Oscillator Performance Qualification Testing for PTP Applications

Application Note

Introduction

This description gives the oscillator performance qualification testing for Precision Time Protocol (PTP) applications. The key performance parameters of the oscillator for PTP applications are ageing and Wander compliance for G.8263. The requirement for ageing is 1 ppb/day (per G.8263 holdover requirements which are often used with the algorithms also), and the requirements for wander are defined for constant and variable temperature effects per G.8263 Wander Generation. PTP servo algorithms may make use of the temperature variation effect of the oscillators as well in the computations.

Evaluating Oscillators for PTP Applications

The following steps are commonly used to evaluate oscillators used for PTP applications.

1. Stabilization time: Switch on the oscillator and leave for 24 hours to allow for the stabilization period.

2. The following ageing tests are possible with the oscillators.
    a. High temp ageing test – The system is soaked at 65°C for 4 hours and then the ageing test is performed.
    b. Low temp ageing test – The system is soaked at -20°C for 4 hours and then the ageing test is performed.
    c. Ambient ageing test – The system is soaked at 25°C for 4 hours and then the ageing test is performed.

3. The following ramp tests are performed for oscillators.
    a. The system is kept at ambient temperature for soaking say at 25°C for 4 hours and ramped down to -20°C at a rate of 0.5°C per minute.
    b. The system is stabilized at -20°C for 4 hours.
    c. The system is ramped to + 65°C at a rate of 0.5°C per minute, and
    d. The system is stabilized at 65°C for 4 hours
    e. The system is ramped down to ambient temperature, say 25°C at a rate of 0.5°C per minute.
    f. The system is stabilized at 25°C for 4 hours.
    g. The overall frequency drift is captured.

4. There are a range of oscillator tests for various temperature change profiles: It is more relevant to consider synchronisation testing with a practical temperature change within a day or a cycle of testing. It is well understood that the systems will never see the entire operating range of the system in one cycle (say -40°C to 85°C) and thus synchronisation testing can be confined to temperature change windows (for example 20°C). This practice is becoming common with synchronisation testing. The reference to such a restricted temperature window for synchronisation testing is mentioned in G.8263 appendix IV.
    a. The system response for a 20°C variation is captured.
    b. For example, the system is soaked at 25°C for 4 hours, then ramped to 45°C at 0.5°C per minute.
    c. The system is soaked at 45°C for 4 hours and then ramped down to 25°C at 0.5°C per minute.
    d. The system is stabilized for 4 hours and the entire frequency drift is captured.
    e. The test may be repeated for other frequency ranges, as required, to ensure that the operating temperature range of the system is covered with the various temperature ranges.

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5. MTIE and TDEV test.
    a. For the above tests, 3 and 4 TIE data of the tests are captured.
    b. The data is passed through the desired high pass filter (of the low pass cut-off frequency for which the oscillator will be used in the loop).
    c. The desired MTIE and TDEV values are computed to be compliant with the G.8263 wander generation masks with temperature effects.

Summary

This note describes the various methods that can be applied to evaluate the performance of oscillators for PTP applications. This by no means represents the complete test regime that may be required for the oscillator to be PTP specification compliant. The algorithm and other system components have a significant impact when evaluating PTP application performance. For a complete list of oscillators qualified for PTP solutions, please contact your nearest Rakon Sales office to speak with application experts or simply send an email to sales@rakon.com.

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