HONG KONG X'TALS LIMITED

Hybrid type Crystal Handling Precautions

Crystals should be handled in a proper way to reduce the risk of performance deterioration. This note describes some common factors affecting the crystal operation which would cause to the oscillation circuit malfunction.

Common Factors Affecting Crystal Operation

1. Ultrasonic Frequency, Conformal Coating & Washing

Ultrasonic technology is widely used in the industrial equipment. Two popular applications of those equipment found in the manufacturing are ultrasonic cleaning process and ultrasonic welding processes. For the Hybrid crystal, it is not suggested to use any ultrasonic cleaning processes.

The ultrasonic welding machines are usually operating in frequency of 20KHz to 60KHz in some applications. This frequency might also destroy the AT-cut crystal blank due to resonance effect.

Some suggestions are described below to reduce crystal failure when products required to performing ultrasonic processes:

- Check the ultrasonic machine if it is suitable for use with the crystals. If possible, perform some crystal dummy tests in advance to verify the performance.
- Ensure the crystal has some space apart from the product housing, this avoids inducing ultrasonic frequency to the crystal structure during assembly of the product.
- For PCB component placement, crystal should be placed in the center part of PCB.
- Change other crystal type if problem has been found in one package type.
- If the ultrasonic machine has control functions available, switch the ultrasonic frequency far away from crystal frequency and reduce the operation power of the machine.
- When the resonance is occurred, the customer can try to change the orientation of the crystal in reference to the ultrasonic wave direction.

Conformal coating or any liquid washing to the component are not recommended, if these processes are necessary in preparation, it is recommended to perform some crystal dummy tests in advance to verify the performance.

2. PCB Cutting

In most cases, small size PCB would be cut from a large PCB board after completed the components assembly. The cutting force on the PCB would be induced to the crystal which placed near to the cutting edge of the board. If this force is too large, it would damage the crystal structure. Generally, the failure is board position dependent; i.e. those small PCBs having problem would always be found at the same position of the large boards. Perforation and V-shape design should also be considered to reduce the force and stress in cutting process.

If CNC router or routing machine is used for PCB cutting, the situation will be similar to ultrasonic cutting. The rotation of the miller would possibly generate a resonance with the crystal blank, hence the crystal blank may have damages. When the resonance is occurred, the customer can try to change the orientation of the crystal in reference to the force direction.

Crystal should be placed in the center of the PCB or keep away from the cutting edge when designing the PCB layout, this would reduce the risk of failure rate due to cutting force effect.

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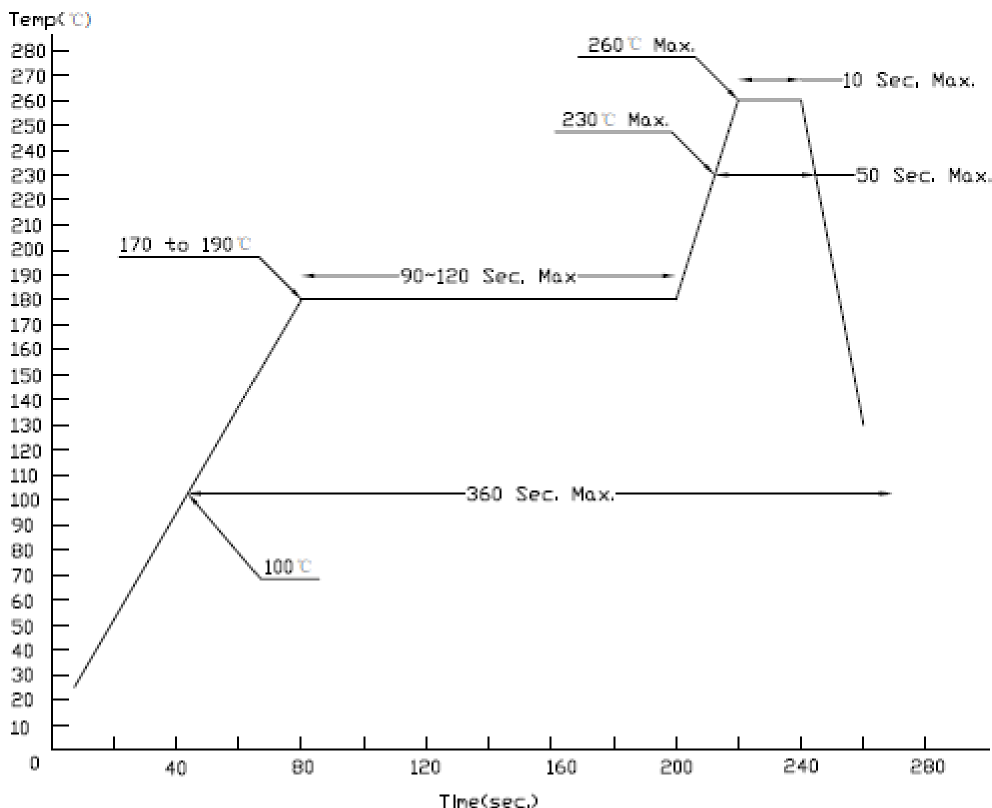
3. Temperature of Reflow Process

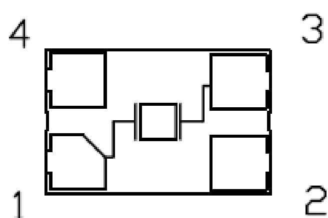
Two popular phenomena are:

- Increase or decrease the reflow temperature rapidly would cause crystal failure. Hence it is strongly recommended to follow the reflow profile provided by crystal manufacturer.(see below)



- PCBA might be required to go through the reflow process two times, especially the board has components on both sides. Crystal would then have high potential of failure after the reflow process in high temperature for two times. Hence it is suggested crystal should always be processed by the reflow one time only.

4. Solder Pads



This is the drawing of DA & D7 type solder pads (4-pad type), #1 and #3 are connecting crystal, #2 and #4 are non-functions. Hence connecting #2 and #4 to external circuit or ground (floating) is forbidden.

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4. Flexing Board

After the PCB installed to the product housing, it is necessary to check if the board has some degree of bending. This mechanical bending stress would cause peeling off portions of soldering or have high potential to crack the package of on-board crystal.

5. Shock by Dropping

Crystal might be damaged when dropping from the work bench to the hard floor, as it would receive excessive shocks when hitting the floor. These crystals should not be used if they have dropped on the floor or received high shocks in whatever conditions.

It is suggested to put anti-static carpet on the floor under the work bench to avoid the excessive shock to the crystal when dropped to the floor.

Other potential shocks to the crystal are :

- Shock caused by mounting the crystal on board.
- Piezobuzzer, speaker etc would cause vibration to the crystal.

6. PCBA Rework

Do not use the crystal again after removing from PCB, a new crystal should be installed during PCBA rework.

7. PCB Design Crystal Oscillation Circuit

Circuit designer should pay attention to the following points in order to avoid the crystal failure.

- Crystal should be placed at the less stressed position of the PCB.
- Crystal should be placed at the center position of PCB and keep away from the part having mechanical vibration, e.g. piezo buzzer.
- For accuracy and stable frequency operation, large parasitic capacitance should be avoided. Hence, crystal should be placed close to IC pins and the crystal connection lines should be routed as short as possible.
- High frequency signal lines and the components which generating high noise should not be placed close to the crystal circuit on PCB layout.

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8. Storage

Crystal products are vacuum-packed in tape and reel form, it is recommended to be kept in the original packing before using, to be stored in 10 – 40degC and 40 – 60%RH, to be used within 6months after delivery, and to be used as soon as possible after unpacked.

Being exposed to high temperature/damp/chloride/sulfide/based gases or other critical environment could induce change of the electrical characteristics, as well as physical properties such as but not limit to outlook, dimension and solderabililty.

The package terminal of hybrid type crystal is silver based electrode, users are responsible to follow the above actions and keep the product properly, otherwise, the product solderability may be affected.

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