Hybrid technology improves ovenized reference crystal oscillators

In the world of electronics, oscillators are the heart of (almost) everything and as such they are indispensable. This is usually taken for granted to such an extent that any developer would like to take the necessary oscillator from the stock to insert it just like a power supply, without any further development. However, this is only possible if there is an oscillator, which is suitable for the specific purposes and optimised as much as possible. The electrical features, shape and prize are probably the most important criteria by which oscillators are selected.

For the last decades different classes of quartz oscillators were developed for their respective area of use, such as simple clock oscillators, used as timing circuits for microprocessors as well as voltage controlled (VCXO) and temperature controlled (TCXO) oscillators. They are mainly employed for the frequency modulation in the telecommunication. Maximal frequency stability, however, can only be achieved with temperature stabilised reference oscillators (OCXO).

Appropriate cases were sought in order to create complete modules. The trend (and the coercion) to miniaturisation led to the development of adequate enclosures, so that these oscillator modules can also be used in the SMD technique. For the XO's, VCXO's and TCXO's there are already cases for quartz oscillators made of plastic or ceramic as small as 5 x 5 x 1.3 mm.

In OCXO's, however, steps to further miniaturisation are more difficult.
The utilised quartz crystals, mainly driven by the harmonic overtone with high Q-factor, usually are hermetically sealed in metal or glass enclosures. The heat transfer to the quartz crystal, necessary to stabilise the frequency, usually requires a complicated mechanical construction which not only results in a stabilised temperature but also in dimensions of more than 20 cm^3 and a mass of more than 20 grams.

The company "Quintenz Hybridtechnik" succeeded in manufacturing temperature controlled reference oscillators in minimal standard cases with measures of 13 x 20 x 9 mm^3 (DIL) and 20 x 20 x 10 mm^3 and a mass of less than 5 and 8 grams. For the production of these modules, we employed the hybrid technology, consistently used by "Quintenz" since the very beginning of the company.

The increased demand for oscillators of this design was initialised by the introduction of mobile phone networks. The base stations, installed to provide a global supply, need frequency stability's for their internal timing generator, which can only be reached with ovenized quartz oscillators. Due to the increased demands in this highly competitive segment of the market, priority was given to small design, high reliability and a good prize.

The use of hybrid technology meets these demands. First, a significant reduction in size was achieved. The function of the carrier substrate, made of ceramic, not only consist in integrating the electronic circuit, but also in transmitting and stabilising the temperature of the quartz crystal.

Besides the reduction of the foot print, necessary to set up the circuit, these technologies offer further considerable advantages.
By selecting suitable compound materials, expensive metallic oven constructions do not need to be applied. Less complicated fitting of the component makes an almost automatic production possible. The laser trimming of the printed or sputtered resistor geometry, employed in this technology, is used as functional adjustment of the entire module. Mechanical trimming elements or the subsequent soldering of the adjustment devices are not necessary. A uniform set-up technology and the use of bare chips further increases the reliability.

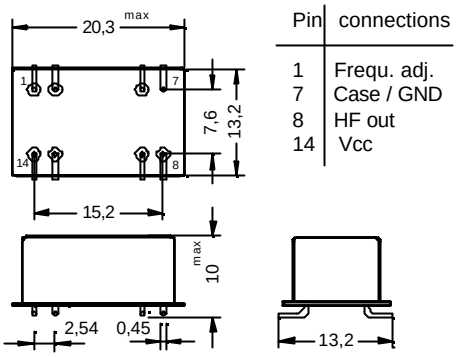
The high temperatures, internally needed by this class of oscillators, exclude the use of most of the customary IC's with a plastic capsule. Typically, their maximal operating temperature is 70 – 85°C. Only materials, such as ceramics with an adopted thermal expansion factor, can absorb the temperature shock arising during the rapid warm-up from room temperature up to +85°C.

These technological advantages improve not only the reliability of the device but also its technical specification. The power consumption and the warm-up time can be limited drastically by reducing the thermal mass. With the support of simulation programmes, the electrical and thermodynamic arrangement of the devices, mounted on the surface of the substrate, could be optimised. Despite the miniaturisation of the oscillator to 4cm^3 (20 x 20 x 10 mm^3), the resulting frequency stability is $^{\Delta f}/_{f_0} \leq \pm 2 \cdot 10^{-8}$ for temperature dependence (-20°C to 70°C) and $^{\Delta f}/_{f_0} \leq \pm 5 \cdot 10^{-11}$/s for the short term stability. The warm-up period from switching on the oscillator to reaching the reference frequency is less than 70 seconds with a power consumption of less than 1300 mW.

Comparable temperature controlled quartz oscillators, conventionally produced in PCB and SMD technique, have a volume of 20 to 50 cm^3 , a warm-up period of some minutes and a heating power of some Watts.

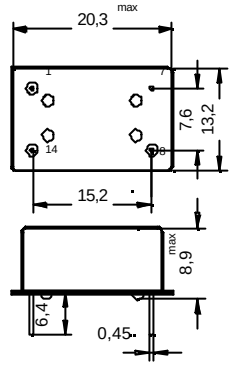
With the above mentioned module, the company "Quintenz" developed a family of oscillators in standard enclosures of 27 x 36 x 14 mm^3 , 25 x 25 x 13 mm^3, 20 x 20 x 10 mm^3 and 13 x 20 x 9 mm^3 (DIL-14 package) which uses the advantages of the hybrid technique. The production in a clean room and the hermetic welding of the steel cases results in a highly reliable component. SMD versions are also available.

Model QO1320S in SMD package



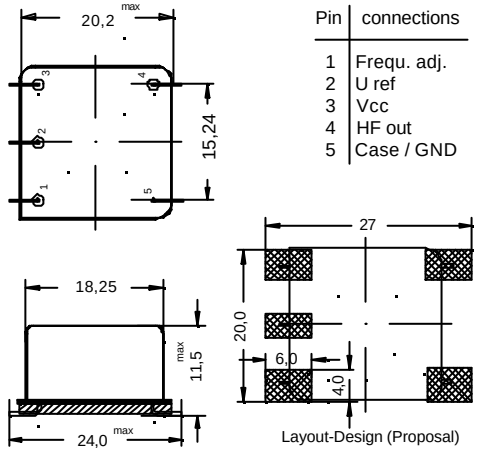
Pin	connections
1	Frequ. adj.
7	Case / GND
8	HF out
14	Vcc

Model QO1320O in DIL14-package



Pin	connections
1	Frequ. adj.
7	Case / GND
8	HF out
14	Vcc

Model QO2024S in SMD package



Pin	connections
1	Frequ. adj.
2	U ref
3	Vcc
4	HF out
5	Case / GND

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