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Industrial requirements for synchronization

Constraints due to the industrial environment and the used XTALs and oscillators for IEEE 802.1AS

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Requirements

- Environmental conditions
  - -40°C/-25°C to +65°C ambient temperature
  - Allow temperature change speed
    - 3 K/s
    - 0,3 K/s (sometimes even lesser for “office environment” products)
  - Applicable for Grandmasters and End Instances hosted in bridges and end stations

- Life time
  - 10 to 15 years running 24/7

- Hardware requirements
  - Maximum +/- 50pmm deviation from f_N (e.g. due to Gigabit Ethernet or other interfaces)

- XTAL or oscillator
  - XTAL / oscillator (in most cases only one) which needs to stay for the guaranteed life time, the guaranteed environmental conditions inside the hardware required frequency band.

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Industrial requirements for synchronization
XTALs or oscillators

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Sources of frequency error

The frequency created by an XTAL or oscillator is dependent on a lot of factors.

Frequency deviation due to

- Production process tolerances and aging
- Temperature and temperature change
- Supply voltage and supply voltage quality
- Shock and vibration
- …

Slower changes are a concern for the “stay inside the upper frequency bounds” from the automation product point of view, faster changes are additionally concer the maximum synchronization deviation for the usage of the automation product.

Feedback from some XTAL / oscillator providers (for the products fitting to the requirements from previous page) required, due to the missing statements on the data sheets.
=> Cite [XTAL / oscillator provider] **“We can guarantee, that under the stated conditions, the df/dt will stay below 3ppm/s for the requested XTALs / oscillators”** – That’s in the responsibility of the different automation product vendors

Industrial requirements for synchronization Guarantees

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Industrial communication means “guaranteed functionality”

Industrial communication is in most cases bound to guarantees and certification.

Thus, even if the 3ppm/s frequency change happens once a day or a week or a month, synchronization SHALL still ensure that the maximum deviation stays inside the +/- 1µs limits.

One may argue that this is a vendor concern and should be solved by the vendor – but that’s not working for synchronization which is a common concern for all connected stations.

The author expected to include these automation products and build for this environmental conditions, too.

Assumption:
The simplest way to include these requirements into the simulation seems to be the use of sinusoidal waveform, knowing that the 3ppm/s or even 6ppm/s frequency change only happens occasionally.

Thus, the author suggests to stay with the 3ppm/s requirements!

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Contact page

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Günter Steindl
Principal engineer
Siemens AG

Werner-von-Siemens-Str. 50
D-92224 Amberg
Germany

E-mail:
Guenter.Steindl@siemens.com

siemens.com/sce