Specifying OCXOs

Oven Controlled Crystal Oscillators (OCXOs) offer frequency stabilities even tighter than those offered by a TCXO. The frequency drift of the quartz crystal due to temperature shift is reduced by heating the crystal in an oven and so holding the temperature of the quartz at a fixed point. Traditionally this technology meant physically large devices with heavy power consumptions, however technology is constantly developing and IQD are proud to offer some of the smallest OCXOs in the world. IQD uses the code OCXO to denote our oven controlled quartz crystal oscillator part numbers.

The electrical parameters are given on the specification to facilitate the correct circuit design. Further guidance can be found in the Application Notes chapter of this book. Our Application Support team can also provide assistance if required; please contact one of our sales offices for this support.

The limits given in the following specifications are indicative of the standard OCXO oscillator design, in the event that a specification is needed which is outside the standard OCXO oscillator designs offered please contact our Sales team.

The following notes define each element of an OCXO specification.

Frequency

Frequency is normally specified in kilohertz (kHz) up to 999.999kHz and in megahertz (MHz) from 1.0MHz. All our computer-generated transaction documents follow this standard convention automatically.

The OCXO frequency should be described to seven significant figures. If seven significant figures are not used, we assume that any figure that might follow those given may be taken as zero. Thus a frequency given as 16.6MHz will be taken as 16.60, not 16.66667.

Input Supply Voltage

Various DC input supply options are available to suit a wide range of applications, eg: +3.3V, +5V, +12V. Miniaturised generation OCXOs also include the input supply option of +3.3V.

Output Compatibility

Various output options are available, e.g. Sinewave and CMOS.

Long Term Stability (Ageing)

Defined as long term stability in OCXOs, the initial ageing is monitored by the manufacturer at final test until the ‘ageing’ rate achieves the agreed rate of change. Ageing rate will normally be specified per day, per month or per year. Very stable OCXOs can have an annual frequency change of a few parts per billion (parts in 10^–9). More typical products will achieve annual drift of a few parts in 10^–8.

Operating Temperature Stability

In the past, only AT-cut crystals were employed in ovened oscillators and were selected such that their upper turnover temperature, where their temperature coefficient is zero, was at or close to the nominal oven temperature.

However for very high stability, so-called ‘doubly-rotated’ crystal cuts are now used. The SC (stress-compensated) cut in particular is used because it is much less sensitive to mounting stress and thermal gradients than an AT-cut crystal. This type of crystal has a family of static f-t curves like the AT, except shifted upwards in temperature by about 70°C. The optimum oven temperature is therefore normally at the crystal’s lower turnover where the slope of its characteristic is low over a relatively wide range. For the most stable OCXOs the crystal is operated on an overtone mode of oscillation to achieve the highest Q factor and stability.

Despite the temperature control applied to the crystal there will still be some variation in frequency with ambient temperature change, usually over one year this is outweighed by the ageing. Typical operating temperature ranges are between –20 to 60°C and –20 to 75°C with resulting variations in frequency in the range of 10^–11 up to 10^–8. Because crystals age more rapidly at high temperatures, it is desirable that the oven temperature be as low as possible. It must however, be a few degrees higher than the maximum ambient temperature or temperature control would become impossible. Take care therefore not to specify too high an operating temperature for the unit unless it is really needed.

Phase Noise

Phase noise is expressed in units of dBc/Hz at a specified offset from the carrier or centre frequency. Other things being equal, the dominating factor which governs the phase noise characteristic of an oscillator is the Q of the crystal and this is one of the reasons why operation on a high overtone is often chosen in preference to the fundamental mode. A very high performance oscillator may exhibit a phase noise in one sideband of –160dBc/Hz at 1kHz offset from its carrier with –150dBc/Hz being a typical performance.

Package Size

There are several standard package size options available for OCXO products and normally one of those should be selected. A fully customised device can be designed if essential but please remember that utilising existing packages will reduce lead time and cost. Even so, if an application requires a non-standard package, we will discuss and advise the most efficient approach.

Warm Up Time

An OCXO will typically take 10 to 15 minutes to warm up and stabilise from the initial power up. During warm up there will be a significant frequency change of several parts per million followed by a very small drift over an hour or so. Consideration should be given to decide whether warm up time is a critical factor to the application. Faster warm up time involves more power consumption but fast warm up products can be provided to meet special needs.

Warm Up Power

At first switch on, the oven will take maximum current and therefore consume the most power as the oven commences to warm up. Again this initial surge of power can be critical in some applications and must be taken into consideration. Once the oven has achieved temperature, the current consumption will dramatically reduce e.g. from 6W to less than half that amount.

Note: The external ambient temperature determines the

Contact Details:
UK: +44 (0)1460 270200
France: 0800 901 383
Email: info@iqdfrequencyproducts.com
Germany: 0800 1808 443
USA: +1.760.318.2824
Web: www.iqdfrequencyproducts.com

amount of power the oven takes. The colder the outer ambient temperature the higher the current consumption will be to maintain the constant internal temperature.

Package Mounting

There are various methods available for mounting the device. Large devices have mounting screws for security/ reliability in addition to connection pins. With lighter and smaller devices PCB, pins or pads are sufficient.

Frequency Adjust

Some means of frequency adjustment is provided to enable re-calibration of frequency after ageing has occurred. If an external control voltage is used to adjust the frequency care should be taken that it is sufficiently stable for the performance required from the oscillator.

Contact Details:
UK: +44 (0)1460 270200
Germany: 0800 1808 443
France: 0800 901 383
USA: +1.760.318.2824
Email: info@iqdfrequencyproducts.com
Web: www.iqdfrequencyproducts.com