

## ICs for use with Crystal Oscillators

### ■ GENERAL DESCRIPTION

The XC2164 series are high frequency, low current consumption CMOS ICs with built-in crystal oscillator and divider circuits. For fundamental oscillation, output is selectable from any one of the following values for  $f_0$ :  $f_0/1$ ,  $f_0/2$ ,  $f_0/4$ , and  $f_0/8$ . With oscillation capacitors and a feedback resistor built-in, it is possible to configure a stable fundamental oscillator or 3rd overtone oscillator using only an external crystal. Also the series has stand-by function built-in and the type, which suspends the oscillation completely (XC2164A~D type) or the type suspends only an output (XC2164K~N type) are available. The XC2164 series are integrated into SOT-26 packages. The series is also available in chip form.

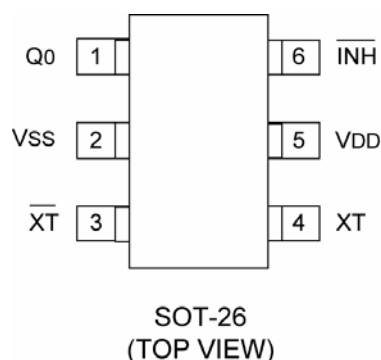
### ■ APPLICATIONS

- Crystal oscillation modules
- Clocks for micro computer, DSPs
- Communication equipment
- Various system clocks

### ■ FEATURES

|                                                                            |                                                                                                             |
|----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| <b>Oscillation Frequency</b>                                               | : 4MHz ~ 30MHz (Fundamental)<br>20MHz ~ 125MHz (3rd Overtone)                                               |
| <b>Divider Ratio</b>                                                       | : Selectable from $f_0/1$ , $f_0/2$ , $f_0/4$ , $f_0/8$ ( $f_0/2$ , $f_0/4$ , $f_0/8$ are fundamental only) |
| <b>Output</b>                                                              | : 3-State                                                                                                   |
| <b>Operating Voltage Range</b>                                             | : $3.3V \pm 10\%$ , $5.0V \pm 10\%$                                                                         |
| <b>Low Power Consumption</b>                                               | : Stand-by function included<br>Selectable from Chip Enable type and Output Enable type                     |
| <b>CMOS</b>                                                                |                                                                                                             |
| <b>Built-in Oscillation Feedback Resistor</b>                              |                                                                                                             |
| <b>Built- in Oscillation Capacitors <math>C_g</math>, <math>C_d</math></b> |                                                                                                             |
| <b>Packages</b>                                                            | : SOT-26, Chip Form (1.3x0.8mm)                                                                             |

### ■ PIN CONFIGURATION



### ■ PIN ASSIGNMENT

| PIN NUMBER | PIN NAME | FUNCTION                               |
|------------|----------|----------------------------------------|
| 1          | $Q_0$    | Clock Output                           |
| 2          | $V_{SS}$ | Ground                                 |
| 3          | $/XT$    | Crystal Oscillator Connection (Output) |
| 4          | $XT$     | Crystal Oscillator Connection (Input)  |
| 5          | $V_{DD}$ | Power Supply                           |
| 6          | $/INH$   | Stand-by Control*                      |

\*Stand-by control pin has a pull-up resistor built-in.

unit [ $\mu m$ ]

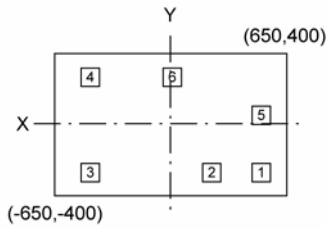
### ■ $/INH$ , $Q_0$ PIN FUNCTION

| $/INH$      | $Q_0$          |
|-------------|----------------|
| "H" or OPEN | Clock Output   |
| "L"         | High impedance |

H = High level

L = Low level

## ■ PAD LAYOUT FOR CHIP FORM



Size (Chip) : 1.3×0.8mm  
 Thickness (Chip) : XC2164xx1xxT : 280±20 μm  
                               XC2164xx1xxF : 200±20 μm  
 Backside (Chip) : V<sub>DD</sub> Level  
 Aperture (Pad) : 100×100 μm

## ■ PAD DIMENSIONS

| PIN NUMBER | PIN NAME        | PAD DIMENSIONS |       |
|------------|-----------------|----------------|-------|
|            |                 | X              | Y     |
| 1          | Q <sub>0</sub>  | 514            | - 264 |
| 2          | V <sub>SS</sub> | 222            | - 264 |
| 3          | / XT            | - 450          | - 264 |
| 4          | XT              | - 450          | 264   |
| 5          | V <sub>DD</sub> | 514            | 27    |
| 6          | / INH           | 47             | 264   |

unit [ μm]

## ■ PRODUCT CLASSIFICATION

### ● Ordering Information

XC2164

| DESIGNATOR | DESCRIPTION                                                               | SYMBOL    | DESCRIPTION                                                 |
|------------|---------------------------------------------------------------------------|-----------|-------------------------------------------------------------|
|            | Divider Ratio & /INH Pin Function                                         | A         | : Chip Enable: f <sub>0</sub> /1                            |
|            |                                                                           | B         | : Chip Enable: f <sub>0</sub> /2 (Fundamental only)         |
|            |                                                                           | C         | : Chip Enable: f <sub>0</sub> /4 (Fundamental only)         |
|            |                                                                           | D         | : Chip Enable: f <sub>0</sub> /8 (Fundamental only)         |
|            |                                                                           | K         | : Output Enable: f <sub>0</sub> /1                          |
|            |                                                                           | L         | : Output Enable: f <sub>0</sub> /2 (Fundamental only)       |
|            |                                                                           | M         | : Output Enable: f <sub>0</sub> /4 (Fundamental only)       |
|            |                                                                           | N         | : Output Enable: f <sub>0</sub> /8 (Fundamental only)       |
|            | Chip Surface Treatment                                                    | 5         | : Not polyimide coating on the chip surface (SOT-26 only)   |
|            |                                                                           | 6         | : Polyimide coating on the chip surface (Chip form only)    |
|            | Duty Level                                                                | 1         | : CMOS (V <sub>DD</sub> /2) *TTL: Fundamental 4MHz to 30MHz |
|            | Frequency Range & R <sub>f</sub> , C <sub>g</sub> , C <sub>d</sub> Values | (Table 1) | : 3rd Overtone, built-in type                               |
|            |                                                                           | (Table 2) | : Fundamental, built-in type                                |
|            | Packages                                                                  | C         | : Chip form                                                 |
|            |                                                                           | M         | : SOT-26                                                    |
|            | Device Orientation                                                        | R         | : Embossed tape, standard feed                              |
|            |                                                                           | L         | : Embossed tape, reverse feed                               |
|            |                                                                           | T         | : Chip tray (Wafer thickness : 280 ± 20 μm)                 |
|            |                                                                           | F         | : Chip tray (Wafer thickness : 200 ± 20 μm)                 |

Table 1: 3rd Overtone, Built-In Type

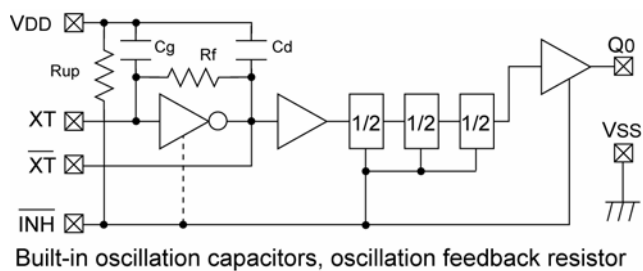
| SYMBOL | FREQUENCY RANGE  |                  | R <sub>f</sub><br>(kΩ) | C <sub>g</sub><br>(pF) | C <sub>d</sub><br>(pF) |
|--------|------------------|------------------|------------------------|------------------------|------------------------|
|        | 3.3V ±10%        | 5.0V ±10%        |                        |                        |                        |
| A      | -                | 20MHz to 30MHz   | 9.0                    | 21.5                   | 21.5                   |
| B      | 20MHz to 30MHz   | 30MHz to 40MHz   | 6.5                    | 20.0                   | 20.0                   |
| C      | 30MHz to 40MHz   | 40MHz to 50MHz   | 5.0                    | 16.0                   | 16.0                   |
| D      | 40MHz to 50MHz   | 50MHz to 65MHz   | 3.5                    | 14.0                   | 14.0                   |
| E      | 50MHz to 65MHz   | 65MHz to 80MHz   | 2.8                    | 12.5                   | 12.5                   |
| F      | 65MHz to 80MHz   | 80MHz to 95MHz   | 2.5                    | 10.0                   | 10.0                   |
| H      | 80MHz to 95MHz   | 95MHz to 110MHz  | 2.2                    | 8.0                    | 8.0                    |
| K      | 95MHz to 110MHz  | 110MHz to 125MHz | 2.0                    | 7.0                    | 7.0                    |
| L      | 110MHz to 125MHz | -                | 2.3                    | 5.5                    | 5.5                    |

Table 2: Fundamental, Built-In Type

| SYMBOL | FREQUENCY RANGE |               | R <sub>f</sub><br>(kΩ) | C <sub>g</sub><br>(pF) | C <sub>d</sub><br>(pF) |
|--------|-----------------|---------------|------------------------|------------------------|------------------------|
|        | 3.3V ±10%       | 5.0V ±10%     |                        |                        |                        |
| M, V   | 4MHz to 30MHz   | 4MHz to 30MHz | 3.5/7.0                | 20.0                   | 20.0                   |
| T      | 4MHz to 30MHz   | 4MHz to 30MHz | 3.5/7.0                | 35.0                   | 35.0                   |

(\*)R<sub>f</sub> = 3.5MΩ @ V<sub>DD</sub> = 5.0V Operation  
 R<sub>f</sub> = 7.0 MΩ @ V<sub>DD</sub> = 3.3V Operation

## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

| Ta=25                       |           |                                  |       |
|-----------------------------|-----------|----------------------------------|-------|
| PARAMETER                   | SYMBOL    | CONDITIONS                       | UNITS |
| Supply Voltage              | $V_{DD}$  | $V_{SS} - 0.3 \sim V_{SS} + 7.0$ | V     |
| Input Voltage               | $V_{IN}$  | $V_{SS} - 0.3 \sim V_{DD} + 0.3$ | V     |
| Power Dissipation           | $P_d$     | 250*                             | mW    |
| Operating Temperature Range | $T_{opr}$ | - 40 ~ + 85                      |       |
| Storage Temperature Range   | $T_{stg}$ | - 65 ~ + 150 (Chip Form)         |       |
|                             |           | - 55 ~ + 125 (SOT-26)            |       |

\*\* When implemented on a glass epoxy PCB. (SOT-26 package)

## ■ ELECTRICAL CHARACTERISTICS

### ● DC Electrical Characteristics

XC2164Ax1M, T, V / XC2164Kx1M, T, V (Fundamental)

5.0V operation (unless otherwise stated, V<sub>DD</sub>=5.0V, No Load, Ta= -30~+80 )

| PARAMETER                                | SYMBOL           | CONDITIONS                                            |               | MIN. | TYP.      | MAX.      | UNITS |
|------------------------------------------|------------------|-------------------------------------------------------|---------------|------|-----------|-----------|-------|
| Operating Voltage                        | V <sub>DD</sub>  |                                                       |               | 4.5  | 5.0       | 5.5       | V     |
| "H" Level Input Voltage                  | V <sub>IH</sub>  |                                                       |               | 2.4  | -         | -         | V     |
| "L" Level Input Voltage                  | V <sub>IL</sub>  |                                                       |               | -    | -         | 0.4       | V     |
| "H" Level Output Voltage                 | V <sub>OH</sub>  | CMOS: V <sub>DD</sub> =4.5V, I <sub>OH</sub> = - 16mA |               | 3.9  | 4.2       | -         | V     |
| "L" Level Output Voltage                 | V <sub>OL</sub>  | CMOS: V <sub>DD</sub> =4.5V, I <sub>OH</sub> =16mA    |               | -    | 0.3       | 0.4       | V     |
| Supply Current 1                         | I <sub>DD1</sub> | /INH=Open,<br>Q <sub>0</sub> =Open<br>f=30MHz         | XC2164Ax1M, V | -    | 11        | (15)      | mA    |
|                                          |                  |                                                       | XC2164Ax1T    | -    | 11        | (15)      |       |
|                                          |                  |                                                       | XC2164Kx1M, V | -    | 11        | (15)      |       |
|                                          |                  |                                                       | XC2164Kx1T    | -    | 11        | (15)      |       |
| Supply Current 2                         | I <sub>DD2</sub> | /INH="L",<br>Q <sub>0</sub> =Open<br>f=30MHz          | XC2164Ax1M, V | -    | 5         | (8)       | μ A   |
|                                          |                  |                                                       | XC2164Ax1T    | -    | 5         | (8)       |       |
|                                          |                  |                                                       | XC2164Kx1M, V | -    | (T.B.D.*) | (T.B.D.*) | mA    |
|                                          |                  |                                                       | XC2164Kx1T    | -    | 9         | (14)      |       |
| Input Pull-Up Resistance 1               | R <sub>UP1</sub> | /INH="L"                                              |               | 0.5  | 1.0       | 2.0       | MΩ    |
| Input Pull-Up Resistance 2               | R <sub>UP2</sub> | /INH=0.7 V <sub>DD</sub>                              |               | 25   | 50        | 100       | kΩ    |
| Internal Oscillation Feedback Resistance | R <sub>f</sub>   |                                                       |               | -    | 3.5       | -         | MΩ    |
| Output Disable Leak Current              | I <sub>OZ</sub>  | /INH="L"                                              |               | -    | -         | 10        | μ A   |

\* T.B.D.: To be determined

XC2164Ax1M, XC2164Kx1M (Fundamental)

3.3V operation (unless otherwise stated, V<sub>DD</sub>=3.3V, No Load, Ta= -30~+80 )

| PARAMETER                                   | SYMBOL           | CONDITIONS                                            |            | MIN. | TYP.      | MAX.      | UNITS |
|---------------------------------------------|------------------|-------------------------------------------------------|------------|------|-----------|-----------|-------|
| Operating Voltage                           | V <sub>DD</sub>  |                                                       |            | 2.97 | 3.30      | 3.63      | V     |
| "H" Level Input Voltage                     | V <sub>IH</sub>  |                                                       |            | 2.4  | -         | -         | V     |
| "L" Level Input Voltage                     | V <sub>IL</sub>  |                                                       |            | -    | -         | 0.4       | V     |
| "H" Level Output Voltage                    | V <sub>OH</sub>  | CMOS: V <sub>DD</sub> =2.97V, I <sub>OH</sub> = - 8mA |            | 2.5  | -         | -         | V     |
| "L" Level Output Voltage                    | V <sub>OL</sub>  | CMOS: V <sub>DD</sub> =2.97V, I <sub>OH</sub> =8mA    |            | -    | -         | 0.4       | V     |
| Supply Current 1                            | I <sub>DD1</sub> | /INH=Open,<br>Q <sub>0</sub> =Open, f=30MHz           | XC2164Ax1M | -    | 5         | (8)       | mA    |
|                                             |                  |                                                       | XC2164Kx1M | -    | 5         | (8)       |       |
| Supply Current 2                            | I <sub>DD2</sub> | /INH="L",<br>Q <sub>0</sub> =Open, f=30MHz            | XC2164Ax1M | -    | 2         | (4)       | μ A   |
|                                             |                  |                                                       | XC2164Kx1M | -    | (T.B.D.*) | (T.B.D.*) | mA    |
| Input Pull-Up Resistance 1                  | R <sub>UP1</sub> | /INH="L"                                              |            | 1.0  | 2.0       | 4.0       | MΩ    |
| Input Pull-Up Resistance 2                  | R <sub>UP2</sub> | /INH=0.7 V <sub>DD</sub>                              |            | 35   | 70        | 140       | kΩ    |
| Internal Oscillation<br>Feedback Resistance | R <sub>f</sub>   |                                                       |            | -    | 7.0       | -         | MΩ    |
| Output Disable<br>Leak Current              | I <sub>d</sub>   | /INH="L"                                              |            | -    | -         | 10        | μ A   |

\* T.B.D.: To be determined

## ■ ELECTRICAL CHARACTERISTICS (Continued)

### ● DC Electrical Characteristics (Continued)

XC2164Ax1T, V / XC2164Kx1T, V (Fundamental)

3.3V operation (unless otherwise stated,  $V_{DD}=3.3V$ , No Load,  $T_a = -30 \sim +80$  )

| PARAMETER                                | SYMBOL           | CONDITIONS                                     |            | MIN. | TYP.      | MAX.      | UNITS |
|------------------------------------------|------------------|------------------------------------------------|------------|------|-----------|-----------|-------|
| Operating Voltage                        | V <sub>DD</sub>  |                                                |            | 2.50 | 3.30      | 3.63      | V     |
| "H" Level Input Voltage                  | V <sub>IH</sub>  |                                                |            | 2.4  | -         | -         | V     |
| "L" Level Input Voltage                  | V <sub>IL</sub>  |                                                |            | -    | -         | 0.4       | V     |
| "H" Level Output Voltage                 | V <sub>OH</sub>  | CMOS: 2.97V, I <sub>OH</sub> = - 8mA           |            | 2.5  | -         | -         | V     |
| "L" Level Output Voltage                 | V <sub>OL</sub>  | CMOS: 2.97V, I <sub>OH</sub> =8mA              |            | -    | -         | 0.4       | V     |
| Supply Current 1                         | I <sub>DD1</sub> | /INH=Open,<br>Q <sub>0</sub> =Open,<br>f=30MHz | XC2164Ax1T | -    | 4         | (6.5)     | mA    |
|                                          |                  |                                                | XC2164Ax1V | -    | 5         | (8)       |       |
|                                          |                  |                                                | XC2164Kx1T | -    | 4         | (6.5)     |       |
|                                          |                  |                                                | XC2164Kx1V | -    | 5         | (8)       |       |
| Supply Current 2                         | I <sub>DD2</sub> | /INH="L",<br>Q <sub>0</sub> =Open,<br>f=30MHz  | XC2164Ax1T | -    | 2         | (4)       | μ A   |
|                                          |                  |                                                | XC2164Ax1V | -    | 2         | (4)       |       |
|                                          |                  |                                                | XC2164Kx1T | -    | (T.B.D.*) | (T.B.D.*) | mA    |
|                                          |                  |                                                | XC2164Kx1V | -    | (T.B.D.*) | (T.B.D.*) |       |
| Input Pull-Up Resistance 1               | R <sub>UP1</sub> | /INH="L"                                       |            | 1.0  | 2.0       | 4.0       | MΩ    |
| Input Pull-Up Resistance 2               | R <sub>UP2</sub> | /INH=0.7 V <sub>DD</sub>                       |            | 35   | 70        | 140       | kΩ    |
| Internal Oscillation Feedback Resistance | R <sub>f</sub>   |                                                |            | -    | 7.0       | -         | MΩ    |
| Output Disable Leakage Current           | I <sub>OZ</sub>  | /INH="L"                                       |            | -    | -         | 10        | μ A   |

\* T.B.D.: To be determined

Comparative Chart of Oscillation Frequency vs. Supply Voltage, and Negative Resistance Value

| SYMBOL | OSCILLATION FREQUENCY vs. SUPPLY VOLTAGE |                        | NEGATIVE RESISTANCE VALUE |                |
|--------|------------------------------------------|------------------------|---------------------------|----------------|
|        | $V_{DD}=3.3V \pm 10\%$                   | $V_{DD}=5.0V \pm 10\%$ | $V_{DD}=3.3V$             | $V_{DD}=5.0V$  |
| M      | $\pm 4.3ppm$                             | $\pm 4.5ppm$           | - 130 $\Omega$            | - 220 $\Omega$ |
| V      | $\pm 1.2ppm$                             | $\pm 2.1ppm$           | - 150 $\Omega$            | - 250 $\Omega$ |
| T      | $\pm 9.4ppm$                             | $\pm 7.0ppm$           | - 660 $\Omega$            | - 760 $\Omega$ |

(The designed value when 30MHz crystal is used.)

## ■ ELECTRICAL CHARACTERISTICS (Continued)

### ● DC Electrical Characteristics (Continued)

XC2164Ax1A ~ XC2164Ax1K (3rd Overtone)

5.0V Operation (Unless otherwise stated,  $V_{DD}=5.0V$ , No Load,  $T_a = -30 \sim +80$  )

| PARAMETER                                   | SYMBOL           | CONDITIONS                          |                       | MIN. | TYP. | MAX.  | UNITS |
|---------------------------------------------|------------------|-------------------------------------|-----------------------|------|------|-------|-------|
| Operating Voltage                           | V <sub>DD</sub>  |                                     |                       | 4.5  | 5.0  | 5.5   | V     |
| "H" Level Input Voltage                     | V <sub>IH</sub>  |                                     |                       | 2.4  | -    | -     | V     |
| "L" Level Input Voltage                     | V <sub>IL</sub>  |                                     |                       | -    | -    | 0.4   | V     |
| "H" Level Output Voltage                    | V <sub>OH</sub>  | CMOS: 4.5V, I <sub>OH</sub> = -16mA |                       | 3.9  | 4.2  | -     | V     |
| "L" Level Output Voltage                    | V <sub>OL</sub>  | CMOS: 4.5V, I <sub>OH</sub> =16mA   |                       | -    | 0.3  | 0.4   | V     |
| Supply Current 1                            | I <sub>DD1</sub> | /INH=Open,<br>Q <sub>0</sub> =Open  | XC2164Ax1A, f0=30MHz  | -    | 17.0 | (23)  | mA    |
|                                             |                  |                                     | XC2164Ax1B, f0=40MHz  | -    | 17.0 | (23)  |       |
|                                             |                  |                                     | XC2164Ax1C, f0=55MHz  | -    | 19.0 | (26)  |       |
|                                             |                  |                                     | XC2164Ax1D, f0=70MHz  | -    | 23.0 | (32)  |       |
|                                             |                  |                                     | XC2164Ax1E, f0=85MHz  | -    | 24.0 | (32)  |       |
|                                             |                  |                                     | XC2164Ax1F, f0=100MHz | -    | 30.0 | (40)  |       |
|                                             |                  |                                     | XC2164Ax1H, f0=110MHz | -    | 30.0 | (40)  |       |
|                                             |                  |                                     | XC2164Ax1K, f0=125MHz | -    | 30.0 | (40)  |       |
| Supply Current 2                            | I <sub>DD2</sub> | /INH="L", Q <sub>0</sub> =Open      |                       | -    | 5.0  | ( 8 ) | μ A   |
| Input Pull-Up Resistance 1                  | R <sub>UP1</sub> | /INH="L"                            |                       | 0.5  | 1.0  | 2.0   | MΩ    |
| Input Pull-Up Resistance 2                  | R <sub>UP2</sub> | /INH=0.7 V <sub>DD</sub>            |                       | 25   | 50   | 100   | kΩ    |
| Internal Oscillation<br>Feedback Resistance | R <sub>f</sub>   | XC2164Ax1A                          | -                     | 9.0  | -    | kΩ    |       |
|                                             |                  | XC2164Ax1B                          | -                     | 6.5  | -    |       |       |
|                                             |                  | XC2164Ax1C                          | -                     | 5.0  | -    |       |       |
|                                             |                  | XC2164Ax1D                          | -                     | 3.5  | -    |       |       |
|                                             |                  | XC2164Ax1E                          | -                     | 2.8  | -    |       |       |
|                                             |                  | XC2164Ax1F                          | -                     | 2.5  | -    |       |       |
|                                             |                  | XC2164Ax1H                          | -                     | 2.2  | -    |       |       |
|                                             |                  | XC2164Ax1K                          | -                     | 2.0  | -    |       |       |
| Output Disable<br>Leak Current              | I <sub>oz</sub>  | /INH="L"                            |                       | -    | -    | 10    | μ A   |

## ■ ELECTRICAL CHARACTERISTICS (Continued)

### ● DC Electrical Characteristics (Continued)

XC2164Ax1B, C, E, F, H, K, L (3rd Overtone)

3.3V Operation (unless otherwise stated,  $V_{DD}=3.3V$ , No Load,  $T_a = -30 \sim +80$  )

| PARAMETER                                   | SYMBOL           | CONDITIONS                           |                       | MIN. | TYP. | MAX. | UNITS |
|---------------------------------------------|------------------|--------------------------------------|-----------------------|------|------|------|-------|
| Operating Voltage                           | V <sub>DD</sub>  |                                      |                       | 2.97 | 3.30 | 3.63 | V     |
| "H" Level Input Voltage                     | V <sub>IH</sub>  |                                      |                       | 2.4  | -    | -    | V     |
| "L" Level Input Voltage                     | V <sub>IL</sub>  |                                      |                       | -    | -    | 0.4  | V     |
| "H" Level Output Voltage                    | V <sub>OH</sub>  | CMOS: 2.97V, I <sub>OH</sub> = - 8mA |                       | 2.5  | -    | -    | V     |
| "L" Level Output Voltage                    | V <sub>OL</sub>  | CMOS: 2.97V, I <sub>OH</sub> =8mA    |                       | -    | -    | 0.4  | V     |
| Supply Current 1                            | I <sub>DD1</sub> | /INH=Open,<br>Q <sub>0</sub> =Open   | XC2164Ax1B, f0=30MHz  | -    | 4.5  | (7)  | mA    |
|                                             |                  |                                      | XC2164Ax1C, f0=40MHz  | -    | 5.0  | (8)  |       |
|                                             |                  |                                      | XC2164Ax1E, f0=70MHz  | -    | 8.0  | (13) |       |
|                                             |                  |                                      | XC2164Ax1F, f0=85MHz  | -    | 8.5  | (13) |       |
|                                             |                  |                                      | XC2164Ax1H, f0=100MHz | -    | 9.5  | (15) |       |
|                                             |                  |                                      | XC2164Ax1K, f0=110MHz | -    | 10.0 | (15) |       |
|                                             |                  |                                      | XC2164Ax1L, f0=125MHz | -    | 10.5 | (15) |       |
| Supply Current 2                            | I <sub>DD2</sub> | /INH="L", Q <sub>0</sub> =Open       |                       | -    | 2.0  | -    | μA    |
| Input Pull-Up Resistance 1                  | R <sub>UP1</sub> | /INH="L"                             |                       | 1.0  | 2.0  | 4.0  | MΩ    |
| Input Pull-Up Resistance 2                  | R <sub>UP2</sub> | /INH=0.7 V <sub>DD</sub>             |                       | 35   | 70   | 140  | kΩ    |
| Internal Oscillation<br>Feedback Resistance | R <sub>f</sub>   | XC2164Ax1B                           |                       | -    | 6.5  | -    | kΩ    |
|                                             |                  | XC2164Ax1C                           |                       | -    | 5.0  | -    |       |
|                                             |                  | XC2164Ax1E                           |                       | -    | 2.8  | -    |       |
|                                             |                  | XC2164Ax1F                           |                       | -    | 2.5  | -    |       |
|                                             |                  | XC2164Ax1H                           |                       | -    | 2.2  | -    |       |
|                                             |                  | XC2164Ax1K                           |                       | -    | 2.0  | -    |       |
|                                             |                  | XC2164Ax1L                           |                       | -    | 2.3  | -    |       |
| Output Disable<br>Leak Current              | I <sub>OZ</sub>  | /INH="L"                             |                       | -    | -    | 10   | μA    |

XC2164Ax1D (3rd Overtone)

3.3V Operation (Unless otherwise stated,  $V_{DD}=3.3V$ , Oscillation Frequency  $f_0=48MHz$ ,  $T_a = -30 \sim +80$  )

| PARAMETER                                   | SYMBOL           | CONDITIONS                           |                                      | MIN. | TYP. | MAX. | UNITS |
|---------------------------------------------|------------------|--------------------------------------|--------------------------------------|------|------|------|-------|
| Operating Voltage                           | V <sub>DD</sub>  |                                      |                                      | 2.70 | 3.30 | 3.63 | V     |
| 'H' Level Input Voltage                     | V <sub>IH</sub>  |                                      |                                      | 2.4  | -    | -    | V     |
| 'L' Level Input Voltage                     | V <sub>IL</sub>  |                                      |                                      | -    | -    | 0.4  | V     |
| 'H' Level Output Voltage                    | V <sub>OH</sub>  | CMOS: 2.97V, I <sub>OH</sub> = - 8mA |                                      | 2.5  | -    | -    | V     |
| 'L' Level Output Voltage                    | V <sub>OL</sub>  | CMOS: 2.97V, I <sub>OH</sub> =8mA    |                                      | -    | -    | 0.4  | V     |
| Supply Current 1                            | I <sub>DD1</sub> | /INH=Open,<br>Q <sub>0</sub> =Open   | XC2164Ax1D,<br>f <sub>0</sub> =55MHz | -    | 6.5  | (10) | mA    |
| Supply Current 2                            | I <sub>DD2</sub> | /INH = 'L', Q <sub>0</sub> =Open     |                                      | -    | 2.0  | -    | μ A   |
| Input Pull-Up Resistance 1                  | R <sub>UP1</sub> | /INH = 'L'                           |                                      | 1.0  | 2.0  | 4.0  | MΩ    |
| Input Pull-Up Resistance 2                  | R <sub>UP2</sub> | /INH = 0.7V <sub>DD</sub>            |                                      | 35   | 70   | 140  | kΩ    |
| Internal Oscillation<br>Feedback Resistance | R <sub>f</sub>   | XC2164Ax1D                           |                                      | -    | 3.5  | -    | kΩ    |
| Output Disable Leak<br>Current              | I <sub>oZ</sub>  | /INH = 'L'                           |                                      | -    | -    | 10   | μ A   |

## ■ SWITCHING CHARACTERISTICS

XC2164Ax1M, T, V (Fundamental) <Chip Enable>

(unless otherwise stated,  $V_{DD}=3.3V$  or  $5.0V$ ,  $T_a=-30\sim+80$  )

| PARAMETER                                | SYMBOL  | CONDITIONS                                          | MIN. | TYP. | MAX. | UNITS |
|------------------------------------------|---------|-----------------------------------------------------|------|------|------|-------|
| Output Rise Time <sup>(*)</sup>          | tr      | CMOS: $C_L=15pF$ , $0.1V_{DD}\rightarrow 0.9V_{DD}$ | -    | 1.5  | -    | ns    |
|                                          |         | TTL: Load=10TTL, $0.4V\rightarrow 2.4V$             | -    | 1.5  | -    | ns    |
| Output Fall Time <sup>(*)</sup>          | tf      | CMOS: $C_L=15pF$ , $0.9V_{DD}\rightarrow 0.1V_{DD}$ | -    | 1.5  | -    | ns    |
|                                          |         | TTL: Load=10TTL, $2.4V\rightarrow 0.4V$             | -    | 1.5  | -    | ns    |
| Output Duty Cycle                        | DUTY    | CMOS: $C_L=15pF$ @ $0.5V_{DD}$                      | 45   | -    | 55   | %     |
|                                          |         | TTL: Load=10TTL @ $1.4V$                            | 45   | -    | 55   | %     |
| Output Disable Delay Time <sup>(*)</sup> | tplz    | $f_0=4MHz$ , $C_L=15pF$                             | -    | -    | 100  | ns    |
| Output Enable Delay Time <sup>(*)</sup>  | tplz    | $f_0=4MHz$ , $C_L=15pF$                             | -    | -    | 6    | ms    |
| Oscillation Start Time <sup>(*)</sup>    | tosc_on | $f_0=4MHz$ , $C_L=15pF$                             | -    | -    | 6    | ms    |

\*1: the values are the designed values.

XC2164Ax1A to L (3rd Overtone) <Chip Enable>

(unless otherwise stated,  $V_{DD}=3.3V$  or  $5.0V$ ,  $T_a=-30\sim+80$  )

| PARAMETER                                | SYMBOL  | CONDITIONS                                          | MIN. | TYP. | MAX. | UNITS |
|------------------------------------------|---------|-----------------------------------------------------|------|------|------|-------|
| Output Rise Time <sup>(*)</sup>          | tr      | CMOS: $C_L=15pF$ , $0.1V_{DD}\rightarrow 0.9V_{DD}$ | -    | 1.5  | -    | ns    |
|                                          |         | TTL: Load=10TTL, $0.4V\rightarrow 2.4V$             | -    | 1.5  | -    | ns    |
| Output Fall Time <sup>(*)</sup>          | tf      | CMOS: $C_L=15pF$ , $0.9V_{DD}\rightarrow 0.1V_{DD}$ | -    | 1.5  | -    | ns    |
|                                          |         | TTL: Load=10TTL, $2.4V\rightarrow 0.4V$             | -    | 1.5  | -    | ns    |
| Output Duty Cycle                        | DUTY    | CMOS: $C_L=15pF$ @ $0.5V_{DD}$                      | 45   | -    | 55   | %     |
|                                          |         | TTL: Load=10TTL @ $1.4V$                            | 45   | -    | 55   | %     |
| Output Disable Delay Time <sup>(*)</sup> | tplz    | $f_0=20MHz$ , $C_L=15pF$                            | -    | -    | 100  | ns    |
| Output Enable Delay Time <sup>(*)</sup>  | tplz    | $f_0=20MHz$ , $C_L=15pF$                            | -    | -    | 6    | ms    |
| Oscillation Start Time <sup>(*)</sup>    | tosc_on | $f_0=20MHz$ , $C_L=15pF$                            | -    | -    | 6    | ms    |

\*1: the values are the designed values.

XC2164Kx1M, T, V (Fundamental) <Output Enable>

(unless otherwise stated,  $V_{DD}=3.3V$  or  $5.0V$ ,  $T_a=-30\sim+80$  )

| PARAMETER                                | SYMBOL  | CONDITIONS                                          | MIN. | TYP. | MAX. | UNITS   |
|------------------------------------------|---------|-----------------------------------------------------|------|------|------|---------|
| Output Rise Time <sup>(*)</sup>          | tr      | CMOS: $C_L=15pF$ , $0.1V_{DD}\rightarrow 0.9V_{DD}$ | -    | 1.5  | -    | ns      |
|                                          |         | TTL: Load=10TTL, $0.4V\rightarrow 2.4V$             | -    | 1.5  | -    | ns      |
| Output Fall Time <sup>(*)</sup>          | tf      | CMOS: $C_L=15pF$ , $0.9V_{DD}\rightarrow 0.1V_{DD}$ | -    | 1.5  | -    | ns      |
|                                          |         | TTL: Load=10TTL, $2.4V\rightarrow 0.4V$             | -    | 1.5  | -    | ns      |
| Output Duty Cycle                        | DUTY    | CMOS: $C_L=15pF$ @ $0.5V_{DD}$                      | 45   | -    | 55   | %       |
|                                          |         | TTL: Load=10TTL @ $1.4V$                            | 45   | -    | 55   | %       |
| Output Disable Delay Time <sup>(*)</sup> | tplz    | $f_0=4MHz$ , $C_L=15pF$                             | -    | -    | 100  | ns      |
| Output Enable Delay Time <sup>(*)</sup>  | tplz    | $f_0=4MHz$ , $C_L=15pF$                             | -    | -    | 10   | $\mu s$ |
| Oscillation Start Time <sup>(*)</sup>    | tosc_on | $f_0=4MHz$ , $C_L=15pF$                             | -    | -    | 6    | ms      |

\*1: the values are the designed values.

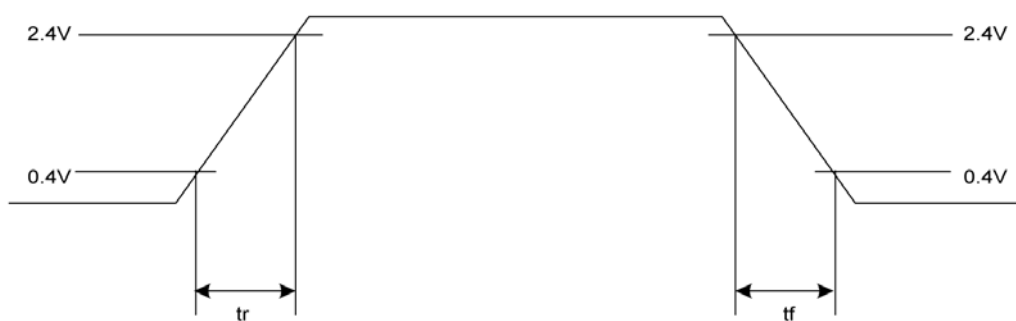
\* The values shown are preliminary so that the values may be changed without a prior announcement.

## ■ SWITCHING WAVEFORMS

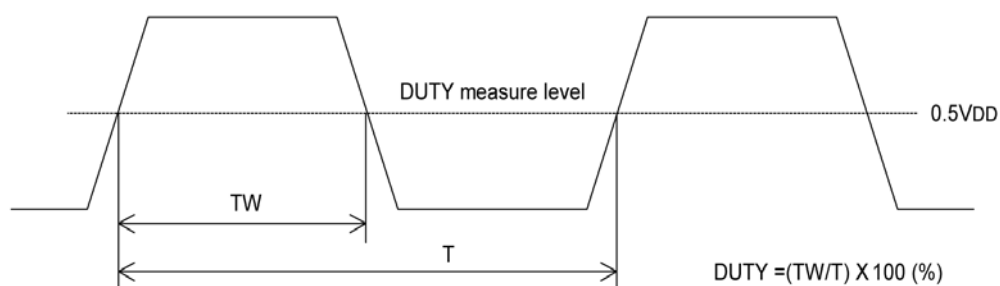
- Switching Time
  - (1) CMOS Output



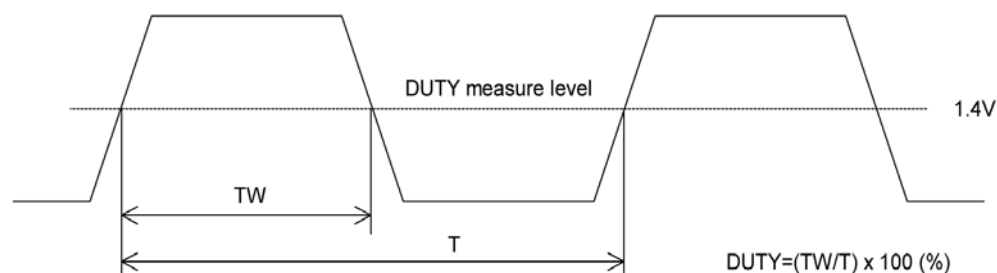
- (2) TTL Output



- Duty Cycle
  - (1) CMOS Output

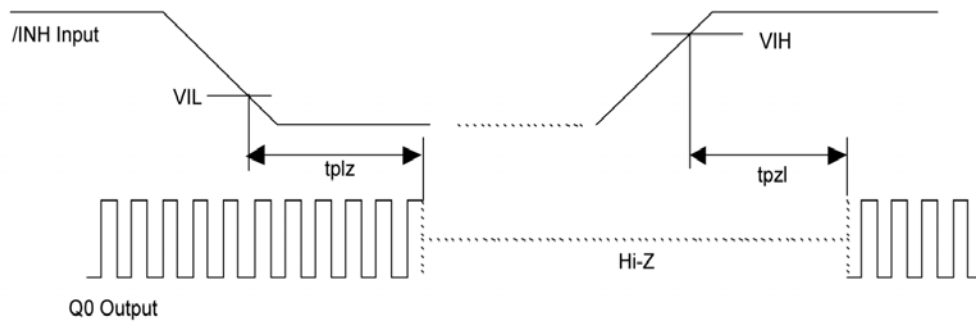


- (2) TTL Output



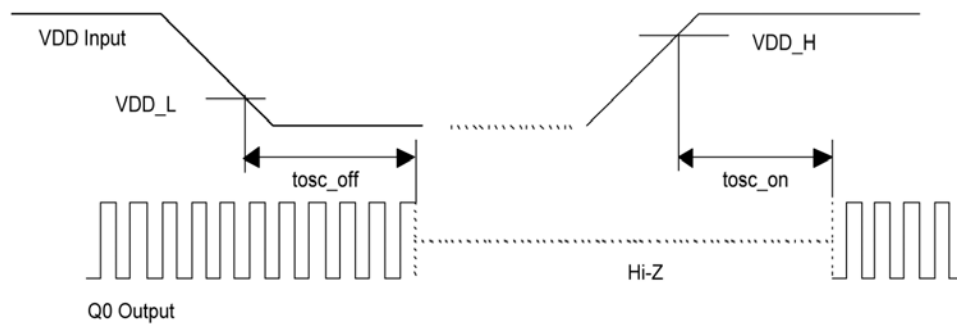
## ■ SWITCHING WAVEFORMS (Continued)

(3) Output Disable Delay Time, Output Enable Delay Time   \*)The /INH pin input waveform: less than  $t_r=t_f=10\text{ns}$ , VDD input



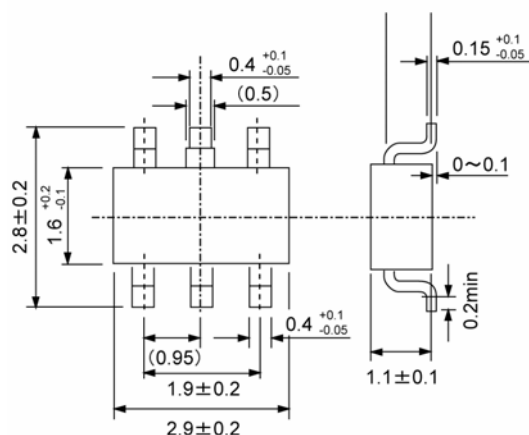
(4) Oscillation Start Time:  $t_{osc\_on}$

\*)The VDD pin input waveform : less than  $t_r=t_f=10\text{ns}$ , /INH=Open



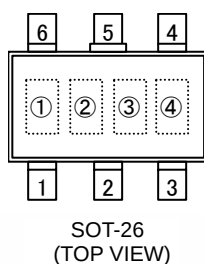
## ■ PACKAGING INFORMATION

### ● SOT-26



## ■ MARKING RULE

### ● SOT-26



Represents product series

| MARK |
|------|
| 4    |

Represents divider ratio

<Chip Enable>

| MARK | RATIO             | MARK | RATIO             |
|------|-------------------|------|-------------------|
| A    | f <sub>0</sub> /1 | C    | f <sub>0</sub> /4 |
| B    | f <sub>0</sub> /2 | D    | f <sub>0</sub> /8 |

\*B, C, D: fundamental only

<Output Enable>

| MARK | RATIO             | MARK | RATIO             |
|------|-------------------|------|-------------------|
| K    | f <sub>0</sub> /1 | M    | f <sub>0</sub> /4 |
| L    | f <sub>0</sub> /2 | N    | f <sub>0</sub> /8 |

\*L, M, N: fundamental only

Represents recommended frequency & R<sub>f</sub>, C<sub>g</sub> & C<sub>d</sub> values

\* Please refer to the ordering information, SYMBOL to

Represents assembly lot number

(Based on internal standards)

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