

## APPLICATION NOTE AXAN-012

### PROCESSING NOTES FOR CRYSTAL OSCILLATORS

#### Application

These processing notes apply to Crystal oscillators incorporating quartz crystal units or resonators from other piezoelectric crystal material such as Langasite, Langatate or Gallium-Orthophosphate.

Unless otherwise noted, the products listed in our catalogue or website are designed for use with ordinary electrical devices, such as stationary and portable communication, control, measurement equipment etc.. They are designed to meet a high degree of reliability (lifetime more than 15 years) under normal „commercial“ application conditions.

Products dedicated for automotive and Hi-Rel / Military applications are specifically identified for these applications.

If you intent to use these „commercial“ products for airborne, space or critical transport applications, nuclear power control, medical devices with a direct impact on human life, or other applications which require an exceptionally high degree of reliability or safety, please contact the manufacturer.

#### Electrostatic Sensitivity

Crystal oscillators are electrostatic sensitive devices. Proper handling according to the established ESD handling rules as in IEC 61340-5-1 and EN 100015-1 is mandatory to avoid degradations of the oscillator performance due to damages of the internal circuitry by electrostatics. If not otherwise stated, our oscillators meet the requirements of the Human Body Model (HBM) according to IEC 61000-4-2.

#### Handling

Excessive mechanical shocks during handling as well as manual and automatic assembly have to be avoided. If the oscillator was unintentionally dropped or otherwise subject to strong shocks, it should be verified that the electrical function is still within specification.

#### Storage / Moisture Sensitivity

Crystal oscillators packaged in metal enclosures meet the moisture sensitivity level MSL 1 in accordance with J-STD-020C. For oscillators in “hybrid” SMD package with a FR4 circuit board acting as base plate of the package, level MSL2 is applicable. After longer storage under higher humidity, it is recommended to bake out such units at 120°C over 2 hours prior to reflow soldering.

#### RoHS Compliance / Lead Free

Unless otherwise explicitly stated\*, all AXTAL oscillators manufactured after June 30, 2007 are RoHS compliant and lead-free in accordance with EU directive 2002/95/EC of January 2003 with its Amendments (Decision of 21 October 2005).

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\*Products for special applications, such as military, Hi-Rel etc.

## Soldering

Crystal oscillators can be processed using conventional soldering processes such as wave soldering, convection with infrared, and vapour phase reflow soldering under normal conditions. Test conditions for solderability, resistance to dissolution of metallization and to soldering heat are as in IEC 60679-1, Clause 4.6.3.

Solderability is guaranteed for one year storage under normal climatic conditions (+5°C to +35°C @ 40% to 75% relative humidity), however typically sufficient solderability – depending on the process – is maintained also for longer time periods. In cases of doubt, components older than one year should undergo a sample solderability test.

The applicable reflow soldering profile for SMT components is depicted in Fig.1, the relevant parameters of temperature and time are defined in Tables 1 and 2 A/2B in accordance with IPC J-STD-020C.

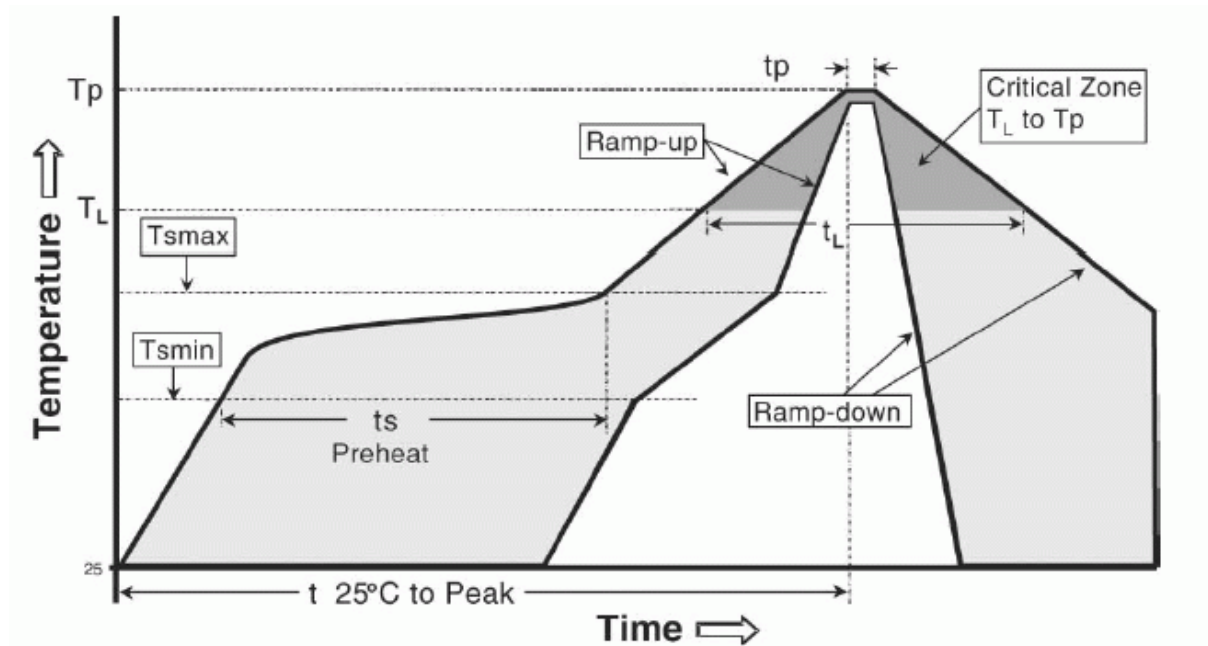


Fig. 1 Recommended Reflow Soldering Temperature Profile [from J-STD-020C]

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T <sub>smax</sub> to T <sub>p</sub> )	3° C/second max.	3° C/second max.
<b>Preheat</b>		
- Temperature Min (T <sub>smin</sub> )	100 °C	150 °C
- Temperature Max (T <sub>smax</sub> )	150 °C	200 °C
- Time (T <sub>smin</sub> to T <sub>smax</sub> ) (ts)	60-120 seconds	60-180 seconds
Time maintained above:		
- Temperature (T <sub>L</sub> )	183 °C	217 °C
- Time (t <sub>L</sub> )	60-150 seconds	60-150 seconds
Peak Temperature (T <sub>p</sub> )	See Table 2A	See Table 2B
Time within 5°C of actual Peak Temperature (tp) <sup>2</sup>	10-30 seconds	20-40 seconds
Ramp-down Rate	6 °C/second max.	6 °C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.

**Note 1:** All temperatures refer to topside of the package, measured on the package body surface.

**Note 2:** Time within 5 °C of actual peak temperature (tp) specified for the reflow profiles is a “supplier” minimum and “user” maximum.

Table 1: Profile parameters [from J-STD-020C]

**Table 2A SnPb Eutectic Process - Package Peak Reflow Temperatures**

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> ≥ 350
<2.5 mm	240 +0/-5 °C	225 +0/-5°C
≥ 2.5 mm	225 +0/-5°C	225 +0/-5°C

**Table 2B Pb-free Process - Package Peak Reflow Temperatures**

Package Thickness	Volume mm <sup>3</sup> < 350	Volume mm <sup>3</sup> 350 - 2000	Volume mm <sup>3</sup> > 2000
< 1.6 mm	260 °C *	260 °C *	260 °C *
1.6 mm - 2.5 mm	260 °C *	250 °C *	245 °C *
> 2.5 mm	250 °C *	245 °C *	245 °C *

Table 2: peak temperatures [from J-STD-020C]

### Reflow hysteresis

After reflow soldering the frequency of crystal oscillator may have shifted by several ppm. This so-called “reflow-hysteresis” relaxes after several hours up to a few days, depending on the products.

### Cleaning

Cleaning is only allowed for hermetically sealed oscillators. Devices with non hermetical enclosures (e.g. with trimmer holes) shall not be cleaned by soaking or in vapour, because residues from the cleaning process may penetrate into the interior, and degrade the performance.

The marking of our oscillators is resistant to usual solvents, such as given in IEC 60068-2-45 Test XA. For applicable test conditions see IEC 60679-1. Please consult the manufacturer, if other solvents are used.

Ultrasonic cleaning is usually not harmful to oscillators at ultrasonic frequencies of 20kHz at the sound intensities conventional in industry. Sensitive devices may suffer mechanical damage if subjected to 40 kHz ultrasound at high sound pressure. In cases of doubt, please conduct tests under practical conditions with the oscillators mounted on the PC board.

### Hermetical seal

If the device is specified as hermetically sealed, it meets the requirements of IEC 60679-1, i.e. for enclosures with a volume smaller than 4000mm<sup>3</sup> the leak rate is below 5\*10<sup>-8</sup> bar cm<sup>3</sup>/s, for larger enclosures it is below 1\*10<sup>-6</sup> bar c bar cm<sup>3</sup>/s, tested according to IEC 60068-2-17 Test Qk.

Glass feed-throughs may be damaged as a result of mechanical overload, such as bending the connection leads or cutting them with an inappropriate tool.

### Power supply

In oscillators with sine wave output signal the supply power should be connected to the device only after connecting the proper load to the RF output.

Wrong polarity or excessive supply voltage can cause a permanent damage of the oscillator.

**Qualification**

Product qualifications in accordance with IEC 60679-5 or customer-specific qualification tests can be provided by AXTAL on request.

**Screening**

Our oscillators are 100% tested in all key parameters. On request, AXTAL can perform screening tests according to MIL-PRF-55310, class B for discrete and hybrid constructions or at customer –specific test conditions.

**Standard Environmental Conditions**

See AXTAL Application Note AXAN-013 for details