Smallest OCXO with 1.5us over 24H holdover for demanding synchronization application

Gweltas BEAUTO, Jean-Charles BILLEBAULT, Rami KHOURI, Vincent CANDELIER
RAKON France SAS / 10, Avenue des Louvresses – Business Park « Carré-92 »
92230 GENNEVILLIERS – France
Email : vincent.candelier@rakon.com

We will present our new generation ROD2522 OCXO performances, with a very low temperature sensitivity of its frequency in different environmental conditions and with different smart manners of working (PPS DO, HV MOD). A maximum of 1.5us time deviation over 24H period of holdover is achieved for many different conditions. We will also present the thermo-mechanical simulation method used for optimizing the design and compacting the structure of thermostat. The integration of the ageing and temperature compensation with a microcontroller in the product was developed previously for other platforms. The ageing compensation can be done after a frequency ageing learning phase using the phase difference between a GNSS receiver 1pps signal and the OCXO 1pps output signal. It has a very small volume of 25x22x12mm^3, compared to the one of 38x27x12mm^3 of the previous model ROD3827. This work gives a new step of the integration of the different compensations in a smaller platform following the first steps presented previously [1],[2]. The platform dimensions (Fig.1) and pin out are fully compatible with the current telecom infrastructure phase and frequency reference. The optimization of the thermostat was done using a 3D thermo-mechanical simulation of the ROD2522S2 platform. The warm up simulation with an external temperature of -40°C gave all the temperature variations of the critical components requested for the dynamic aspect and the stabilized state (Fig.2). With a non-linear RF simulation, we found the impact of the critical components on the thermal frequency sensitivity. From these two results of simulation, the optimization of the design permitted to have a very small simulated thermal frequency sensitivity (<5E-10) and a very small simulated hysteresis (1E-10/°C/min) in the temperature range -40°C to 85°C. For this design, a patent is pending. The ROD2522S2 frequency versus temperature sensitivity measurement will be shown and in all vertical orientations (X, Y, Z) of the product in the thermal chamber. The hysteresis with a gradient of 1°C/min is very small (<+/- 5E-11). The holdover performance will be shown for 6 parts of 1PPS disciplined OCXO (PPS DO) and in holdover module mode (HV MOD). HV MOD means the product is in free run during the learning phase of its frequency ageing and with an ageing compensation during the holdover period. In these two modes conditions and with a 4 °C cycle variation of temperature or one step of 4°C, the parts have a time interval error less than 1.5us over 24H of holdover.

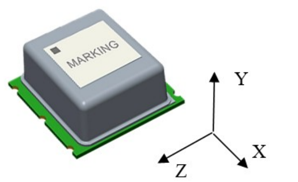

Fig. 1: ROD2522S2 (25*22*12 mm^3 SMD package).

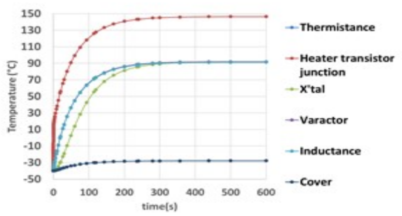

Fig. 2: ROD2522S2 warm up thermo-mechanical simulation: Temperature variation of the critical components.

This platform is now in production and ready for demanding synchronization application.

---

[1] Jean-Charles Billebault, Didier Thorax, Nicolas Gufflet, Alexander Kovach, Vincent Candelier, Hamdi Henchiri, Ullas Kumar, Frédéric Vittrant, “Industrial “5G” telecom Infrastructure Time and Frequency Reference”, PTTI 2020

[2] J.-C. Billebault, D. Thorax, N. Gufflet, A. Kovak, V. Candelier, H. Henchiri, U. Kumar, F. Vittrant, “Next step for delivery of precise frequency and phase OCXO for “5G” telecom and beyond", EFTF IFCS 2021