

Handling Notes for Quartz Crystal Oscillators

Generally, quartz crystal oscillators are designed to be quite insensitive against environmental conditions, nevertheless care should be taken during transportation, storing and production to avoid deteriorations of the crystal oscillator performance, or even destruction of the built-in crystal based component.

1. Storage conditions and moisture

A crystal oscillator is a hermetically sealed device; therefore no humidity gets inside the cavity of its package. As the handling conditions and the pre-production conditioning being defined in JEDEC J-STD-020 do only apply to non-hermetic devices, they basically do not apply to quartz crystal components.

Nevertheless, long storage of quartz crystal oscillators at hot and humid conditions should be avoided. Therefore, we recommend storing our oscillators within the conditions described as MSL level 2, to avoid slight oxidation of the component's contact pins.

SMD oscillators with gold-plated contact pads are even less susceptible to pad oxidation, and storage temperature and humidity conditions according to MSL level 1 may be applied.

During storage of the component, the storage conditions should never exceed the temperature limits as specified in the catalogue or datasheets. Please note that the storage temperature range applies to the component only.

Preferably, please keep the storage temperature between +10° ~ +45°C (50°F ~ 115°F) and below 60% RH as long as the component is packed and reeled.

If the oscillators were stored over a long period or the storage conditions were not appropriate, before using please make sure that the crystal components still comply to their specifications by performing visual and electrical inspections.

2. Transportation and Handling

During transportation and during the manufacturing process, please avoid high shock and vibration levels to quartz crystal oscillators, which are exceeding their maximum specifications. Severe drops or being hit with a hard object could also cause damages to the component.

Quartz crystal oscillators which have suffered from excessive shocks and vibrations may show partial or full cracks of their built-in crystal plate (crystal blank), or partial cracks of their cementing points, which might lead to intermittent failures of the component.

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3. Mounting

- **SMD oscillators**

Please make sure not to exceed the appropriate reflow conditions as recommended in the component specification, such as the peak temperature, the maximum duration, the number of exposures, the rate of temperature change vs. time, etc.

Hand Soldering can be performed at a temperature of 350°C max. for 3 sec. max.

Soldering on the metallic package surface or the welded packaging edges is not allowed.

Please avoid extreme deformations of the board. Deformations may result in a detachment of the PCB contact pad, a detachment of the SMD oscillator terminals or cracks in the solder joints.

Full attention is requested especially when splitting the board with the component already mounted. Any deformation or bending of the board should be avoided.

Should an automatic mounting system be used, please select an equipment with minor shock generation, and check for the intensity of the shock before use.

- **Pin type components**

Please do not apply excessive soldering heat or soldering duration on the oscillator terminals. Please refer to the recommended wave soldering conditions.

Hand Soldering can be performed at a temperature of 350°C max. for 3 sec. max.

Soldering of the metallic package surface (for example for mechanical fixation) is not allowed.

Do not apply excessive force to cut or bend leads. Doing so could crack the glass insulation or resin seal and cause a leak which deteriorates the oscillator performance.

When bending crystal oscillator leads for SMD mount, please do not bend the pins directly at the oscillator package, which might cause a crack in the glass insulation at the body of the package. We recommend using an appropriate bending tool to keep a safe distance between the component body and the bending point.

4. Cleaning

Ultrasonic cleaning should be avoided due to the risk of damage to the crystal blank inside the oscillator.

If ultrasonic cleaning is used, there is a risk of generating mechanical resonances, which may cause an intermittent or permanent damage of the crystal oscillator. Please be aware that ultrasonic waves propagate over a board in a way which is not under control of the oscillator manufacturer.

Therefore, it is impossible for us to confirm each customer's mounting and cleaning conditions, such as the mechanical resonance conditions of the board, the cleaner's type, the applied power, the time, the placement in the cleaning tank and so on. Consequently, we are unable to define general conditions for cleaning or guidelines to protect our component against damage.

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If ultra-sonic waves are used during cleaning or manufacturing, please make sure to perform an appropriate inspection to make sure that the quartz crystal oscillator still meets its specification. Moreover, if there is a change in cleaning conditions, board or placement of the component after a redesign of the board, please be sure to perform the same inspection for confirmation.

- **Cleaning Solvents**

It is recommended that aqueous cleaning methods such as demineralized water or high-pressure water cleaning is used in order to avoid physical damage caused by solvents. Some aggressive solvents (such as those containing Chlorine), may cause an oxidation of the metallic crystal oscillator packages or a discoloration on the component surface or marking. Do not exceed a temperature of +50°C (120°F) during cleaning.

5. ESD Handling and Packing

All Jauch oscillators use a built-in semiconductor die / chip being based on (H)CMOS technology, which is sensitive against electrostatic discharges. Hence, for our quartz crystal oscillators, the same typical rules for ESD protection apply as for other (H)CMOS devices.

We deliver all our oscillator products in anti-static bags to meet the requirements of ESD compliant production environments. We use various ESD compliant packing methods such as anti-static tube, foam or ESD compliant tape and reel on our products. We recommend opening packaging tubes or bags in ESD compliant environment to avoid damage to our products.

6. Operating Conditions

- **Supply Voltage and Polarity**

Jauch crystal oscillators should be operated inside the specified supply voltage and voltage tolerances as given in the catalogue or datasheets. An operation outside the supply voltage specification could cause intermittent or total failures of the crystal oscillator.

Reversed polarity connections may cause the unit to be irreversibly damaged electrically (dead) and/or mechanically (burn). Therefore, please confirm the correct voltage polarity before powering up the oscillator device.

- **Supply Voltage Limits**

Under any circumstance, please apply a supply voltage level to the oscillator which is not exceeding the absolute maximum value, being typically 7V DC max. for most (H)CMOS IC's. Please also note that supply voltages below 70 ~ 80% of the nominal voltage may cause an unstable operation of the oscillator.

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For best performance and stability, oscillators may be supplied by separately stabilized supply voltage rails, to avoid interferences from supply voltage noise typically being present in digital circuits.

- **Oscillator Startup**

Crystal oscillators consist of a crystal blank and a semiconductor chip, which integrates a crystal driving circuit and clock output driver stage. The semiconductor chip itself does not contain sophisticated reset logic or supply voltage monitoring circuits, which gate the oscillator output signal.

For best system stability, we recommend the usage of an external supply voltage monitoring circuit to prevent subsequent circuits to start their operation before the supply voltage has fully powered up and the oscillator output frequency has fully stabilized. Please refer to the oscillator startup time which is defined in our oscillator datasheets.

- **Bypass Capacitor**

Please be aware that due to the small size of Jauch SMD oscillators, no bypass capacitor is built-in. We strongly recommend placing an external bypass capacitor of $\sim 0.01\mu\text{F}$ near the VDC terminal/pad with a low impedance connection to the GND terminal/pad. The bypass capacitor is able to buffer dynamic supply currents to the oscillator at output signal transitions, and it can also help to reduce RF-transmissions through the supply voltage rails.

- **Load Capacitance**

Any capacitive load below the specified max. load capacitance can be connected to the oscillator's output. The PCB trace from the oscillator output to the load (next IC) shall be kept short to avoid additional stray capacitance, and distortion of the output waveform.

- **Supply Current**

The current consumption of an oscillator will depend on the actual load capacitance that is connected to the oscillator's output stage. The smaller the actual capacitive load is, the smaller the current consumption will be.

If an oscillator that was designed for 30pF load is connected to an actual load of 15pF, the current consumption will be about the same as the current consumption of an oscillator that was designed for 15pF.

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- **Orientation (Pin1 Marking)**

For oscillators, Pin 1 is usually identified by a dot marked on the lid and/or a slant at the corresponding SMD pad. Please make sure to mount the oscillator to the PCB with the correct orientation. A wrong orientation could cause a reverse supply voltage polarity, which may cause the unit to be irreversibly damaged.

- **PCB Layout**

We recommend to layout crystal oscillator connections with short distances to the chip or receiver circuit's clock input. Preferably avoid long traces, and close-by signal traces which could interfere to the crystal clock signal.

Undesired stray capacitance and inductance caused by long signal traces have major effects on the output impedance of the oscillator unit and shall be minimized.

- **Suggested Pad Layout**

Please be aware that our pad layout suggestions are given for your reference. Please use them as a design suggestion and apply your company's design rules. Pins that are identified as NC should remain unconnected.

- **Operating Temperature**

All crystal oscillators should be operated within the temperature limits as specified in the catalogue or datasheet.

- **Oscillator Testing and Test Circuits**

The oscilloscope probe impedance shall be greater than 1 MOhm with a low probe capacitance. The load applied to the oscillator shall take the probe capacitance and test jig stray capacitance into account. All lead length should be kept as short as possible, especially the ground trace. We recommend wide bandwidth low capacitance active probes to characterize oscillator output signals.

Please refer to the appropriate documents which you can find on the technical section of our homepage (www.jauch.com).