Ultrasonic Cleaning of PCB's with Quartz Based Products

The use of an ultrasonic-bath is a common method of cleaning electronic components and printed circuit boards (PCBs).

This method uses ultrasound and a solvent to clean items by creating cavitation bubbles which are produced by high frequency pressure (sound) waves. The high frequency waves in turn agitate the cleaning liquid, forcing contamination to be removed.

Ultrasound is sound beyond the normal hearing range of humans with a typical bath operating around 40 kHz although other frequency equipment is available.

Modern ultrasonic cleaning baths may have the facility to alter the bath frequency and this is useful as it may help to reduce self-resonance by sweeping the frequency up and down. This in turn helps to alleviate damage that may be created at one specific frequency.

To date, little research on the use of ultrasonic cleaning of quartz components has been done. The only generally available background information was published by GEC-Marconi, Hirst Research Centre in England in 1992. The title of the research was 'Effects of Ultrasonic Cleaning on Device Degradation — Quartz Crystal Devices.' The authors of the report are surprisingly optimistic in the tone of their conclusions, despite finding many failures even in their small sample size. Failures were found to be significantly higher in low cost high volume quartz devices. However, while considering this report, it is important to recognise that quartz crystal manufacturing has changed very dramatically in the following years. The size, packaging and mounting structure of modern ceramic packages are not comparable to the metal can packages analysed in this report, additionally the general quality control of low cost high volume manufacturing is very different today than in 1992.

As a general comment, crystals in the MHz range (which use AT cut quartz blanks), should survive an ultrasonic cleaning process unharmed. Although the overall frequency and specification must be taken into account because higher frequencies use thinner quartz blanks which are more susceptible to breakage than thicker lower frequency devices.

However, crystals that use 'tuning-fork' technology to produce low frequencies such as the common 32.768kHz watch crystals are significantly at higher risk. In their application these crystals are designed to work at very low drive levels, the internal architecture of these crystals is designed to excite resonance with very low input power levels, meaning higher power levels can cause physical damage more easily than other products. The frequencies used in ultrasound are also much closer to the resonant frequency of the quartz, further increasing the likelihood of self-resonance.

With the above points, it can be seen that the use of ultrasonic cleaning on PCB's containing quartz products is not without risks. For low frequency crystals, in the kHz range, IQD do not recommend the use of ultrasonic cleaning. For other crystal types we recommend that experimentation is undertaken to assess the risk before use in production.

We also recommend that the specific crystal to be used on the PCB for the assessment experimentation. The Institute for Interconnecting and Packaging Electronic Circuits (IPC) paper IPC-TM-650, titled 'Test to Determine Sensitivity of Electronic Components to Ultrasonic Energy', provides a good starting point for any experimentation.

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