

## VCXO ICs with Built-in Variable Capacitor

### ■ GENERAL DESCRIPTION

The XC2311 Series is VCXO (Voltage Controlled Crystal Oscillator) ICs with built-in variable capacitor diode.

With the originally developed variable capacitor diode and a constant-voltage circuit built-in, the series achieves the wide variable frequency range, frequency stability to supply voltage and low power consumption.

By combining with the AT-cut crystal oscillator, the ultra small and highly accurate Frequency Voltage Controlled Crystal Oscillator of 16 to 50MHz can be formed.

The small SOT-26, USP-6C, and SOP-8 packages make high density mounting possible.

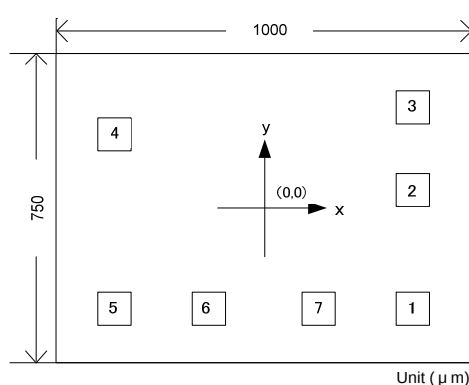
### ■ APPLICATIONS

- VCXO modules
- Communication equipment

### ■ FEATURES

- Supply Voltage Range** : 2.6V ~ 3.6V
  - Output Frequency Range** : 16MHz ~ 50MHz  
(V2B0 = 16MHz~36MHz,  
V3B0 = 30MHz~50MHz)\*
  - Pull Range** : more than  $\pm 110$ ppm  
(XC2311V2B0xx,  
Vc = 1.65V  $\pm$  1.35V)
  - Output Waveform Symmetry** : 50% /  $\pm 5$  %
  - Operating Ambient Temperature** : - 40 ~ +85
  - Supply Current** : 3mA (TYP.)  
(when VDD is 3.6V, 27MHz  
and output is enable)
  - CMOS Output**
  - Ultra Small Packages** : SOT-26, USP-6C, SOP-8
  - Chip Form** : Chip size 1000 x 750  $\mu$ m
- \* Please refer to the Electrical Characteristics for versions' details.

### ■ CHIP PAD LAYOUT



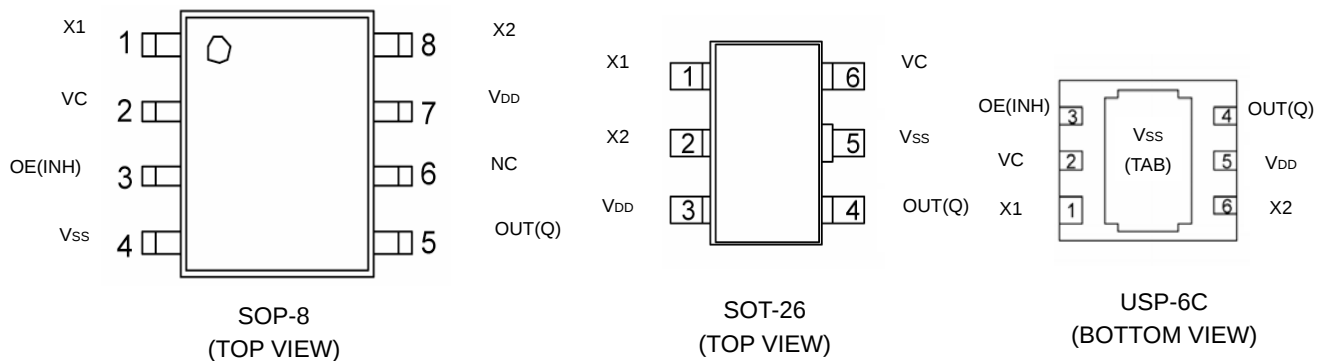
### ■ PAD COORDINATE

| PAD NAME  | PAD No. | X ( $\mu$ m) | Y ( $\mu$ m) |
|-----------|---------|--------------|--------------|
| VC        | 1       | 359          | -244         |
| OE (/INH) | 2       | 359          | 44           |
| VSS       | 3       | 359          | 244          |
| OUT(Q)    | 4       | -359         | 179          |
| VDD       | 5       | -359         | -244         |
| X2        | 6       | -132         | -244         |
| X1        | 7       | 132          | -244         |

\* The coordinate origin of XY-coordinate is a chip center.

|                |                      |
|----------------|----------------------|
| Pad Size       | 80 x 80 $\mu$ m      |
| Chip Thickness | 200 $\pm$ 10 $\mu$ m |

## PIN CONFIGURATION



## PIN ASSIGNMENT

### • SOP-8

| PIN NUMBER | PIN NAME  | I/O | FUNCTIONS                              |
|------------|-----------|-----|----------------------------------------|
| 1          | X1        | I   | Crystal Oscillator Connection (Input)  |
| 2          | Vc        | I   | Oscillation Frequency Control Input    |
| 3          | OE (/INH) | I   | Output Control Input                   |
| 4          | Vss       | -   | (-) Ground                             |
| 5          | OUT (Q)   | O   | Output                                 |
| 6          | NC        | -   | No Connection                          |
| 7          | VDD       | -   | (+) Power Supply                       |
| 8          | X2        |     | Crystal Oscillator Connection (Output) |

### • SOT-26 Note : No OE (/INH) function available.

| PIN NUMBER | PIN NAME | I/O | FUNCTIONS                              |
|------------|----------|-----|----------------------------------------|
| 1          | X1       | I   | Crystal Oscillator Connection (Input)  |
| 2          | X2       |     | Crystal Oscillator Connection (Output) |
| 3          | VDD      | -   | (+) Power Supply                       |
| 4          | OUT (Q)  | O   | Output                                 |
| 5          | Vss      | -   | (-) Ground                             |
| 6          | Vc       | I   | Oscillation Frequency Control Input    |

### • USP-6C

| PIN NUMBER | PIN NAME  | I/O | FUNCTIONS                              |
|------------|-----------|-----|----------------------------------------|
| 1          | X1        | I   | Crystal Oscillator Connection (Input)  |
| 2          | Vc        | I   | Oscillation Frequency Control Input    |
| 3          | OE (/INH) | I   | Output Control Input                   |
| TAB        | Vss       | -   | (-) Ground                             |
| 4          | OUT (Q)   | O   | Output                                 |
| 5          | VDD       | -   | (+) Power Supply                       |
| 6          | X2        | -   | Crystal Oscillator Connection (Output) |

## OE (/INH), OUT (Q) PIN FUNCTION

| OE (/INH)   | OUT (Q)        |
|-------------|----------------|
| "H" or OPEN | Clock Output   |
| "L"         | High Impedance |

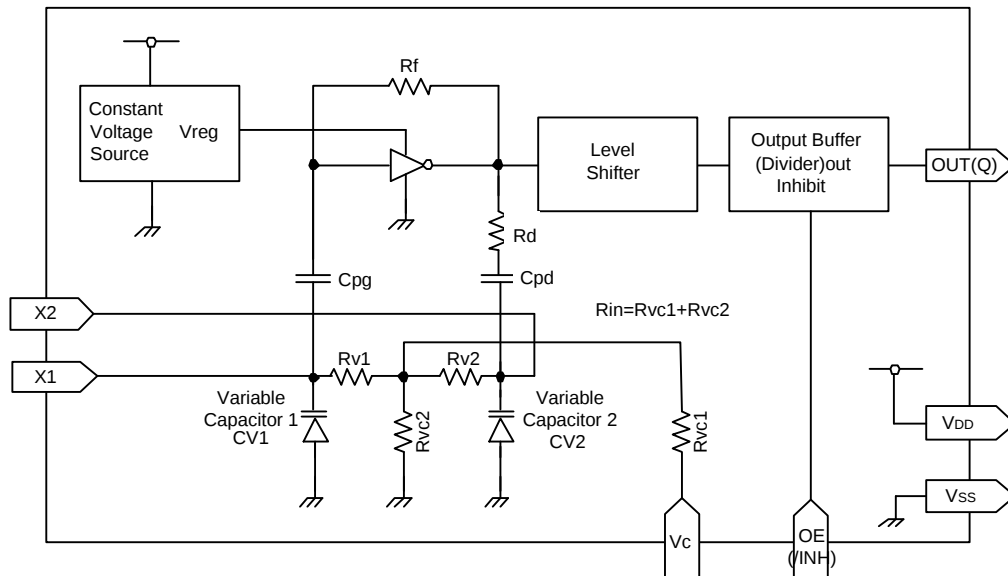
## ■ PRODUCT INFORMATION

- Ordering Information

XC2311 \_\_\_\_\_

| DESIGNATOR | DESCRIPTION           | SYMBOL | DESCRIPTION                    |
|------------|-----------------------|--------|--------------------------------|
|            | VCXO product          | V      | : Fixed number                 |
|            | Oscillation Frequency | 2      | : 16MHz ~ 36MHz                |
|            |                       | 3      | : 30MHz ~ 50MHz                |
|            | -                     | B      | : Fixed number                 |
|            | -                     | 0      | : Fixed number                 |
|            | Package               | S      | : SOP-8                        |
|            |                       | M      | : SOT-26                       |
|            |                       | E      | : USP-6C                       |
|            |                       | C      | : Chip form                    |
|            | Device Orientation    | R      | : Embossed tape, standard feed |
|            |                       | L      | : Embossed tape, reverse feed  |
|            |                       | T      | : Chip tray                    |

## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

Vss=0V, Ta=25°C

| PARAMETER                     |        | SYMBOL | RATINGS |      |          | UNIT |
|-------------------------------|--------|--------|---------|------|----------|------|
|                               |        |        | MIN.    | TYP. | MAX.     |      |
| Supply Voltage                |        | VDD    | VSS-0.5 | -    | +7.0     | V    |
| Input Voltage                 |        | VIN    | VSS-0.5 | -    | VDD +0.5 | V    |
| Output Voltage                |        | VOUT   | VSS-0.5 | -    | VDD +0.5 | V    |
| Output Current                |        | IOUT   | -       | -    | 30       | mA   |
| Power Dissipation             | SOP-8  | Pd     | 300     |      |          | mW   |
|                               | SOT-26 |        | 250     |      |          |      |
|                               | USP-6C |        | 100     |      |          |      |
| Operating Ambient Temperature |        | Topr   | -40     | -    | +85      |      |
| Storage Temperature Range     |        | Tstg   | -55     | -    | +125     |      |

## ■ RECOMMENDED OPERATING CONDITIONS

### ● XC2311VxB0 Series

Recommended Operating Conditions : Vss = 0V, Ta = -40 ~ +85

Unless otherwise stated, the item is common in XC2311V2B0 or XC2311V3B0.

| PARAMETER                   | SYMBOL | CONDITIONS        | RATINGS   |      |           | UNITS |
|-----------------------------|--------|-------------------|-----------|------|-----------|-------|
|                             |        |                   | MIN.      | TYP. | MAX.      |       |
| Operating Supply Voltage    | VDD    | -                 | 2.6       | 3.3  | 3.6       | V     |
| "H" Level Input Voltage     | VIH    | OE (/INH) Pin     | 0.7 x VDD | -    | -         | V     |
| "L" Level Input Voltage     | VIL    | OE (/INH) Pin     | -         | -    | 0.3 x VDD | V     |
| Input Voltage               | VIN    | OE (/INH) Pin     | VSS       | -    | VDD       | V     |
| Control Voltage             | VC     | 2.6V ≤ VDD ≤ 3.6V | 0         | -    | VDD + 1.0 | V     |
| Oscillation Frequency Range | f0     | XC2311V2B0        | 16        | -    | 36        | MHz   |
|                             |        | XC2311V3B0        | 30        | -    | 50        | MHz   |

## ■ ELECTRICAL CHARACTERISTICS

### ● XC2311VxB0 Series

Condition : Unless otherwise stated, V<sub>SS</sub> = 0V, V<sub>DD</sub> = 3.3V, V<sub>C</sub> = 1.65V, T<sub>a</sub> = 25 and the item is common in XC2311V2B0 or XC2311V3B0.

| PARAMETER                                                   | SYMBOL             | CONDITIONS                                                          | RATINGS              |      |      | UNITS |
|-------------------------------------------------------------|--------------------|---------------------------------------------------------------------|----------------------|------|------|-------|
|                                                             |                    |                                                                     | MIN.                 | TYP. | MAX. |       |
| Pull Range                                                  | fcntr              | V <sub>C</sub> = 1.65 ± 1.35V (*1), XC2311V2B0, 27MHz               | ± 110                | -    | -    | ppm   |
|                                                             |                    | V <sub>C</sub> = 1.65 ± 1.35V (*1), XC2311V3B0, 47MHz               | ± 100                | -    | -    |       |
| Operating Supply Current                                    | I <sub>DD1</sub>   | XC2311V2B0, V <sub>DD</sub> =3.6V, f <sub>osc</sub> =27MHz, CL=15pF | -                    | 3.0  | 5.0  | mA    |
|                                                             |                    | XC2311V3B0, V <sub>DD</sub> =3.6V, f <sub>osc</sub> =47MHz, CL=15pF | -                    | 6.0  | 12.0 |       |
| Supply Current Disable <sup>(*)3</sup>                      | I <sub>DD2</sub>   | f <sub>osc</sub> =27MHz, CL=15pF, OE(/INH)= "L"                     | -                    | 1.0  | 2.0  | mA    |
|                                                             |                    | f <sub>osc</sub> =47MHz, CL=15pF, OE(/INH)= "L"                     | -                    | 1.5  | 3.0  |       |
| "H" Level Output Voltage                                    | V <sub>OH</sub>    | I <sub>OH</sub> = -5mA                                              | V <sub>DD</sub> -0.4 | -    | -    | V     |
| "L" Level Output Voltage                                    | V <sub>OL</sub>    | I <sub>OL</sub> = 5mA                                               | -                    | -    | 0.4  | V     |
| Input Pull-up Resistance                                    | R <sub>up</sub>    | OE(/INH) = 0V                                                       | 1.0                  | 2.5  | 5.0  | MΩ    |
| Output Off Leak Current <sup>(*)3</sup>                     | I <sub>oz</sub>    | V <sub>DD</sub> = 3.6V, OE(/INH) = "L"                              | -                    | -    | 10   | μA    |
| Output Waveform Symmetry                                    | DUTY               | CL = 15pF                                                           | 45                   | 50   | 55   | %     |
| Input Resistance <sup>(*)2</sup>                            | R <sub>in</sub>    | Between the V <sub>C</sub> and the Ground pins                      | 100                  | -    | -    | kΩ    |
| Pull Range Linearity <sup>(*)2</sup>                        | L <sub>in</sub>    | V <sub>C</sub> = 1.65 ± 1.35V <sup>(*)1</sup>                       | -                    | -    | 10   | %     |
| Cut-off Frequency at Modulation <sup>(*)2</sup>             | f <sub>c</sub>     | V <sub>C</sub> = 1.65 ± 1.35V <sup>(*)1</sup> , Sine wave input     | 15                   | -    | -    | kHz   |
| Output Rise Time <sup>(*)2</sup>                            | tr                 | XC2311V2B0, CL = 15pF (from 10% to 90%)                             | -                    | 4.5  | -    | ns    |
|                                                             |                    | XC2311V3B0, CL = 15pF (from 10% to 90%)                             | -                    | 3.0  | -    |       |
| Output Fall Time <sup>(*)2</sup>                            | tf                 | XC2311V2B0, CL = 15pF (from 10% to 90%)                             | -                    | 4.5  | -    | ns    |
|                                                             |                    | XC2311V3B0, CL = 15pF (from 10% to 90%)                             | -                    | 3.0  | -    |       |
| Output Enable Delay Time <sup>(*)2</sup> , <sup>(*)3</sup>  | t <sub>pe</sub>    | -                                                                   | -                    | -    | 100  | ns    |
| Output Disable Delay Time <sup>(*)2</sup> , <sup>(*)3</sup> | t <sub>pd</sub>    | -                                                                   | -                    | -    | 100  | ns    |
| Oscillation Start-up Time <sup>(*)2</sup>                   | t <sub>start</sub> | -                                                                   | -                    | 1.5  | -    | ms    |
| Feedback Resistance <sup>(*)2</sup>                         | R <sub>f</sub>     | -                                                                   | -                    | 100  | -    | kΩ    |
| DC Block Capacity <sup>(*)2</sup>                           | C <sub>pg</sub>    | -                                                                   | 13                   | 16   | 19   | pF    |
| DC Block Capacity <sup>(*)2</sup>                           | C <sub>pd</sub>    | -                                                                   | 40                   | 50   | 60   | pF    |
| Output Load Capacity <sup>(*)2</sup>                        | CL                 | XC2311V2B0, CMOS level                                              | -                    | 15   | 30   | pF    |
|                                                             |                    | XC2311V3B0, CMOS level                                              | -                    | -    | 15   |       |

NOTE:

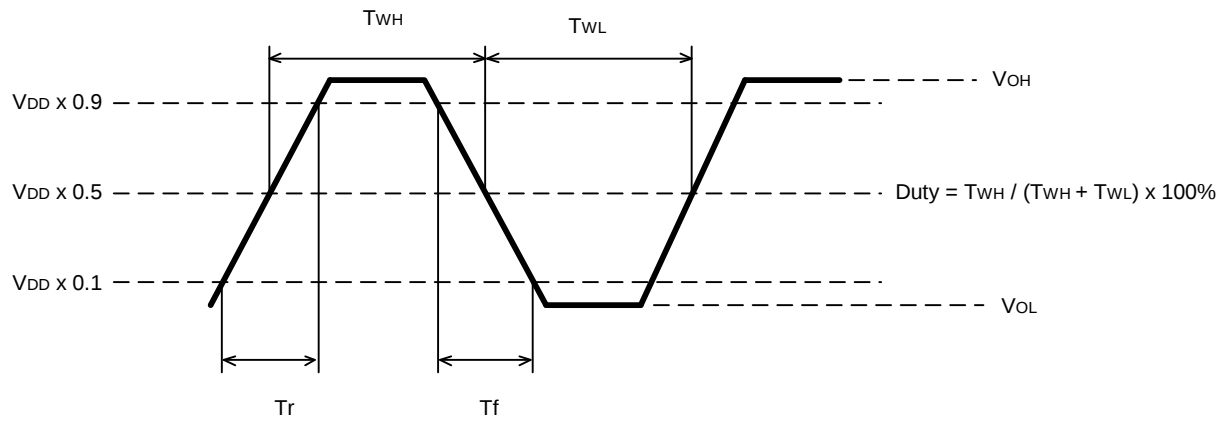
\*1: Crystal Oscillator Equivalent Parameter,  $\gamma = CO/C1 < 300$

\*2: The value shown above indicates a design value.

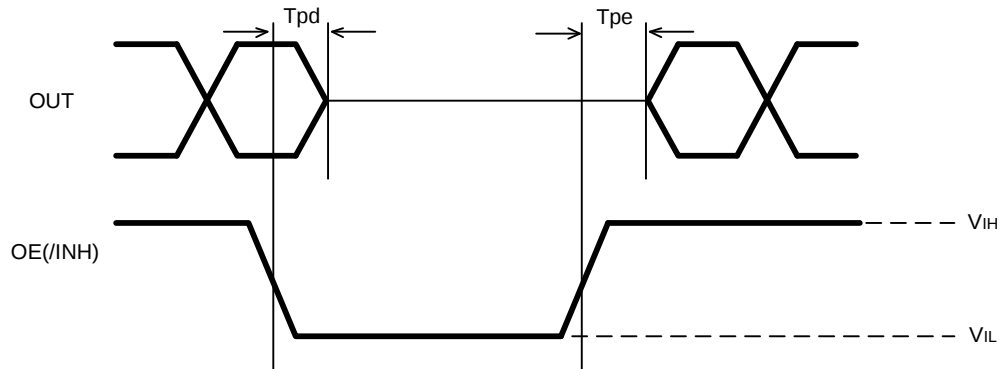
\*3: For the SOT-26 package products, the OE (/INH) pin is fixed by an internal pull-up. No OE (/INH) function available.

## ■ OUTPUT WAVEFORMS (Duty, Tr, Tf, Tpe, Tpd)

Duty / Tr, Tf: Output Duty, Output Rise / Fall Time

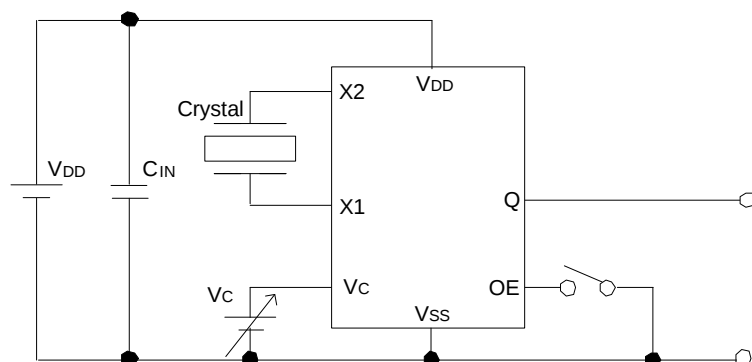


Tpe / Tpd: Output Enable / Disable Time



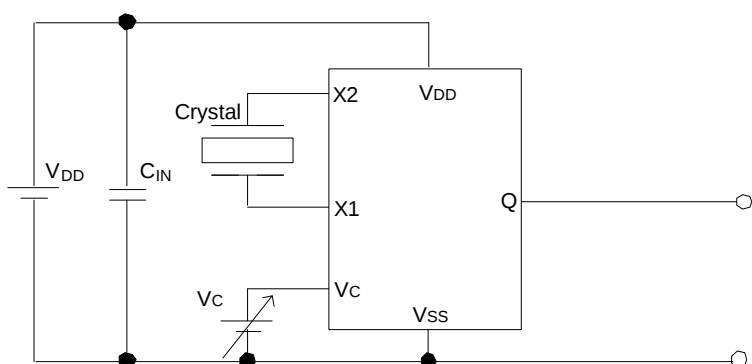
## ■ TYPICAL APPLICATION CIRCUITS

### 1) SOP-8 and USP-6C



\*) Please mount the  $C_{IN}$  in a near position from both the VDD and the VSS pins as much as possible.

### 2) SOT-26



\*) Please mount the  $C_{IN}$  in a near position from both the VDD and the VSS pins as much as possible.

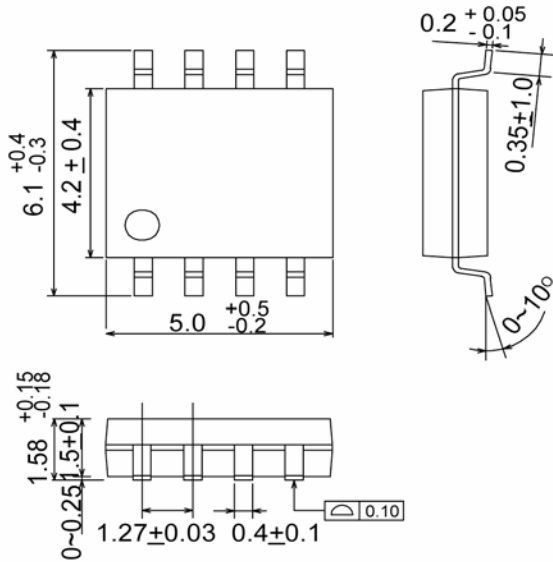
## ■ NOTE ON USE

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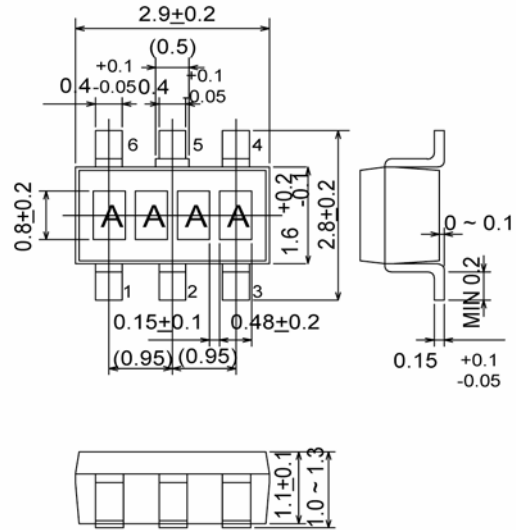
Please contact Torex, sales offices, or representatives to make the inquiry of latest information.

## ■ PACKAGING INFORMATION

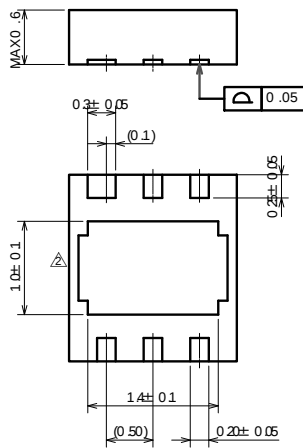
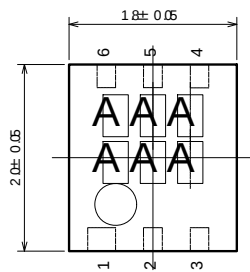
### ● SOP-8



### ● SOT-26



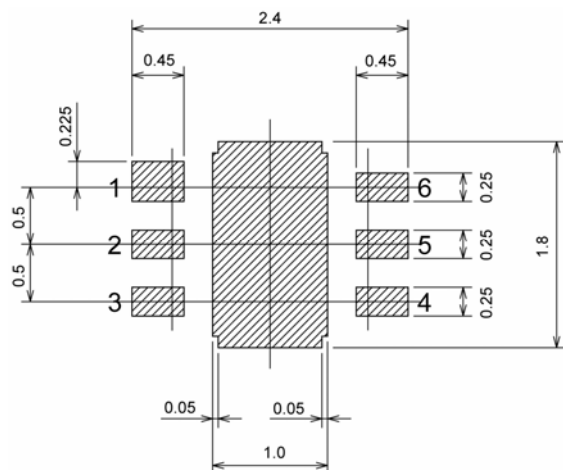
### ● USP-6C



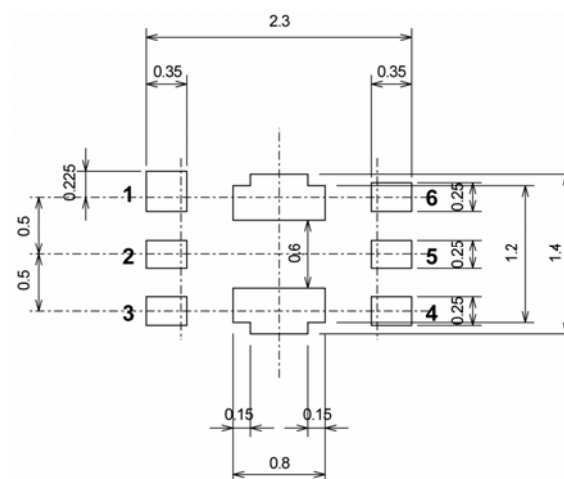
Note: The side of pins are not gilded, but nickel is used.

## ■ PACKAGING INFORMATION (Continued)

### ● USP-6C Recommended Pattern Layout



### ● USP-6C Recommended Metal Mask Design



## ■ MARKING RULE

### ● SOP-8

Represents product series

| MARK |   | PRODUCT SERIES |
|------|---|----------------|
|      |   |                |
| 2    | 1 | XC2311xxxxxx   |

Represents VCXO product

| MARK | PRODUCT SERIES |
|------|----------------|
| V    | XC2311Vxxxxx   |

Represents oscillation frequency range

| MARK | FREQUENCY RANGE | PRODUCT SERIES |
|------|-----------------|----------------|
| 2    | 16MHz ~ 36MHz   | XC2311x2xxxx   |
| 3    | 30MHz ~ 50MHz   | XC2311x3xxxx   |

Represents operating voltage range

| MARK | OPERATING VOLTAGE RANGE | PRODUCT SERIES |
|------|-------------------------|----------------|
| B    | 2.6V ~ 3.6V             | XC2311xxBxxx   |

Represents divider circuit

| MARK | DIVIDER CIRCUIT | PRODUCT SERIES |
|------|-----------------|----------------|
| 0    | No Divider      | XC2311xxx0xx   |

Represents last digit of production year

ex)

| MARK | YEAR |
|------|------|
| 5    | 2005 |
| 6    | 2006 |

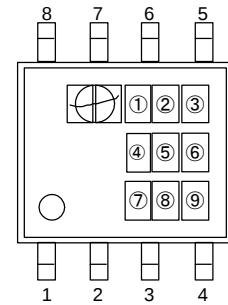
Represents production lot number

0 to 9, A to Z repeated (G, I, J, O, Q, W excepted. No high-order zero marked. )

Note: No character inversion used.

ex)

| MARK |   | PRODUCTION LOT NUMBER |
|------|---|-----------------------|
|      |   |                       |
| -    | 3 | 03                    |
| 1    | A | A                     |



SOP-8  
(TOP VIEW)

## ■ MARKING RULE (Continued)

### ● SOT-26

Represents oscillation frequency range

| MARK | FREQUENCY RANGE | PRODUCT SERIES |
|------|-----------------|----------------|
| L    | 16MHz ~ 36MHz   | XC2311x2xxxx   |
| M    | 30MHz ~ 50MHz   | XC2311x3xxxx   |

Represents operating voltage range

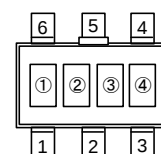
| MARK | OPERATING VOLTAGE RANGE | PRODUCT SERIES |
|------|-------------------------|----------------|
| B    | 2.6V ~ 3.6V             | XC2311xxBxxx   |

Represents divider circuit

| MARK | DIVIDER CIRCUIT | PRODUCT SERIES |
|------|-----------------|----------------|
| 0    | No Divider      | XC2311xxx0xx   |

Represents production lot number

0 to 9, A to Z, reverse character 0 to 9, A to Z repeated (G, I, J, O, Q, W excepted.)



SOT-26  
(TOP VIEW)

### ● USP-6C

Represents product series

| MARK |   | PRODUCT SERIES |
|------|---|----------------|
|      |   |                |
| 2    | 1 | XC2311xxxxxx   |

Represents oscillation frequency range

| MARK | FREQUENCY RANGE | PRODUCT SERIES |
|------|-----------------|----------------|
| 2    | 16MHz~36MHz     | XC2311x2xxxx   |
| 3    | 30MHz~50MHz     | XC2311x3xxxx   |

Represents operating voltage range

| MARK | OPERATING VOLTAGE RANGE | PRODUCT SERIES |
|------|-------------------------|----------------|
| B    | 2.6V~3.6V               | XC2311xxBxxx   |

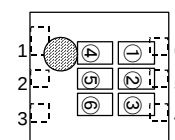
Represents divider circuit

| MARK | DIVIDER CIRCUIT | PRODUCT SERIES |
|------|-----------------|----------------|
| 0    | No Divider      | XC2311xxx0xx   |

Represents production lot number

0 to 9, A to Z repeated (G, I, J, O, Q, W excepted.)

Note: No character inversion used.



USP-6C  
(TOP VIEW)

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