



## ■ HANDLING PRECAUTIONS

Please use the each product under the conditions provided in respective specifications and catalogues.

The crystal products are designed and manufactured to satisfy its specification, and quality and reliability of the products are ensured through our stringent reliability tests before shipments. However, it is essential to store, mount, and use the products under proper conditions in order to keep the quality and reliability. Please pay careful attention to following precautions and use the products under the optimal conditions. We shall not be responsible for any deteriorated performance of the products caused by any application or usage of the products adopted at customer's own discretion.

### ■ Common points for all products

#### 1. Shock resistance

Crystal products may be damaged under some conditions, such as dropping from desks or receiving shocks during mounting. Please do not use the products if products have received any excessive shocks.

#### 2. Radiation

Exposure to radiation can cause deterioration in performance, so avoid irradiation.

#### 3. Chemicals / pH

Do not use or store the product in a pH range that may cause corrosion or dissolution of the materials or packaging.

#### 4. Adhesive

Do not use an adhesive that may cause corrosion of the packing materials, terminals, components, glass materials, and vapor deposited materials used in the products. (For example, a chlorine-based adhesive may corrode the metal parts "lid" of a crystal unit to diminish the hermetic qualities, lowering the performance.)

#### 5. Halogen Compound

Do not use products in halogen gas. Even a slight amount of halogen gas, such as that found in chlorine gas in the air or in metal parts used in the package, may corrode. Also, do not use any resin that emits halogen gas.

#### 6. Static electricity

Excessive levels of static electricity may damage the product, please treat it in anti-static condition. Choose conductive materials for containers and packing materials. Use a soldering gun and a measurement circuit free from high-voltage leakage and provide grounding conduction when working with them.

### 7. When designing

#### 7.1 The affect of mechanical vibration

While there is any given shock or mechanical vibration periodically to crystal products, such as, a piezo sounder, a piezo buzzer, and speaker, to crystal products, output frequency and amplitude can be changed. Especially the quality of telecommunication equipment could be affected by this phenomenon. Although crystal products are designed to minimize the effect of mechanical vibration, we recommend to check them in advance and to follow the PCB design guidelines as below.

#### 7.2 PCB design guidelines

- (1) Ideally, the mechanical buzzer source should be mounted on a separate PCB from the crystal device. It is advisable to use cushion or cutting PCB, if you mount on same PCB. Traveling mechanical vibration differs when applied to the PCB only vs. inside the body. It is advisable to confirm characteristics in the body.
- (2) Refer to the recommend footprint when designing.
- (3) In case of using solder flux, please use it on the basis of the flux of the JIS standard (JIS C 60068-2-20/IEC 60,068-2-20).
- (4) Please use the solder on the basis of the JIS standard (JIS Z 3282, Pb content 1000ppm, 0.1wt% or less) lead -free solder.

### 8. Notes on storage

- (1) Storing the crystal products under higher or lower temperature or high humidity for a long period may affect frequency stability or solderability. Please store the crystal products at the normal temperature and humidity, avoid storing them for a long period and mount them as soon as possible after unpacking.

#### Normal temperature and humidity:

Temp, +15 °C to +35 °C, humidity 25 % RH to 85 % RH

- (2) Please carefully handle the inner and outer boxes and reel. External pressure may cause deformation of reel and tape.

### 9. Mounting precautions

#### 9.1 Soldering heat resistance

The crystal products except SMD products use solder having a +180°C to +200°C melting point. Heating up the package more than +150°C may deteriorate the characteristics or damage the products. If the crystal products need to be soldered at temperature of more than +150°C, SMD products are recommended. Using higher temperatures over the following reflow conditions to crystal products, even SMD products, may cause the characteristics to deteriorate. The reflow conditions within following profile are recommended. Always check the soldering temperature and time before mounting these products. Also, please check them again when the mounting conditions are changed. Please contact us for inquiries about heat-resistance if crystal products need to be soldered over the following profile.

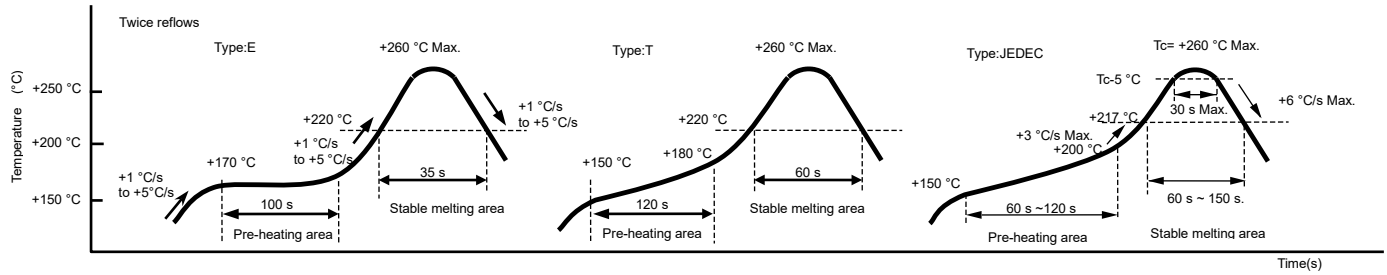
- (1) Cylinder products and DIP products

Note: \* = Not recommended for new design or Discontinued products

| Model        |                          | Soldering conditions  |
|--------------|--------------------------|---|
| [ Cylinder ] | HTS-206 *                | +280 °C or under @ Max. 5 s.<br>Do not heat the package at more than +150 °C. |
| [ DIP ]      | SG- 531P *, SG-8002 DC * | +260 °C or under @ Max.10 s.<br>Do not heat the package at more than +150 °C. |

## (2) SMD products Reflow profile (example)

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



Please make temperature rate as gentle a curve as possible.

Note: \* = Not recommended for new design or Discontinued products

| Category                  | Model                    | Type:E    | Type:JEDEC        | Remarks    |
|---------------------------|--------------------------|-----------|-------------------|------------|
| kHz Range<br>Crystal unit | FC3215AN                 |           | √                 |            |
|                           | FC2012AN                 |           | √                 |            |
|                           | FC-12D *                 |           | √                 |            |
|                           | FC-12M                   |           | √                 |            |
|                           | FC-135/ FC-135R          | √         | Please contact us |            |
|                           | FC-13A                   | √         | Available         |            |
|                           | FC1610AN                 |           | √                 |            |
|                           | MC-146                   |           | Please contact us |            |
|                           | MC-306 *                 | √         | Available         |            |
|                           | MC-30A                   | √         | Available         |            |
|                           | MC-405 *                 | √         | Available         |            |
| MC-406 *                  | √                        | Available |                   |            |
| MHz Range<br>Crystal unit | FA1210AN                 |           | √                 |            |
|                           | FA1008AN                 |           | √                 |            |
|                           | FA-118T                  |           | √                 |            |
|                           | FA-128                   |           | √                 |            |
|                           | FA-128S *                |           | √                 |            |
|                           | FA2016AA                 |           | √                 |            |
|                           | FA2016AN *               |           | √                 |            |
|                           | FA-20H                   |           | √                 |            |
|                           | FA1612AS                 |           | √                 |            |
|                           | FA2016AS                 |           | √                 |            |
|                           | FA-20HS *                |           | √                 |            |
|                           | FA-238                   | √         | Available         |            |
|                           | FA-238A                  | Available | √                 |            |
|                           | FA-238V                  | √         | Available         |            |
|                           | MA-306 *                 | √         | Please contact us |            |
|                           | MA-406 *                 | √         | Available         | Tc=+250 °C |
|                           | MA-505 *                 | √         | Available         | Tc=+250 °C |
| MA-506 *                  | √                        | Available | Tc=+250 °C        |            |
| TSX-3225                  |                          | √         |                   |            |
| SAW<br>Resonator          | NS-21R *                 |           | √                 |            |
|                           | NS-32R *                 | √         | Available         |            |
|                           | FS-335 *                 | √         | Please contact us |            |
|                           | FS-555 *                 | √         | Please contact us |            |
| SPXO                      | SG2520EGN/ VGN           |           | √                 |            |
|                           | SG2520EHN/ VHN           |           | √                 |            |
|                           | SG2016CAN/ CAA           |           | √                 |            |
|                           | SG-210 series *          |           | √                 |            |
|                           | SG-211S*E *              |           | √                 |            |
|                           | SG-3030CM *              |           | √                 |            |
|                           | SG-3030LC */ JF */ JC *  | √         | Please contact us |            |
|                           | SG-3040 series *         | √         | Please contact us |            |
|                           | SG-310 series *          |           | √                 |            |
|                           | SG3225CAN                |           | √                 |            |
|                           | SG3225EAN/ VAN/ EEN/ VEN |           | √                 |            |
|                           | SG5032CAN/ CBN */ CCN    |           | √                 |            |
|                           | SG5032EAN/ VAN           |           | √                 |            |
|                           | SG5032EEN/ VEN           |           | √                 |            |
|                           | SG-615P *                | √         | Available         | Tc=+245 °C |
|                           | SG-636 series *          | √         |                   |            |
|                           | SG7050CAN/ CBN */ CCN    |           | √                 |            |
| SG7050EAN/ VAN/ EEN/ VEN  |                          | √         |                   |            |
| SG7050EBN *               |                          | √         |                   |            |
| SG3225HBN                 |                          | √         |                   |            |
| Selectable<br>SPXO        | SG-8503CA                |           | √                 |            |
|                           | SG-8504CA                |           | √                 |            |
|                           | SG-8506CA                |           | √                 |            |

√ : Standard Spec.

| Category                 | Model                               | Type:E | Type:JEDEC | Remarks    |
|--------------------------|-------------------------------------|--------|------------|------------|
| SPSO<br>(Low-jitter SAW) | EA-2102CB                           |        | √          |            |
|                          | EG-2001CA *                         |        | √          |            |
|                          | EG-2002CA *                         |        | √          |            |
|                          | EG-2021CA *                         |        | √          |            |
|                          | EG-2101CA *                         |        | √          |            |
|                          | EG-2102CA *                         |        | √          |            |
|                          | EG-2102CB                           |        | √          |            |
|                          | EG-2103CB                           |        | √          |            |
|                          | EG-2121CA                           |        | √          |            |
|                          | EG-2121CB                           |        | √          |            |
|                          | EG-2123CB                           |        | √          |            |
|                          | EG-4101CA                           |        | √          |            |
|                          | EG-4121CA                           |        | √          |            |
|                          | XG-1000CA *                         |        | √          |            |
|                          | XG-1000CB *                         |        | √          |            |
|                          | XG-2102CA                           |        | √          |            |
|                          | XG-2103CA                           |        | √          |            |
|                          | XG-2121CA                           |        | √          |            |
|                          | XG-2123CA *                         |        | √          |            |
|                          | XG5032HAN                           |        | √          |            |
| Programmable             | SG-8002CA */ CE *                   | √      | Available  | Tc=+245 °C |
|                          | SG-8002JA *                         | √      | Available  |            |
|                          | SG-8002JC *                         | √      |            |            |
|                          | SG-8101CA/ CB/ CE/ CG               |        | √          |            |
|                          | SG-8018CA/ CB/ CE/ CG               |        | √          |            |
| Spread<br>Spectrum       | SG-8101CGA                          |        | √          |            |
|                          | SG-9101CA/ CB/ CE/ CG               |        | √          |            |
| VCXO / VCSO              | SG-9101CGA                          |        | √          |            |
|                          | EV7050EAN                           |        | √          |            |
|                          | VG7050CDN                           |        | √          |            |
|                          | VG2520CAN *                         |        | √          |            |
|                          | VG7050CAN *                         |        | √          |            |
|                          | VG-4231CA *                         | √      | Available  |            |
|                          | VG-4231CB *                         |        | √          |            |
|                          | VG-4231CE                           |        | √          |            |
|                          | VG-4232CA *                         |        | √          |            |
|                          | VG-4501CA * / VG-4502CA *           |        | √          |            |
|                          | VG-4512CA *                         |        | √          |            |
|                          | VG-4513CA */ CB *                   |        | √          |            |
|                          | VG5032EDN / VDN                     |        | √          |            |
|                          | VG7050EAN/ EBN/ ECN                 |        | √          |            |
| VG3225/ 5032/ 7050EFN    |                                     | √      |            |            |
| VG3225/ 5032/ 7050VFN    |                                     | √      |            |            |
| TCXO                     | TG1612SAN                           |        | √          |            |
|                          | TG2016SAN *                         |        | √          |            |
|                          | TG2016SMN                           |        | √          |            |
|                          | TG2016SBN                           |        | √          |            |
|                          | TG2520SMN                           |        | √          |            |
|                          | TG2520SBN                           |        | √          |            |
|                          | TG2520CEN                           |        | √          |            |
|                          | TG3225CEN                           |        | √          |            |
|                          | TG-5006CE                           |        | √          |            |
|                          | TG-5006CG                           |        | √          |            |
|                          | TG-5006CJ                           |        | √          |            |
|                          | TG5032CKN /SKN                      |        | √          |            |
|                          | TG5032CMN /SMN                      |        | √          |            |
|                          | TG7050CKN /SKN                      |        | √          |            |
|                          | TG7050CMN /SMN                      |        | √          |            |
|                          | TG5032CGN/ SGN/ CFN/ SFN            |        | √          |            |
|                          | TG5032CAN */ CBN */<br>CCN */ CDN * |        | √          |            |
|                          | TG5032SAN */ SBN */<br>SCN */ SDN * |        | √          |            |
|                          | TG-5035CE *                         |        | √          |            |
|                          | TG-5035CG *                         |        | √          |            |
|                          | TG-5035CJ *                         |        | √          |            |
|                          | TG-5500CA *                         |        | √          |            |
|                          | TG-5501CA *                         |        | √          |            |
|                          | TG-5510CA                           |        | √          |            |
|                          | TG-5511CA                           |        | √          |            |
|                          | TG-5510CB                           |        | √          |            |
|                          | TG-5511CB                           |        | √          |            |
|                          | TG-3541CE                           |        | √          |            |
| TG-3541CEA               |                                     | √      |            |            |

√ : Standard Spec.

| Category                | Model           | Type:E | Type:JEDEC | Remarks           |
|-------------------------|-----------------|--------|------------|-------------------|
| Multi output Oscillator | MG7050 series * |        | √          |                   |
| OEXO                    | OG1409CAN *     |        | √          | Tc=+245 °C 1 time |
| Module                  | SR3225SAA       |        | √          |                   |

√: Standard Spec.

| Category               | Model        | Type:E | Type:JEDEC        | Remarks    |            |
|------------------------|--------------|--------|-------------------|------------|------------|
| Real Time Clock Module | RA-4565SA    |        | √                 | Tc=+250 °C |            |
|                        | RA-4574SA *  | √      | Please contact us | Tc=+250 °C |            |
|                        | RA4803SA     |        | √                 | Tc=+250 °C |            |
|                        | RA-8565SA    |        | √                 | Tc=+250 °C |            |
|                        | RA-8581SA    | √      | Please contact us | Tc=+250 °C |            |
|                        | RA8803SA     |        | √                 | Tc=+250 °C |            |
|                        | RA4000CE     |        | √                 |            |            |
|                        | RA8000CE     |        | √                 |            |            |
|                        | RA8900CE     |        | √                 |            |            |
|                        | RA8804CE     |        | √                 |            |            |
|                        | RTC-4543SA * | √      | Please contact us | Tc=+250 °C |            |
|                        | RTC-4574JE * | √      | Please contact us |            |            |
|                        | RTC-4574NB * | √      | Please contact us |            |            |
|                        | RTC-4574SA   | √      | Please contact us | Tc=+250 °C |            |
|                        | RTC-72423 *  | √      | Please contact us | Tc=+245 °C |            |
|                        | RTC-7301SF * | √      | Please contact us |            |            |
|                        | RTC-8564JE * | √      | Please contact us |            |            |
|                        | RTC-8564NB * | √      | Please contact us |            |            |
|                        | RX-4035LC    |        |                   | √          |            |
|                        | RX-4035SA    |        |                   | √          |            |
|                        | RX-4045NB *  | √      | Please contact us |            |            |
|                        | RX-4045SA    | √      | Please contact us | Tc=+250 °C |            |
|                        | RX-4571LC    |        |                   | √          |            |
|                        | RX-4571NB *  |        |                   | √          |            |
|                        | RX-4571SA    |        |                   | √          | Tc=+250 °C |
|                        | RX-4574LC    | √      | Please contact us |            |            |
|                        | RX-4581NB *  | √      | Please contact us |            |            |
|                        | RX-4803LC    |        |                   | √          |            |
|                        | RX-4803SA    |        |                   | √          | Tc=+250 °C |
|                        | RX6110SA     |        |                   | √          | Tc=+250 °C |
|                        | RX8010SJ     |        |                   | √          | Tc=+250 °C |
|                        | RX-8025NB *  | √      | Please contact us |            |            |
|                        | RX-8025SA    | √      | Please contact us | Tc=+250 °C |            |
|                        | RX-8035LC    |        |                   | √          |            |
|                        | RX-8035SA    |        |                   | √          |            |
|                        | RX8130CE     |        |                   | √          |            |
|                        | RX-8564LC    | √      | Please contact us |            |            |
|                        | RX-8571LC    |        |                   | √          |            |
|                        | RX-8571NB *  |        |                   | √          |            |
|                        | RX-8571SA    |        |                   | √          | Tc=+250 °C |
|                        | RX-8581JE *  | √      | Please contact us |            |            |
|                        | RX-8581SA *  | √      | Please contact us | Tc=+250 °C |            |
| RX-8731LC              |              |        | √                 |            |            |
| RX-8803LC              |              |        | √                 |            |            |
| RX-8803SA              |              |        | √                 | Tc=+250 °C |            |
| RX4901CE               |              |        | √                 |            |            |
| RX8901CE               |              |        | √                 |            |            |
| RX8804CE               |              |        | √                 |            |            |
| RX8900CE               |              |        | √                 |            |            |
| RX8900SA               |              |        | √                 | Tc=+250 °C |            |
| SAW Filter             | FF-555 *     | √      | Please contact us |            |            |

√: Standard Spec.

| Category  | Model                  | Type:E | Type:JEDEC | Remarks    |
|-----------|------------------------|--------|------------|------------|
| Sensor    | XV-3500CB */ XV-3510CB |        | √          |            |
|           | XV-3900CB *            |        | √          |            |
|           | XV4001Bx               |        | √          |            |
|           | XV4001Kx               |        | √          |            |
|           | XV7001BB               |        | √          |            |
|           | XV7011BB               |        | √          |            |
|           | XV7081BB               |        | √          |            |
|           | XV7021BB               |        | √          |            |
|           | XV-8000CB *            |        | √          |            |
|           | XV-8000LK *            |        | √          |            |
|           | XV-9100CD              |        | √          |            |
|           | XV-9100LP              |        | √          | Tc=+250 °C |
|           | XV-9100LV              |        | √          | Tc=+250 °C |
|           | XV-9300CD              |        | √          |            |
|           | XV-9300LP              |        | √          | Tc=+250 °C |
| XV-9300LV |                        | √      | Tc=+250 °C |            |

√ : Standard Spec.

## 9.2 Shocks by auto mounting

Shocks caused by auto mounting and vacuuming may deteriorate the characteristics and affect the products. Please set the mounting conditions to minimize the shocks as much as possible, and be sure that there is no affect on the characteristics before mounting. Please review the conditions after the conditions are changed. Also please be sure that crystal products don't hit machines or other electric boards, etc. before or after mounting.

## 9.3 Notes for each package type

### (1) Ceramic package products and SON products

Bending the board after soldering ceramic package products and SON products (MC-146,RTC-\*\*\*\*NB,RX-\*\*\*\*NB) may cause peeling off portions of soldering or package cracks by mechanical stress. Particularly, in the case of cutting boards after soldering these products, please be sure to layout the crystal on a less stressed location and use less stressed cutting method.

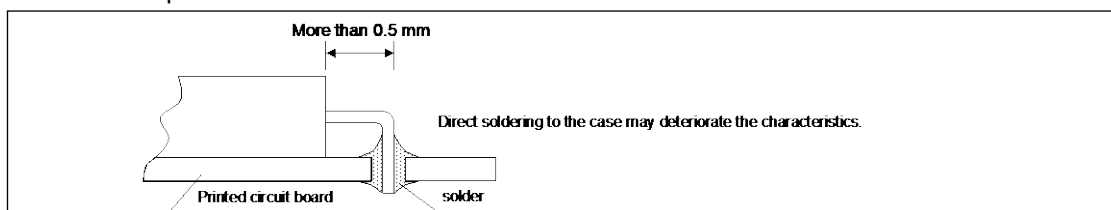
### (2) Ceramic package products

In the case of soldering ceramic package products on a different expansion-coefficient board (ex. Epoxy Glass), soldering crack at the foot pattern would be expected under repeated temperature changes for a long period. Under these conditions, be sure to check the solderability in advance.

### (3) Cylinder products

Bending the lead on the glass or pulling the lead strongly may cause cracking of the hermetic seal glass at the root of the lead and may cause the airtightness and the characteristics to deteriorate. When the lead of crystal products need to be bent as in the figure below, leave more than 0.5 mm of lead from the case and hold the lead to prevent the lead from cracks. When the lead needs to be repaired, do not pull it, and hold the bent part to correct it. Giving undue pressure on this portion of hermetic seal may cause the airtightness to deteriorate. Please avoid applying pressure. Gluing the case of products on the electric board is recommended to prevent the airtightness from deteriorating.

#### ● Installation example



### (4) DIP products and Pin type OCXO

Deformed leads cannot be inserted into board holes. Avoid applying stress sufficient to deform leads.

### (5) SOJ Products and SOP products

Please avoid applying stress sufficient to deform the leads. Deformed leads may cause incorrect soldering. Particularly SOP products need to be handled with the greatest care.

## 9.4 Ultrasonic cleaning

(1) Products using AT-cut crystal and SAW resonator/filter can be cleaned by ultrasonic methods. But under some conditions, the crystal characteristics may be affected and internal wiring may be damaged. Please be sure to check the suitability of your system in advance.

(2) Products using tuning-fork crystals, gyro sensors and OCXOs cannot be guaranteed if cleaned using ultrasonic methods, because crystal may be destroyed.

(3) Do not wash open-type products.

(4) With washable products, avoid the use of cleaners or solvents that may negatively affect the product.

(5) By solder flux residual moisture absorption and solidification, it may cause of migration etc. So, it may affect the reliability and quality of the product negatively. Please clean up the residue of flux and dry the PCB.

**10. Handling**

Do not touch the surface of IC directly with tweezers or any hard tools, jigs.

**11. Use environment (temperature and humidity)**

Please use the products within rating temperature range in concern temperature distribution in body and seasonal changes. In high humidity environment, it may cause malfunction caused by the dew condensation. Please prevent dew condensation.



## ■ Crystal unit / Resonator

### 1. Drive level

Applying excessive drive level to the crystal units may cause deterioration of characteristics or damage. Circuit design must be such as to maintain a proper drive level.(refer to page "Drive level")

### 2. Negative resistance

Unless adequate negative resistance is allocated in the oscillation circuit, oscillation or oscillation start up time may increase (refer to page "Allowance for Oscillation".)

### 3. Load capacitance

Differences in the load capacitance in the oscillation circuit may result in deviations in the oscillation frequency from the desired frequency. Attempting to tune by force may merely cause abnormal oscillation. Before use, please specify the load capacitance of the oscillation circuit.(refer to page "Load capacitance" )

## ■ Crystal Oscillator and real time clock module

All crystal oscillators and real time clock modules are provided with an IC.

### 1. Noise

Applying excessive level of extraneous noise to power source or input terminal may cause latch up or spurious phenomenon, which results in malfunction and breakdown.

### 2. Power supply line

Line impedance of a power supply should be as low as possible.

### 3. Output Load

It is recommended that output load is installed as close as possible to an oscillator (within 20 mm).

### 4. Treatment of unused input terminals

Unused pins that are left open may collect noise, thereby resulting in malfunction. Also, power consumption may increase when both P-channel and N-channel are turned on, therefore connect unused input terminals to VCC or GND.

### 5. Heat impact

Repeated large changes in temperature may degrade the characteristics of a deteriorated crystal unit and cause breakage of wires inside the plastic mold. This must be avoided.

### 6. Mounting direction

Incorrect mounting of the oscillator may cause malfunction and breakdown, so please check the mounting direction when installing.

### 7. Power on

It is not recommended to power on from intermediate electric potential and / or extreme fast power on. Powering on under such conditions may cause no oscillation and / or malfunction.

## ■ Sensing device

### 1. Interference between the sensors

The crystal sensor may catch the interference by board vibration and power supply common impedance.

### 2. Protection against vibration

Please consider about protection against vibration when the crystal sensor is operated in vibration condition.

# PRECAUTIONS IN DESIGNING OSCILLATION CIRCUITS

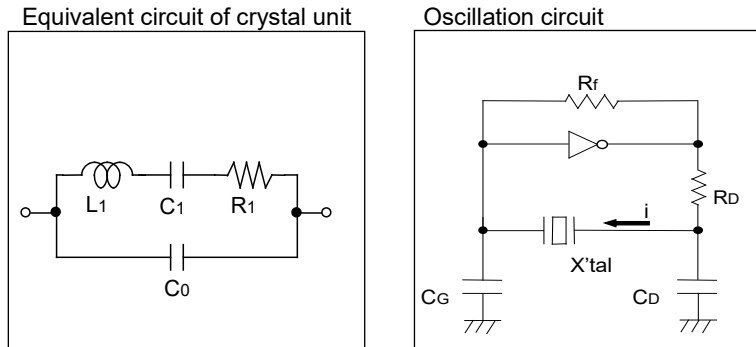
## 1. Drive level

Drive level denotes electric power required to oscillate a crystal unit, which can be calculated using the following formula.

$$\text{Drive level (P)} = i^2 \cdot R_e$$

Where  $i$  stands for current to pass in the crystal unit,  $R_e$  for effective resistance of crystal unit, and  $R_e = R_1(1 + C_0/C_1)^2$ .

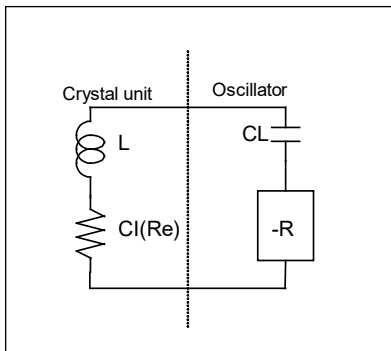
If the Drive level (P) exceeds the specified level, oscillation frequency will shift. This occurs because an excessive level of power causes stress for the crystal and, consequently, temperature rises. If excessive drive level of power is applied to the crystal unit, this may deteriorate or damage the characteristics.



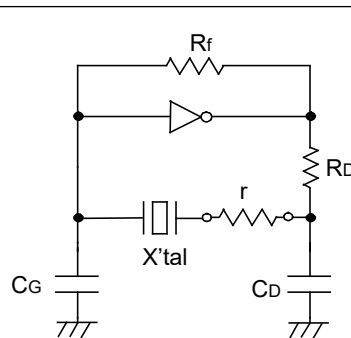
## 2. Allowance for oscillation

Unless adequate negative resistance is allocated in the oscillation circuit, oscillation start-up time may be increased, or No oscillation may occur. In order to avoid this, provide enough negative resistance in the circuitry design.

### ● Crystal unit and Oscillator



### ● Check of Negative resistance



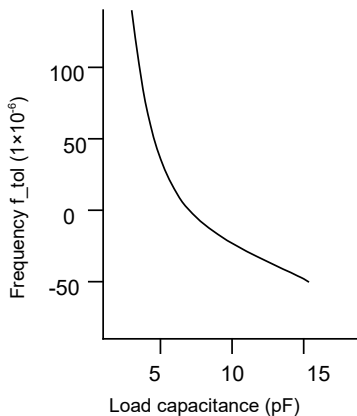
1. Connect the resistance ( $r$ ) to the circuit in series with the crystal unit.
2. Adjust ( $r$ ) so that oscillation can start (or stop).
3. Measure ( $r$ ) when oscillation just starts (or stops) in (2) above.
4. Recommended ( $r$ )  
 $(r) > C_1 \times (5 \text{ to } 10)$

## 3. Load capacitance

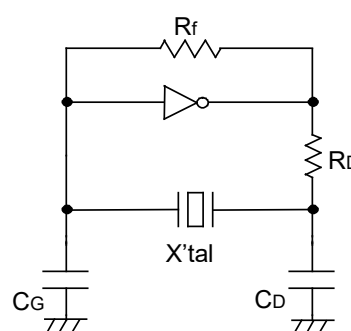
Differences in the load capacitance of the oscillation circuit may result in a different oscillation frequency from the desired one, as shown in the figure below. Approximate expression of the load capacitance of the circuit  $CL \cong CG \times CD / (CG + CD) + CS$ .

Where  $CS$  stands for stray Capacity of the circuit.

### ● Frequency and load capacitance characteristics



### ● Reference for setting parameters of oscillation circuit



| Symbol                          | R <sub>f</sub> (MΩ) | R <sub>D</sub> (kΩ) | C <sub>G</sub> (pF) | C <sub>D</sub> (pF) |
|---------------------------------|---------------------|---------------------|---------------------|---------------------|
| Frequency range                 |                     |                     |                     |                     |
| 20 kHz to 60 kHz                | 20                  | 500                 | 10                  | 10                  |
| 60 kHz to 165 kHz               | 10                  | 300                 | 10                  | 10                  |
| 5.5 MHz to 30 MHz (Fundamental) | 1                   | 0.5                 | 5~15                | 5~15                |
| 30 MHz~50 MHz (Fundamental)     |                     |                     | 5~10                | 5~10                |

IC: equivalent to TC74HCU04 (Unbuffer)  
IC: equivalent to TC74VHCU04 (Unbuffer) (30 MHz to 50 MHz)  
(TC74HCU04 and TC74VHCU04 are product number of Toshiba Corp.)