CRYSTAL HANDLING PRECAUTIONS

CRYSTAL UNIT STRUCTURE
A quartz crystal unit includes a small strip or disk of quartz that is processed to an exact size and thickness dependent on the customer specified resonating frequency. The quartz is plated with conducting electrodes and mounted in a hermetically sealed protective enclosure (see Figure 1).

Figure 1

Crystal units are often encapsulated together with other circuitry to realise a fully functional module, e.g. an oscillator or a complex filter. Figures 2 and 3 illustrate simple crystal oscillators. Because of the nature of the crystal unit, correct handling is very important.

Figure 2

MECHANICAL SHOCK
Crystal components are manufactured to withstand a certain level of mechanical shock. These levels are outlined within the environmental specifications for each individual component type throughout the specification sheets.

Cracked HC49

Excessive levels of shock can cause a change to the electrical characteristics, which will most likely manifest itself as a change of frequency. Severe mistreatment, such as dropping onto a hard surface, may well result in actual breakage of the quartz blank. In the case of ceramic packaged components it is also possible that the ceramic may crack, resulting in a loss of hermeticity.

Broken Watch Crystal

Cracked 14-pin DIL
**Cracked Strip Resonator**

**Cracked Ceramic Package**

**HANDLING LEADS**

Excessive bending of leads can cause damage to the glass-to-metal seal, which can result in loss of hermeticity of the enclosure. Enclosures are filled with a dry inert gas and loss of hermeticity will result in a rapid deterioration of the product due to atmospheric contamination. Care should therefore be taken when handling a crystal not to pull or bend the leads. If the component needs to be moved in a way that involves bending, the lead should be bent slightly away from the glass seal to avoid cracking it. The recommended minimum radius of curvature is product dependent, e.g. 2 mm for HC49 crystals and 1 mm for UM1s.

**Bent Leads**

**TEMPERATURE**

If crystals are subjected to extreme temperatures outside storage temperature limits, the electrical performance can be affected, resulting in eventual failure. During soldering it will be necessary to subject the components to high temperatures for limited periods of time, please refer to the Soldering Guidelines in the Application Notes chapter.

**ELECTROSTATIC DISCHARGE (ESD)**

Only at extreme voltages can static electricity be seen, heard or even felt, but even the lowest voltages can damage electronic circuits. The damage caused to oscillators as a result of ESD may not immediately be evident but can be delayed, causing the oscillator circuitry to degrade, which in turn can cause failure of the oscillator in the field. Although quartz is not necessarily susceptible to ESD damage, the associated electronic circuitry contained within an oscillator is, and should be considered as an Electro Static Discharge Sensitive (ESDS) device. ESDS devices should only be handled in an ESD Protected Area (EPA), where proper precautions against ESD damage are taken.

Any transportation should be undertaken using the appropriate protective packaging. All packaging should be marked with a warning notice, and protective measures and packaging should conform to BS EN 61340-5-1. For a more detailed breakdown of the precautions that should be taken, please contact our Customer Support Department.

**GENERAL INFORMATION**

The approximate thickness of the quartz disc or strip is given by the following equation:

\[
\text{Thickness (mm)} = \frac{1.67}{f (MHz)}
\]

Note: Multiply thickness (mm) x O/T mode if using overtone crystal (e.g. 16MHz crystal = 0.1mm thick).

**STABILITY CONVERSION TABLE**

Crystal and oscillator accuracy is generally referred to in Parts Per Million (ppm). The table below shows conversion factors.

<table>
<thead>
<tr>
<th>10^X</th>
<th>PPM</th>
<th>%</th>
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<tbody>
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<td>10^-3</td>
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<tr>
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<td>100</td>
<td>0.01</td>
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<tr>
<td>10^-5</td>
<td>10</td>
<td>0.001</td>
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<td>1</td>
<td>0.0001</td>
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<td>0.0000001</td>
</tr>
<tr>
<td>10^-10</td>
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</tr>
</tbody>
</table>

**TAPE-AND-REEL PRODUCT**

Before using crystal components on automated placement machines, tests should be undertaken to assess the level of shock that the crystal devices will be subjected to during the placement process. If necessary the shock level should be reduced.