WHITE PAPER

– Quartz products for Base Transceiver Station –

(1) Transition of information and communication

A smartphone that everyone has now. Today, you can talk (transmit information) with anyone anytime, anywhere, but we have seen a big transition to date.

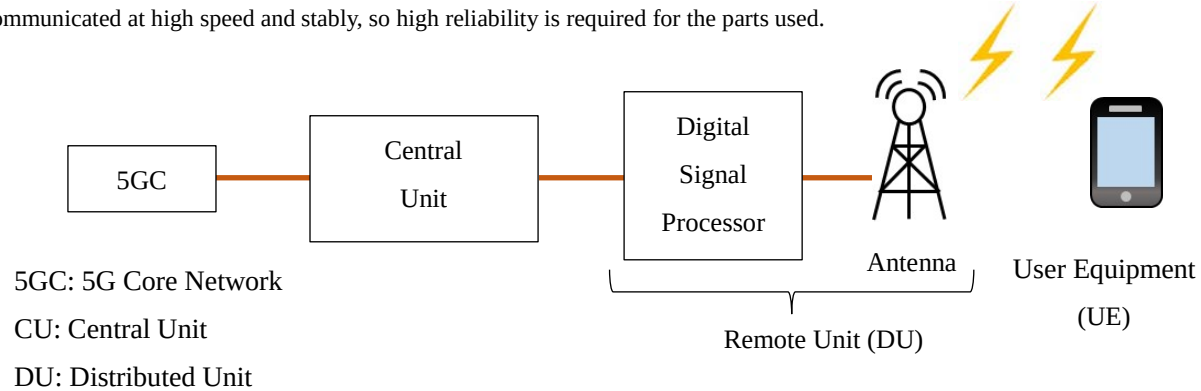
In the old days, information was transmitted by means of wolf smoke and the color of flags. There are only a few ways to provide detailed information, such as meeting in person or contacting by letter. Such communication also changed with the invention of the wired communication telephone by Graham Bell in 1876. Even in Japan, about 40 years ago, each household had one black telephone. With the digitization of mobile phones in the 1990s, it spread all at once, and we are now in an era where each person has a phone. Since then, mobile phones have continued to evolve, and now, as smartphones, not only voice communication but also e-mail, the Internet, sending and receiving videos, and the amount of information transmitted have become extremely large. It is no exaggeration to say that this year (2020) is the first year of 5G, but crystal devices are indispensable for realizing 5G high-speed capacity-to-capacity communication, multiple connections, and low latency.

(2) Crystal device demanded for information communication

Information and communication equipment and crystal. Quartz is widely used as a vibration source that can obtain a stable frequency due to its own piezoelectric phenomenon. Especially in wireless communication, it is not possible if the reference signal changes often. In such a case, if a crystal device is used as a frequency source, the signal will be stable and communication will be easy. Yes, it is also used in your mobile phones and wireless earphones, it has contributed to the development of information and communication by playing a role as a stable frequency source.

Figure 1 shows an example of network connection in 5G. Various crystal devices such as OCXO, VCXO, and SPXO are used for each of application. For example, OCXO and SPXO for data communication, which require high frequency stability, are used for the centralized base station (CU section), and SPXO, VCXO, and high-precision TCXO for data communication are used for the remote station (DU section). For mobile terminals, TCXO and crystal resonator with thermistor are used for GPS / GNSS and 5G connection

In 5G wireless communication, the 28 GHz band called millimeter wave will also be used. In such a high frequency band, more power consumption becomes a concern. Also, since we aim to create an environment that can be connected everywhere with a view to future autonomous driving, a considerable number of antenna parts are expected to be installed, therefore, it strongly demand the smaller size and lower cost parts. In addition, not only the wireless part but also the each base station connected by the optical fiber needs to be communicated at high speed and stably, so high reliability is required for the parts used.



5GC: 5G Core Network
CU: Central Unit
DU: Distributed Unit
UE: User Equipment

Fig.1 5G Network

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Given the demand for low power consumption, small size / low cost, and high reliability, taking OCXO as an example, a general OCXO keeps the built-in crystal oscillator at a constant temperature to make it a crystal oscillator. High stability is achieved by suppressing the influence of frequency fluctuations due to temperature changes, but the conventional product has a large core size, which is the oscillation circuit including the crystal oscillator, so the heat capacity and heat dissipation amount increase, and a lot of power is consumed.

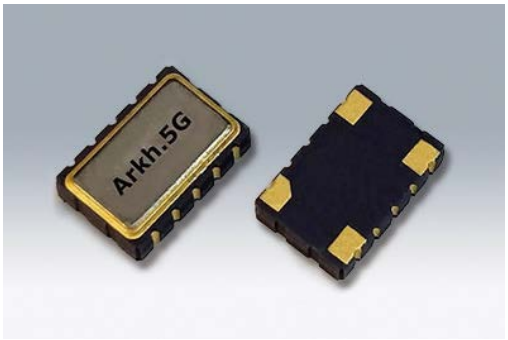
KDS has succeeded in developing a smaller (7.3×4.9×2.0 mm) and higher performance OCXO than before due to its unique structure that uses an ultra-small Arkh.3G (oscillator) for the core of the OCXO. Arkh.3G is a product that is 85% or more small in volume ratio and less than 1/2 the thickness of the conventional product (the world's smallest class 1612 size crystal oscillator). Incorporating this Arkh.3G into the core part led to miniaturization, making it possible to reduce the heat capacity and heat dissipation to the utmost limit. In addition, the core of conventional products is generally in an atmospheric atmosphere, but this product has a vacuum atmosphere and has a core structure that is hard to be affected by heat convection.

The development of the small core translates into further downsizing, to 5.0×3.2 mm for example. Moreover, a multi-layered package will improve thermal insulation with the dimensions maintained the same or slightly larger, which achieves precision enhancement while preventing an increase in size. We are also planning to expand our product lineup.

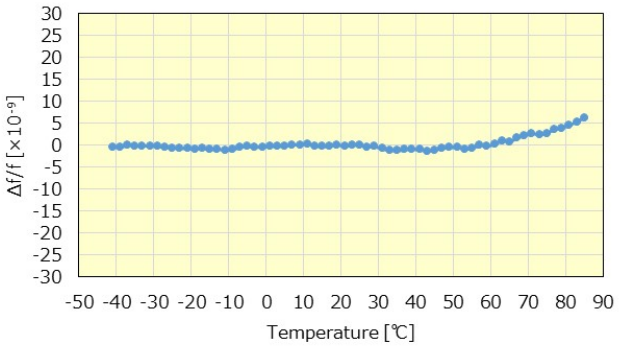
Conventional OCXOs are assembled manually due to their complicated structures and large numbers of components, which raises production costs, making them unsuitable for mass production. On the other hand, our new OCXO is sealed in a ceramic package, which has been widely used because of its simple structure. This design facilitates assembling on a fully automatic production line, which will enable us to supply a large number of OCXOs at low prices to the base station market, which is expected to grow rapidly.

【OCXO: DC7050AS (Arkh.5G)】

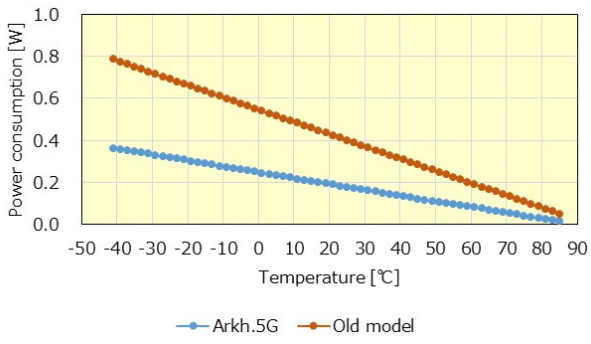
Item	Specification
Size	7.3×4.9×2.0 mm
Frequency range	5 to 100 MHz
Vcc	+3.3V
Power Consumption	Max. 1W, Steady 0.25W (Room Temperature)
Frequency stability vs temperature	±30×10^{-9}／-40 to +85℃



【Frequency stability vs temperature】



【Power consumption】



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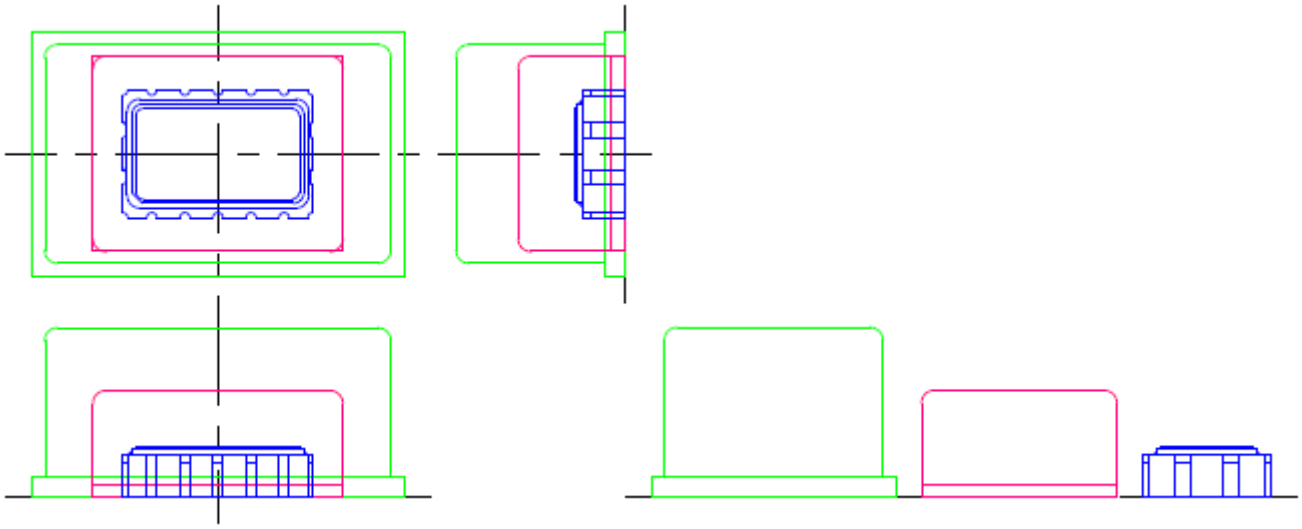
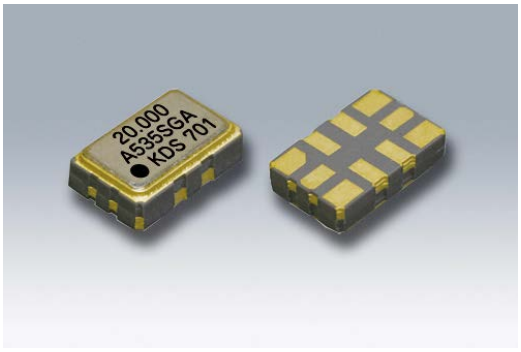
【OCXO Outline】

Green: 14×9 size OCXO　　Red: 9×7 size OCXO　　Blue: DC7050AS

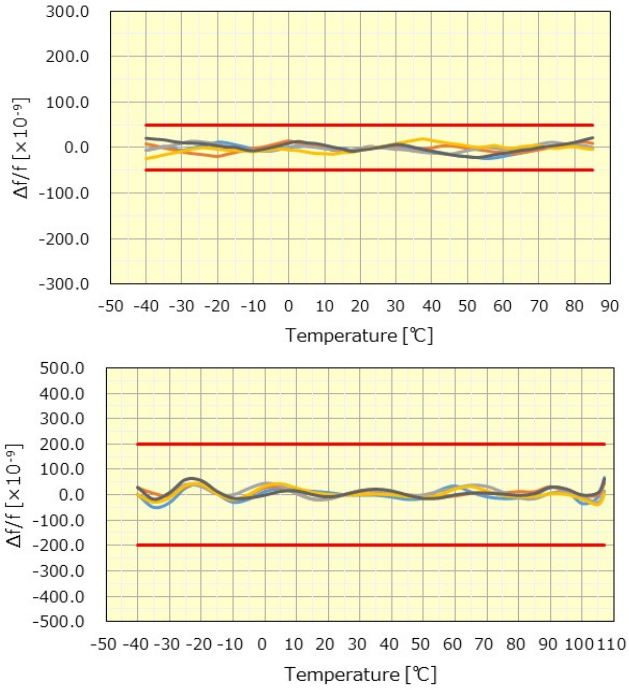


【TCXO: DSA/DSB535SGA】

Item	Specification
Size	5.0 × 3.2 × 1.5 mm
Frequency range	10 to 52MHz
Vcc	+3.3V
Current consumption	Max. 4mA
Frequency stability vs temperature	±50 × 10^{-9}／-40 to +85℃ ±200 × 10^{-9}／-40 to +105℃



【Frequency stability vs temperature】



【20MHz　SSB Phase Noise】

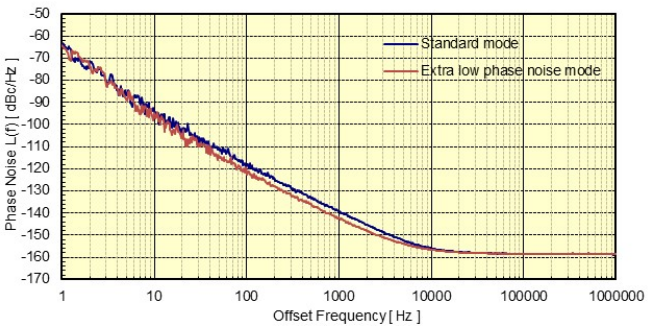


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Table.1: Line up for Base Transceiver Station

	CU	DSP	Antenna	UE
OCXO	Arkh.5G	Arkh.5G		
TCXO		DSA/B535SGA	DSA/B535SGA	Wx series SDN series
VCXO	DSV series	DSV series		
SPXO	DSO series	DSO series	DSO series	DSO series
Crystal resonator with thermistor				DSR series
Crystal resonator				DSX series
32kHz crystal resonator				DST series

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