

This Document is:

1. ISOTEMP's interpretation of the Frequency Stability requirements as outlined in Bellcore GR-1244-CORE.
2. In accordance with Bellcore's request for industry comments.
3. Does not endorse or disclaim any requirements set by Bellcore.

## I. OVERVIEW

Stratum 3 and Stratum 3E oscillators have two frequency stability specifications (**Free Run** and **Holdover**). Bellcore has somewhat defined a third requirement, **Drift**. The **Drift** requirement is not per say a Bellcore specification. However Bellcore suggests that the **Drift** be used for calculating the **Holdover** specification and suggests **Drift** values.

**Free Run** ( $\pm 4.6$  PPM/20 years Stratum 3 and 3E)

**Holdover** ( $\pm 0.37$  PPM/24 hours for Stratum 3 and  $\pm 0.01$  PPM/24 hours for Stratum 3E)

**Drift** (In a lab environment:  $\pm 0.04$  PPM/24 hours for Stratum 3 and  $\pm 0.001$  PPM/24 hours for Stratum 3E)

## II. FREE RUN

The **Free Run** requirement is easily obtainable for any precision oscillator. However part of the system requirement is that any Stratum 3 and 3E system must be able to lock to any other Stratum 3 or 3E system. The reference signal into the system may be from an operating free running system that can be off as much as  $\pm 4.6$  PPM. Further clarifying the lock requirement, a Stratum 3E system must be able to lock to a Stratum 3 system. This means that a system where the VCO input of the oscillator is used to lock the frequency in the system, the oscillator in that system must be able to adjust  $\pm 4.6$  PPM plus the stability of the oscillator. It is very difficult to design and build a Stratum 3E oscillator that will pull  $\pm 4.6$  PPM. Therefore system designers must use other techniques to adjust the frequency of Stratum 3E systems. It is not difficult to design a Stratum 3 oscillator to pull  $\pm 9.2$  PPM ( $\pm 4.6$  PPM for the oscillator in the system plus  $\pm 4.6$  PPM for the reference signal into that system.)

## III. HOLDOVER

**Holdover** is the next easiest requirement. The **Holdover** requirement is defined to be over all possible conditions. These conditions include aging, temperature, voltage, and initial offset. Initial offset is how close the unit was locked to the reference signal at the time the signal was lost; not the INITIAL frequency accuracy of the oscillator. Bellcore breaks down the **Holdover** requirement into 3 major components: Initial offset, Temperature, and **Drift**. **Drift** is explained in the next section. Bellcore suggests adding the Initial offset, Temperature and **Drift** to obtain the **HOLDOVER** requirement. Their suggestion does not account for voltage changes, but alludes to it in the **Drift** calculation. If one is not concerned about the recommended **Drift** requirement and the temperature range is limited, then a TCXO could be used to meet the Stratum 3 requirement. System designers have some flexibility in this area because:

1. The temperature range is not fully defined. They can specify it in their system specification.
2. The designer can choose a power supply circuit to reduce voltage effects.
3. The designer can control the lock accuracy (initial offset) by careful design.

## IV. DRIFT

The suggested **Drift** value is the most difficult to satisfy but is not a requirement. The temperature range is pseudo defined (Bellcore suggest the temperature change in a lab environment of  $\pm 5^\circ\text{F}$ .) The voltage change is alluded to because the **Drift** value is to INCLUDE OTHER EFFECTS along with aging and temperature. Since **Drift** is the tightest specification; aging, temperature, and voltage characteristics of the oscillator are large factors in this stability value. Usually TCXO's will not meet this value, because they usually do not have a frequency versus temperature characteristic that is as linear as an oven oscillator. Like the **Holdover** requirement, the system designer has some flexibility:

1. In controlling the oscillator voltage by choice of power supply.
2. Specifying the temperature change for the **Drift**.

## IV. CONCLUSIONS

The system manufacturer has some flexibility in specifying the conditions of the **Holdover** and **Drift** values. Since **Drift** is not a requirement, it can be overlooked in the system specification. A limited temperature range for the **Holdover** could also be specified. The purchaser of systems for end use should take into account the conditions of **Holdover** and **Drift** to determine the best value that will meet their requirements.

References:

GR-1244-CORE, *Clocks for the Synchronized Network: Common Generic Criteria*, Issue 1 (Bellcore, June 1995)

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