



VSE and VSEW_mk2

Fine Sampling Clock Adjustment

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1 Introduction

VSE and VSEW_mk2 devices have two separate clock references:

- An accurate date/time clock that is used to timestamp every recorded point when recording RMS values and/or peaks and averages. That reference has a typical accuracy of 30ppm.
- A less accurate time reference that is used to clock the sampling of raw signals. That reference has a typical accuracy of 1% for the VSEW_mk2, and 2 to 3% for the VSE series.

The low accuracy of the sampling clock may be a problem in some applications. For instance, if an accurate frequency needs to be measured, or to avoid temporal drift when recording for a long time.

To alleviate this problem, version 9.0 and higher of *Instrument_Manager* implement a correction that can be applied to individual instruments.

Note: The correction discussed here only applies to errors in the sampling frequency. Errors in the date/time clock can be corrected by the clock correction function of Instrument Manager.

2 Frequency Correction

The correction of the sampling frequency is done in 3 steps:

1. Measurement: The sampling frequency error is measured.
2. Reporting: The sampling frequency error is encoded in the User_ID of the individual instrument.
3. Correction: Whenever the instrument takes a measurement, whether real-time or recorded, it will use that encoded error value to correct for the true sampling frequency.

3 Measurement

There are varying ways of measuring the sampling frequency error. Two of the most usual are described below:

3.1 Time Domain

A time domain measurement is very simple and does not require very sophisticated equipment. Simply start a very long recording of raw signal, and time its duration using a stopwatch. Then compare the real duration as measured by the stopwatch, to the reported duration as displayed on the X-axis after displaying the recorded trace.

The drawbacks of this method are:

- The precision is usually low. It improves with the length of the recorded signal, but timing errors in the starting and stopping of the stopwatch make it difficult to achieve the best possible precision.
- It takes a long time to get a result, especially if you want a result with a good precision.

3.2 Frequency Domain

With this method, the accelerometer is excited with a vibration of known (and hopefully precise) frequency, while the measured frequency spectrum is displayed in real-time. To facilitate a high-

precision measurement the frequency spectrum is displayed with a high resolution. The correction is simply measured by comparing the real (known) excitation frequency, with the frequency that the instrument measures.

That method yields a result in a relatively short time, but it requires a vibration source at a known frequency.

4 Reporting

The way to specify the correction for an individual instrument is to include the following code in the User-ID of the instrument: FsErxx.yy% where xx.yy represents the sampling frequency error in %.

For instance, if the sampling frequency is 5% too fast, the code would be FsEr5%. If the sampling frequency is 3.5% too slow, the code would be FsEr-3.5%

That code can be inserted anywhere in the User-ID. But we recommend at the end, and following an underscore (as in “_FsEr-3.5%”)

Because the correction is included in the *User_ID* of the instrument, it will follow the individual instrument, and not the software.

5 Correction

The correction is applied at the following steps:

- Whenever the instrument is measuring in real-time (for instance when observing the real-time spectrum display in *Instrument Manager*). This way it is possible to make sure that the correction is in effect and accurate after writing a new *User_ID* including an encoded correction value.
- Whenever data that is in the instrument's memory is read via USB. This way all data visualized using Instrument Manager, and later saved or exported includes that correction.
- Whenever data that is in a .wlg file is read or exported to any other format. This way all data transferred by the instrument via WiFi, includes that correction.

5.1 Mode of Correction

Prior to Instrument Manager V 12.7, raw signals recorded with a correction in effect were not resampled. Only the sampling period value was adjusted in the output signal. This had the advantage of not leaving the raw signal untouched but had the disadvantage of making it difficult to precisely align exported signals captured with instruments having the same ideal sampling frequency but different sampling clock errors.

For instrument Manager V12.7 and above, the raw signals are resampled at the ideal sampling frequency. This way exported signals captured with instruments having the same ideal sampling frequency but different sampling clock errors can easily be aligned on a sample-by-sample basis.