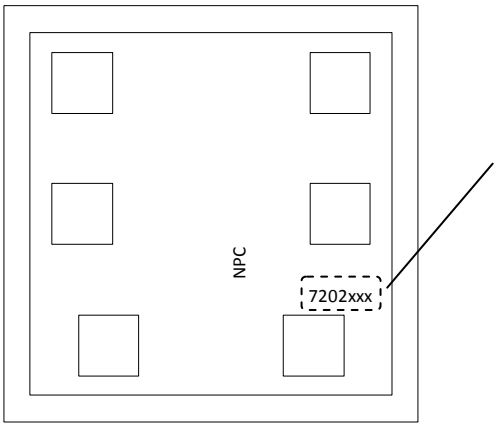
(3) Oscillation frequency designator
- 1 : 16.777216MHz
- 2 : 25.165824MHz
- 3 : 33.554432MHz

(4) Current consumption designator
- A : Current consumption Low (Current consumption serious type)
- B : Current consumption Middle (Balance type)
- C : Current consumption High (Negative resistance serious type)




### 6.2. Distinguishing between versions

The 7202H series device type is determined by switched mask.
Device is produced by corresponded mask to the ordered version, and electrical characteristics tested.
The version is identified by the version name marking on the chip.




**The version name marking on the chip**
Series name other than "H" + Version name

## 7. ABSOLUTE MAXIMUM RATINGS

$V_{SS}$=0V

| Parameter | Symbol | Conditions | Rating | Unit | Remarks |
|---|---|---|---|---|---|
| Supply voltage range | $V_{DD}$ | Voltage between VDD and VSS | -0.3 to +4.5 | V | *1 |
| Input voltage range | $V_{IN1}$ | INHN pin | -0.3 to $V_{DD}$+0.3 | V | *1,*2 |
| | $V_{IN2}$ | XT pin | -0.3 to +2.5 | V | *1,*2 |
| Output voltage range | $V_{OUT1}$ | Q pin | -0.3 to $V_{DD}$+0.3 | V | *1,*2 |
| | $V_{OUT2}$ | XTN pin | -0.3 to +2.5 | V | *1,*2 |
| Output current | $I_{OUT}$ | Q output | ±5.0 | mA | *3 |
| Junction temperature | $T_j$ | | 150 | °C | *3 |
| Storage temperature range | $T_{STG}$ | Chip form wafer form | -55 to +150 | °C | *4 |

*1: Absolute maximum ratings are the values that must never exceed even for a moment. This product may suffer breakdown if any one of these parameter ratings is exceeded. Operation and characteristics are guaranteed only when the product is operated at recommended supply voltage range.
*2: $V_{DD}$ is a $V_{DD}$ value of recommended operating conditions.
*3: Do not exceed the absolute maximum ratings. If they are exceeded, a characteristic and reliability will be degraded.
*4: When stored alone in nitrogen or vacuum atmosphere.

## 8. RECOMMENDED OPERATING CONDITIONS

$V_{SS}$=0V

| Parameter | Symbol | Conditions | MIN | TYP | MAX | Unit |
|---|---|---|---|---|---|---|
| Oscillator frequency | $f_{osc}$ | C1xVer. $V_{DD}$=1.6～3.63V | | 16.777216 | | MHz |
| | | C2xVer. $V_{DD}$=1.6～3.63V | | 25.165824 | | |
| | | C3xVer. $V_{DD}$=1.6～3.63V | | 33.554432 | | |
| Output frequency | $f_{out}$ | $V_{DD}$=1.6～3.63V,$C_{LOUT}$=15pF | | 32.768 | | kHz |
| Operating supply voltage | $V_{DD}$ | Voltage between VDD and VSS *1 | 1.6 | | 3.63 | V |
| Input Voltage | $V_{IN1}$ | INHN input | $V_{SS}$ | | $V_{DD}$ | V |
| Operating temperature | $T_a$ | | -40 | | +125 | °C |
| Output load capacitance | $C_{LOUT}$ | Q output | | | 15 | pF |

*1: For stable operation of this product, please mount ceramic chip capacitor that is more than 0.01uF between VDD and VSS in close proximity to IC (within 3mm). Wiring pattern between IC and capacitor should be as thick as possible.
* Since it may influence the reliability if it is used out of the recommended operating conditions range, this product should be used within this range.

## 9. ELECTRICAL CHARACTERISTICS

### 9.1. DC Characteristic

$V_{DD}$=1.6 to 3.63V, $V_{SS}$=0V, Ta=-40 to +125°C unless otherwise noted

| Parameter | Symbol | Conditions | | MIN | TYP | MAX | Unit |
|---|---|---|---|---|---|---|---|
| Current consumption (C1A ver. : divide-by-512) | $I_{DD}$_3.3V | Measurement circuit1,INHN="Open", No load, $f_{OSC}$=16.777216MHz, $f_{OUT}$=32.768kHz | $V_{DD}$=3.3V | | 7 | 12 | µA |
| | $I_{DD}$_1.8V | | $V_{DD}$=1.8V | | 6.5 | 11 | |
| Current consumption (C3A ver. : divide-by-1024) | $I_{DD}$_3.3V | Measurement circuit1,INHN="Open", No load, $f_{OSC}$=33.554432MHz, $f_{OUT}$=32.768kHz | $V_{DD}$=3.3V | | 18 | 32 | µA |
| | $I_{DD}$_1.8V | | $V_{DD}$=1.8V | | 17.5 | 31 | |
| Q pin HIGH-level output voltage | $V_{OH}$ | Measurement circuit3,$I_{OH}$=-1mA | | $V_{DD}$ -0.4 | | $V_{DD}$ | V |
| Q pin LOW-level output voltage | $V_{OL}$ | Measurement circuit3,$I_{OL}$=1mA | | 0 | | 0.4 | V |
| INHN pin HIGH-level input voltage | $V_{IH}$ | Measurement circuit4 | | 0.7$V_{DD}$ | | | V |
| INHN pin LOW-level input voltage | $V_{IL}$ | Measurement circuit4 | | | | 0.3$V_{DD}$ | V |
| Q pin Output leakage current | $I_Z$ | Q pin, Measurement circuit5, INHN="Low" | Q=$V_{DD}$ | | | 5 | µA |
| | | | Q=$V_{SS}$ | -5 | | | |
| Standby current | $I_{ST}$ | Measurement circuit1,INHN= $V_{SS}$ | | | | 5 | µA |
| INHN pin pull-up resistance | $R_{PU1}$ | Measurement circuit6, INHN=$V_{SS}$ | | 1 | 2 | 3 | MΩ |
| | $R_{PU2}$ | Measurement circuit6, INHN=0.7$V_{DD}$ | | 50 | 100 | 150 | kΩ |
| Oscillator feedback resistance | $R_f$ | | | 250 | 350 | 500 | kΩ |
| Oscillator capacitance | $C_G$ | Design value, including parasitic capacitance. | | | 2.5 | | pF |
| | $C_D$ | Design value, including parasitic capacitance. | | | 2.5 | | |

*1: The consumption current $I_{DD}(C_{LOUT})$ with a load capacitance ($C_{LOUT}$) connected to the Q pin is given by the following equation, where $I_{DD}$ is the no-load consumption current and $f_{OUT}$ is the output frequency.

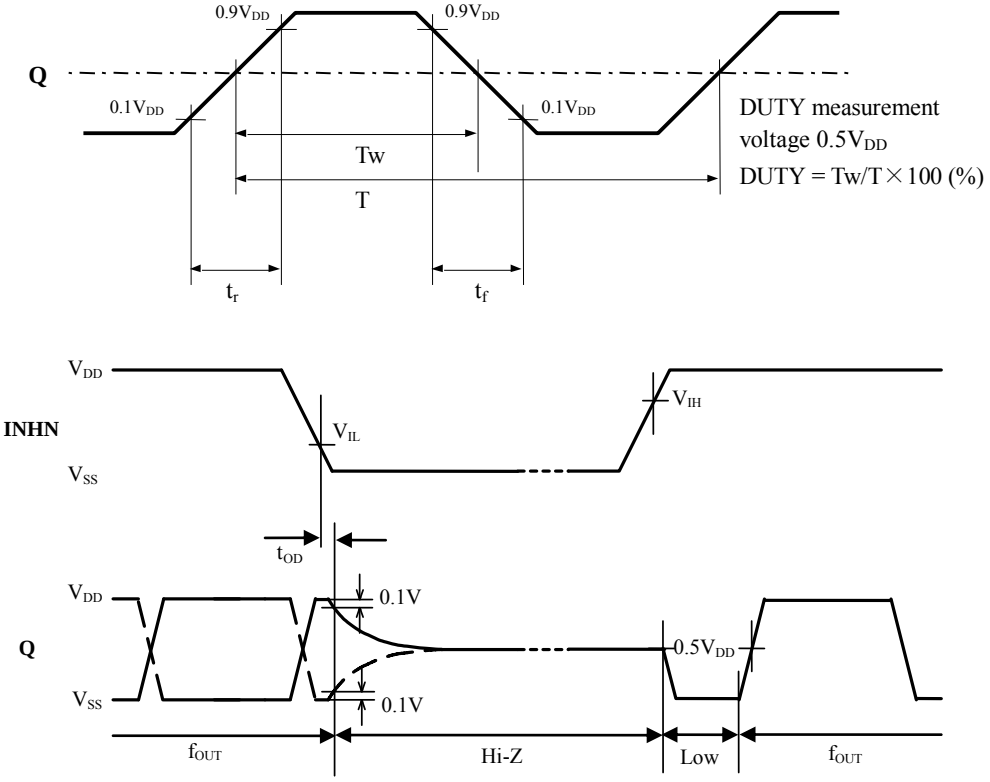
$$I_{DD}(C_{LOUT})[uA] = I_{DD}[uA] + C_{LOUT}[pF] \times V_{DD}[V] \times f_{OUT}[kHz] \cdot 10^{-3}$$

### 9.2. AC Characteristics

$V_{DD}$=1.6 to 3.63V, $V_{SS}$=0V, Ta=-40 to +125°C unless otherwise noted

| Parameter | Symbol | Conditions | MIN | TYP | MAX | Unit |
|---|---|---|---|---|---|---|
| Q pin<br>Output rise time | $t_r$ | Measurement circuit1, $C_{LOUT}$=15pF,<br>$0.1V_{DD}\rightarrow0.9V_{DD}$ | | 10 | 50 | ns |
| Q pin<br>Output fall time | $t_f$ | Measurement circuit1,$C_{LOUT}$=15pF,<br>$0.9V_{DD}\rightarrow0.1V_{DD}$ | | 10 | 50 | ns |
| Q pin<br>Output duty cycle | DUTY | Measurement circuit1,$T_a$=25°C,<br>$C_{LOUT}$=15pF | 45 | 50 | 55 | % |
| Q pin<br>Output disable delay time | $t_{OD}$ | Measurement circuit2,$T_a$=25°C,$C_{LOUT}\leq$15pF | | | 1 | µs |

TIMING DIAGRAMS




・When INHN goes HIGH to LOW, the Q output becomes high impedance.

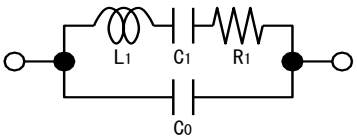
・When INHN goes LOW to HIGH, the Q output goes LOW once and then becomes normal output operation after having detected oscillation signals.

## 10. REFERENCE DATA (7202HC1A Typical characteristic)

The following characteristics are measured using the crystal below.
Note that the characteristics will vary with the crystal used.

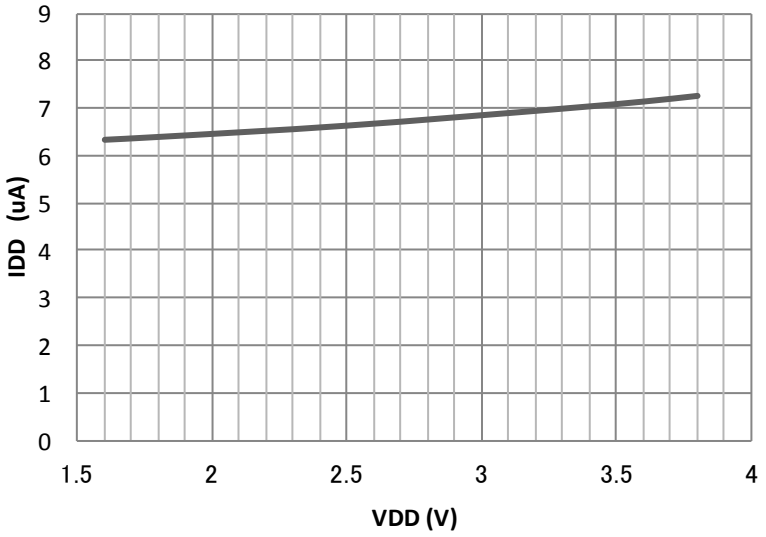
* Crystal used for measurement

| Parameter | 16.777MHz |
|---|---|
| C0(pF) | 0.6 |
| R1(Ω) | 64.9 |

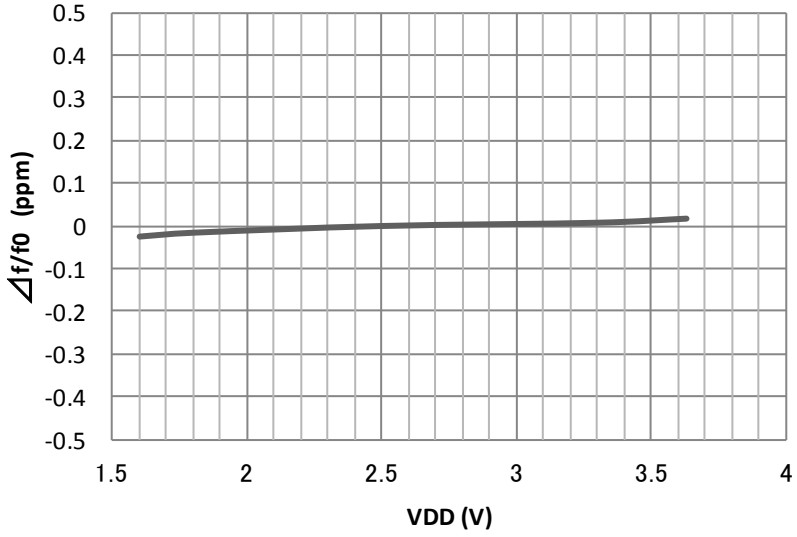



**Crystal parameters**

### 10.1. Current Consumption




### 10.2. Frequency Deviation with Voltage



## 11. FUNCTIONAL DESCRIPTION

### 11.1. INHN Function

Q output is stopped and becomes high impedance.

| INHN | Q | Oscillator |
|---|---|---|
| HIGH or Open | $f_{OUT}$ | Operating |
| LOW | Hi-Z | Stopped |

### 11.2. Power Saving Pull-up Resistor

The INHN pin pull-up resistance changes its value to $R_{PU1}$ or $R_{PU2}$ in response to the input level (HIGH or LOW).

When INHN is tied to LOW level, the pull-up resistance becomes large ($R_{PU1}$), thus reducing the current consumed by the resistance. When INHN is left open circuit or tied to HIGH level, the pull-up resistance becomes small ($R_{PU2}$), thus internal circuit of INHN becomes HIGH level.

Consequently, the IC is less susceptible to the effects of noise, helping to avoid problems such as the output stopping suddenly.

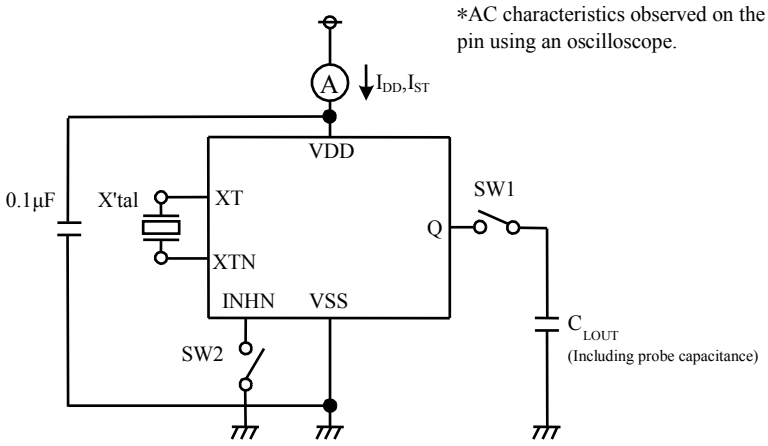
### 11.3. Oscillation Detection Function

The 7202H series have an oscillation detection circuit.

The oscillation detection circuit disables the output until crystal oscillation becomes stable when oscillation circuit starts up. This function avoids the abnormal oscillation in the initial power up and in a reactivation by INHN.

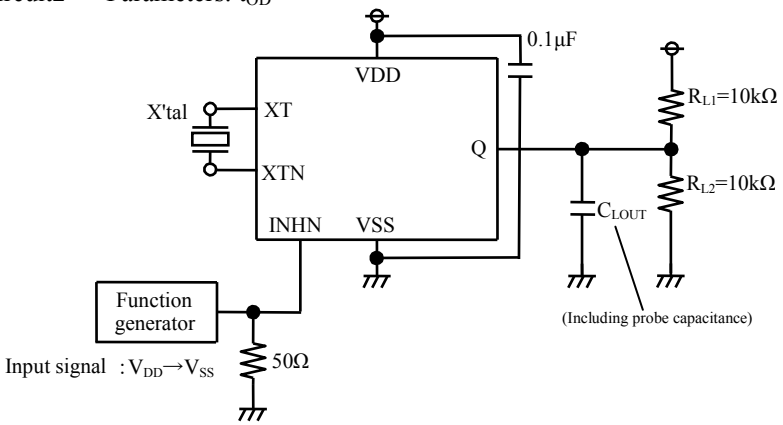
## 12. MEASUREMENT CIRCUIT

- Measurement circuit1 Parameters: $I_{DD}$,$I_{ST}$,DUTY,$t_r$,$t_f$

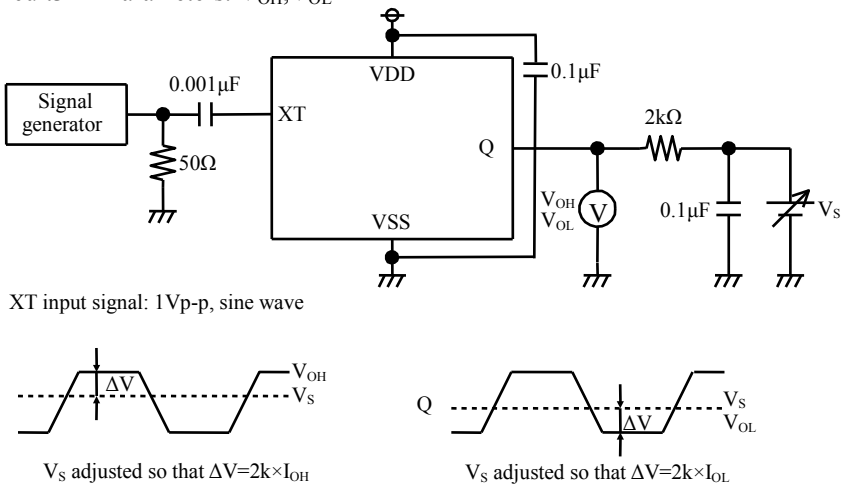



| Parameter | SW1 | SW2 |
|---|---|---|
| $I_{DD}$ | OFF | OFF |
| $I_{ST}$ | ON or OFF | ON |
| DUTY,$t_r$,$t_f$ | ON | OFF |

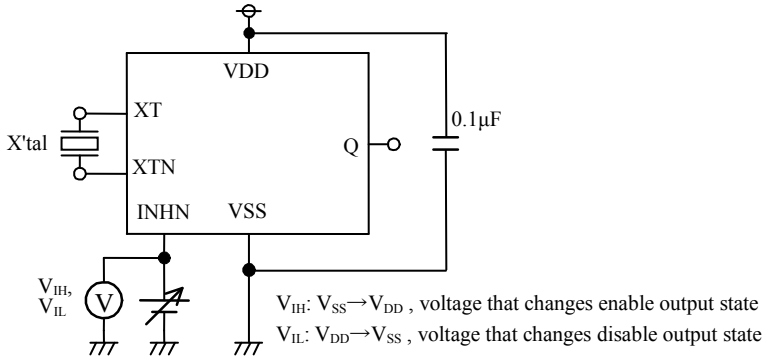
- Measurement circuit2 Parameters: $t_{OD}$



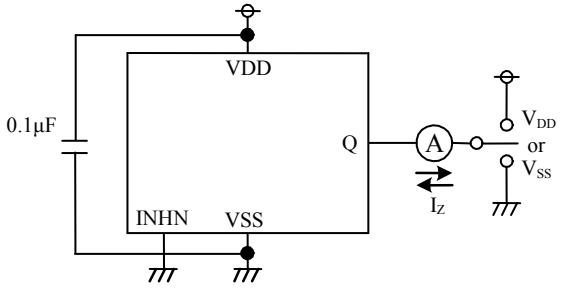

- Measurement circuit3 Parameters: $V_{OH}$,$V_{OL}$



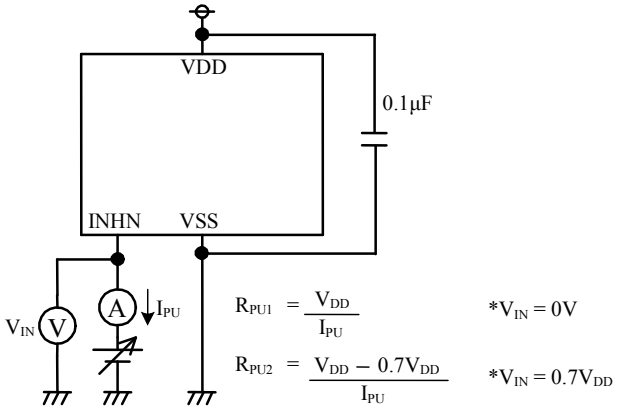
- Measurement circuit4 Parameters: $V_{IH}$,$V_{IL}$




- Measurement circuit5 Parameters: $I_Z$

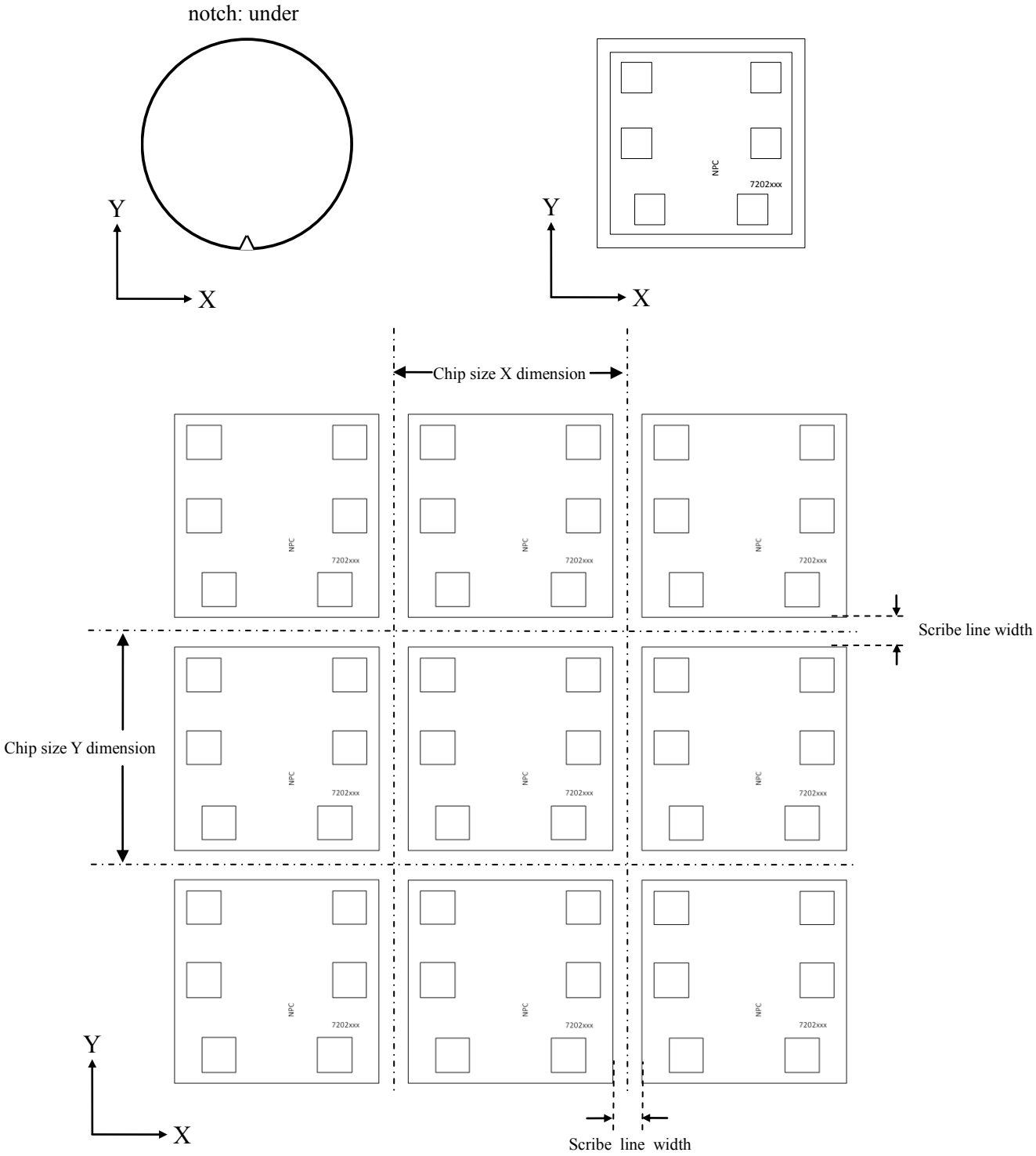



- Measurement circuit6 Parameters: $R_{PU1}$,$R_{PU2}$



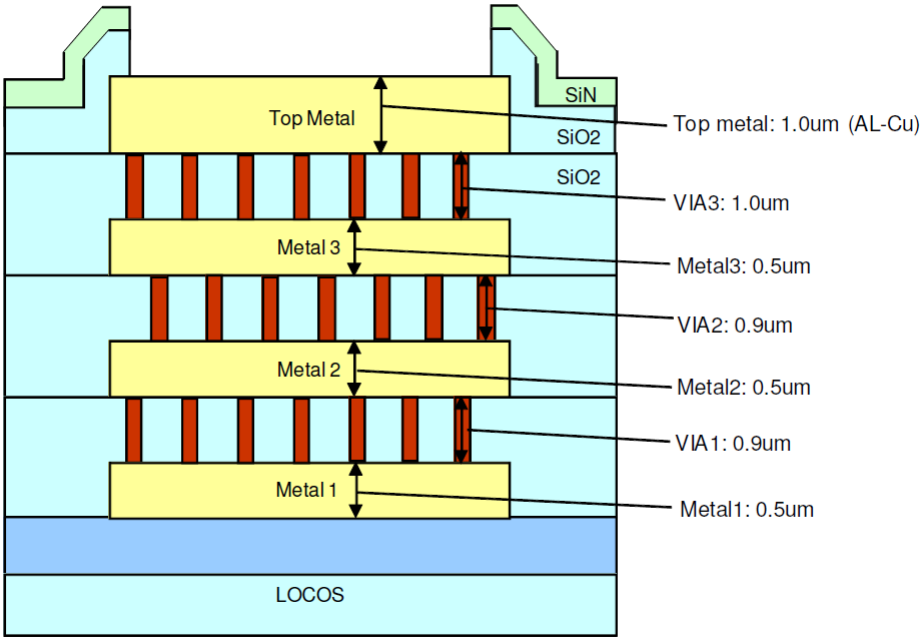
## 13. WAFER SURFACE ALIGNMENT DIAGRAM

Wafer size: 200mm ± 0.5mm
Scribe line width: 70µm



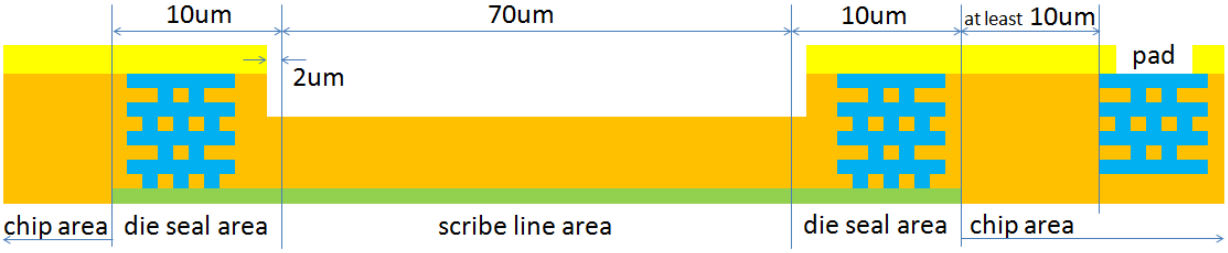
## 14. CROSS SECTION STRUCTURE

### 14.1. PAD Cross Section Structure




*Film thicknesses of mention is a value in the designs as above and is not the actual value in the chip.

### 14.2. Seal Ring and Scribe Line Cross Section Structure




*Widths of mention is a value in the designs as above and is not the actual value in the chip.

## 15. USAGE AND PRECAUTIONS

This product is designed and manufactured to the generally accepted standards of reliability as expected for use in general electronic and electrical equipment, such as personal equipment, machine tools, and measurement equipment. This product is not designed and manufactured to be used in any other special equipment requiring extremely high level of reliability and safety, such as aerospace equipment, nuclear power control equipment, medical equipment, transportation equipment, disaster prevention equipment, security equipment.
If you wish to use this product in equipment requiring extremely high level of reliability, please contact our sales department or representative in advance.
In the event that this product is used in such equipment, please take scrupulous care and apply fail-safe techniques including redundancy and malfunction prevention in order to prevent damage to life, health, property, or infrastructure etc. in case there is some malfunction in the product.

Please pay your attention to the following points at time of using the products shown in this document.

1. The products shown in this document (hereinafter "Products") are designed and manufactured to the generally accepted standards of reliability as expected for use in general electronic and electrical equipment, such as personal equipment, machine tools and measurement equipment. The Products are not designed and manufactured to be used in any other special equipment requiring extremely high level of reliability and safety, such as aerospace equipment, nuclear power control equipment, medical equipment, transportation equipment, disaster prevention equipment, security equipment. The Products are not designed and manufactured to be used for the apparatus that exerts harmful influence on the human lives due to the defects, failure or malfunction of the Products.
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SEIKO NPC CORPORATION

2-9-4,Taito,Taito-ku,
Tokyo 110-0016, Japan
Telephone: +81-3-6747-5300
Facsimile: +81-3-6747-5303
http://www.npc.co.jp/
Email:sales@npc.co.jp

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