

Universal Data Acquisition and Monitoring System for insula- tion condition monitoring of high voltage machines

UDL-8000 V5

Application Manual

**Endwinding Vibration Monitoring
(EWM + M8001)**

This publication supersedes all earlier versions, Specifications subject to change.

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List of Abbreviations

PD	Partial Discharge
A/D	Analogue to Digital Converter
D/A	Digital to Analogue Converter

PRPD Phase Resolved Partial Discharge Pattern

UTC Coordinated Universal Time

1 Read This First!

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1.1 Warranty and Product Support

It is recommended that you thoroughly inspect the contents of the UDL-8000 Monitoring System packaging immediately upon receipt. Compare the contents to the packing list/invoice shipped with the instrument. Unless is notified promptly of any missing or damaged item, we cannot accept responsibility for its replacement. Contact your nearest Customer Service Center or national distributor immediately.

We warrant the UDL-8000 products for normal use and operation within specifications for a period of two years from the date of shipment. Spares, replacement parts and repairs are warranted for 90 days. The instrument's firmware has been thoroughly tested and is thought to be functional, but is supplied without warranty of any kind covering detailed performance.

Products not made by Manufacturer are covered solely by the warranty of the original equipment manufacturer. Under the warranty, the supplier will repair or, at its option, replace any product returned within the warranty period to a authorized service center. However, this will be done only if the product is determined after examination by the manufacturer to be defective due to workmanship or materials, and not to have been caused by misuse, neglect or accident, or by abnormal conditions or operation.

NOTE: This warranty replaces all other warranties, expressed or implied, including but not limited to any implied warranty of merchantability, fitness, or adequacy for any particular purpose or use. The Manufacturer shall not be liable for any special, incidental, or consequential damages, whether in contract or otherwise. The client will be responsible for the transportation and insurance charges for the return of products to the service facility.

For Further Technical Information and application information of the device, please read the Knowledgebase at the end of this document or to the available/applicable IEC / EN Standards.

1.2 About this Manual

This manual is an extension to the main manual and describes the specific features and functions of the Endwinding Vibration Monitoring for rotating machines. The Endwinding Vibration (EWM) acquisition module is specifically designed such purposes

This manual is built up as follows

- Chapter 2
Introduction of the Endwinding Vibration Monitoring
- Chapter 3
Application Description
- Chapter 4
Hardware and Software requirements
- Chapter 5
Hardware Module M8001
- Chapter 6
Acquisition Module Configuration
- Chapter 7
Acquisition Module Data Presentation

2 Introduction

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The Endwinding vibration monitoring is used to monitor the vibration condition of the Endwinding of the stator winding of a rotating machine.

By measuring the Endwinding vibrations aging effects of the fixing and structure of the Endwinding can be detected.

The UDL-8000 with the hardware module M8001 and the software module EWM is specially designed for this type of application and allows an easy and simple monitoring of the Endwinding vibration by typically installing 6 or more vibration sensors along the Endwinding on each side as the driven and the non driven end of the stator winding.

Typically, one module is used per side, means for a typical installation, the UDL-8000 system is equipped with two M8001 Modules.

The following illustration show the standard UDL-8000 system with the central controller and two 8 channel modules, installed in the 28TE DIN Rail enclosure.



Figure 1: UDL-8000 System for Endwinding Vibration Monitoring

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3 Application Description

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The endwinding vibration is generally measured with fiberoptic vibration sensors installed at the driven and at the non driven end. The sensors offer generally a sensitivity of 100mV/g and the M8001 has a build in double integrator to convert the acceleration signal into a displacement signal.

Typically 6 sensors on each side are installed in radial direction, of course there are other installation layouts with either biaxial sensors installed at radial and tangential direction and sometimes also in axial direction.

Smaller machines are often only equipped with 3 sensors, this is up to the customer needs.

One input module M8001 can accept either 7 fiberoptic acceleration Sensors and 1 reference sensor or 8 vibration sensors without a reference sensor. The reference sensor is used to determine the phase angle of the vibration signal and for installation without a reference sensor, the first vibration sensor is used as a reference angle.

Even typically the Endwinding vibration monitoring is installed on large turbo generators, it is also possible to install it on hydro generators. The measurement and data evaluation remains the same for both types of machines.

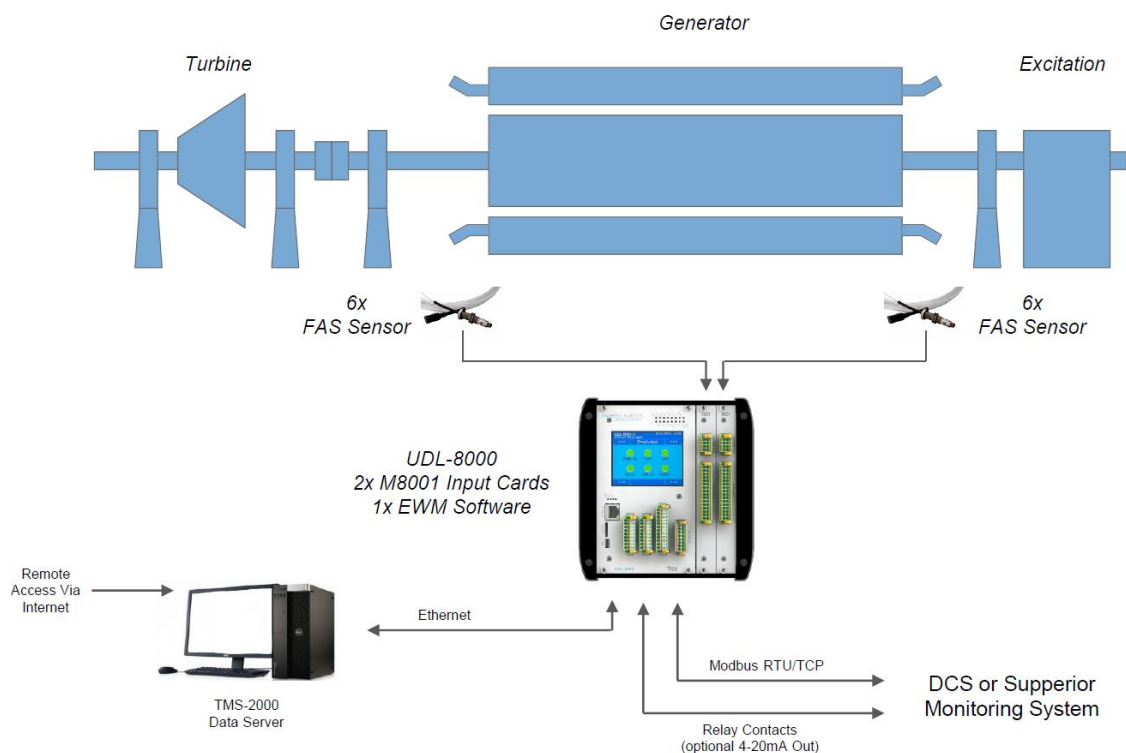


Figure 2: Endwinding Vibration Monitoring on a rotating machine

The Fiberoptic Accelerometer Sensor is a non-metallic vibration sensor ideally suited for installation on high voltage potentials.

The sensor is typically powered by +24V DC and provides a voltage signal output with a sensitivity of 100mV/g, with alternative outputs as either 10mV/mm/s or 10mV/ μ m

Key Features

- Resistant to high electrical and magnetic field
- Complete Metal Free Sensing Element
- Excellent electrical insulation > 65kVrms
- Acceleration and Displacement output
- Single +24VDC Power Supply



Figure 3: Example of a Fibreoptic Accelerometer Sensor

3.1 Measurement and Analysis

The main parameter of the endwinding vibration monitoring is the main frequency component of the 2x network frequency which is usually 100Hz for a 50Hz network or 60Hz for a 120Hz network. This frequency component is critical as it is forced by the electromagnetic forces within the stator winding. Additionally, the rotation frequency is monitored as well in order to separate possible vibration between the machine vibration and the vibration created by the electromagnetic forces.

The system has built in 4th order narrow band filters with a bandwidth of +/-3Hz:

For the Rotation frequency F1:

Rotation Frequency 25Hz: Monitored frequency: 22..28Hz

Rotation Frequency 30Hz: Monitored frequency: 27..33Hz

Rotation Frequency 50Hz: Monitored frequency: 47..53Hz

Rotation Frequency 60Hz: Monitored frequency: 57..63Hz

For the network frequency F2:

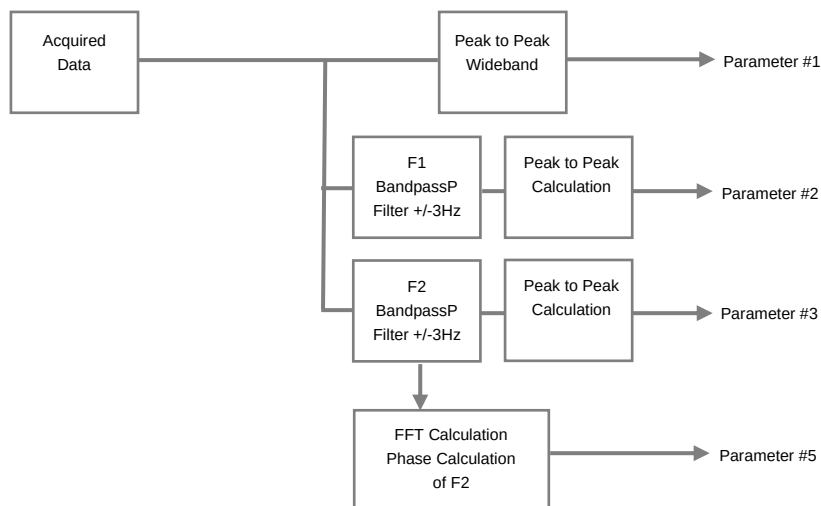
Network Frequency 50Hz: Monitored frequency: 97..103Hz

Network Frequency 60Hz: Monitored frequency: 117..123Hz

The main parameter used for the Endwinding vibration monitoring is the displacement in μm peak-to-peak of the 2x Network frequency. For the results shown on the FFT diagram, amplitudes are rescaled from rms to peak-to-peak by using a factor $2 \times \text{SQRT}(2)$.

Additionally for some customer requests, the phase angle of the main frequency component (100/120Hz) is calculated from a FFT. If a reference sensor is used, the phase angles are determined from the reference signal, while if no reference sensor is used, the phase angle is determined based on the first sensor, which is then automatically set to 0 deg.

The vibration sensors connected to one input module M8001 are acquired simultaneously.



Parameter #4 is measured separately and is used to check the bias voltage of the sensor in order to determine the correct operation of the sensor.

Figure 4: Calculation of the Endwinding Vibration parameters

3.2 General parameter handling

The UDL-8000 system is capable to handle 8 Channels with 8 parameters per channel. This gives a total of 64 parameters.

The addressing of the parameters is fixed and depends on the acquisition module, input channel and parameter channel. Refer to the general user manual for a complete addressing information of the UDL-8000 system.

The first 64 channels (0..63) are reserved for the controller, channels 64..127 are for the acquisition module 1, 128..191 for the software module 2 etc.

These channels are called channel ID's and the structure is kept identical for the Modbus RTU interface and for the UDL-DataServer.

In order to identify the location of the specific parameter, simply add the following numbers depending on the software module ID:

- Acquisition module ID 1: 64
- Acquisition module ID 2: 128
- Acquisition module ID 3: 192
- Acquisition module ID 4: 256
- Acquisition module ID 5: 320
- Acquisition module ID 6: 384
- Acquisition module ID 7: 448

3.3 Calculated parameters

Note: Add the offset depending on the Acquisition module ID. Channels not listed up here are not used. One of the two reference inputs can be selected to trigger the acquisition.

3.3.1 Reference Channel – CH1 (optional)

The following parameters are calculated from channel 1

CH ID	Calculation Type	Unit	Remarks
0	Frequency of Reference	Hz	
1	RPM of Reference	rpm	CH1 * 60s
2	RMS Amplitude	V	

Table 1: EWM Parameter Table, Reference - Channel 1

3.3.2 Endwinding Vibration – CH1 (alternative)

The following parameters are calculated from channel 1

CH ID	Calculation Type	Unit	Remarks
0	Vibration Sensor #1 Wideband peak-peak	um pp	alternative
1	Vibration Sensor #1 Narrowband F1 peak-peak	um pp	alternative
2	Vibration Sensor #1 Narrowband F2 peak-peak	um pp	alternative
3	Vibration Sensor #1 DC Bias Voltage	V	alternative
4	Vibration Sensor #1 Phase F2	Deg	alternative

Table 2: EWM Parameter Table, Vibration Sensor #1

3.3.3 Endwinding Vibration – CH2

The following parameters are calculated from channel 2

CH ID	Calculation Type	Unit	Remarks
8	Vibration Sensor #2 Wideband peak-peak	um pp	alternative
9	Vibration Sensor #2 Narrowband F1 peak-peak	um pp	alternative
10	Vibration Sensor #2 Narrowband F2 peak-peak	um pp	alternative
11	Vibration Sensor #2 DC Bias Voltage	V	alternative
12	Vibration Sensor #2 Phase F2	Deg	alternative

Table 3: EWM Parameter Table, Vibration Sensor #2

3.3.4 Endwinding Vibration – CH3

The following parameters are calculated from channel 3

CH ID	Calculation Type	Unit	Remarks
16	Vibration Sensor #3 Wideband peak-peak	um pp	alternative
17	Vibration Sensor #3 Narrowband F1 peak-peak	um pp	alternative
18	Vibration Sensor #3 Narrowband F2 peak-peak	um pp	alternative
19	Vibration Sensor #3 DC Bias Voltage	V	alternative
20	Vibration Sensor #3 Phase F2	Deg	alternative

Table 4: EWM Parameter Table, Vibration Sensor #3

3.3.5 Endwinding Vibration – CH4

The following parameters are calculated from channel 4

CH ID	Calculation Type	Unit	Remarks
24	Vibration Sensor #4 Wideband peak-peak	um pp	alternative
25	Vibration Sensor #4 Narrowband F1 peak-peak	um pp	alternative
26	Vibration Sensor #4 Narrowband F2 peak-peak	um pp	alternative
27	Vibration Sensor #4 DC Bias Voltage	V	alternative
28	Vibration Sensor #4 Phase F2	Deg	alternative

Table 5: EWM Parameter Table, Vibration Sensor #4

3.3.6 Endwinding Vibration – CH5

The following parameters are calculated from channel 5

CH ID	Calculation Type	Unit	Remarks
32	Vibration Sensor #5 Wideband peak-peak	um pp	alternative
33	Vibration Sensor #5 Narrowband F1 peak-peak	um pp	alternative
34	Vibration Sensor #5 Narrowband F2 peak-peak	um pp	alternative
35	Vibration Sensor #5 DC Bias Voltage	V	alternative
36	Vibration Sensor #5 Phase F2	Deg	alternative

Table 6: EWM Parameter Table, Vibration Sensor #5

3.3.7 Endwinding Vibration – CH6

The following parameters are calculated from channel 6

CH ID	Calculation Type	Unit	Remarks
40	Vibration Sensor #6 Wideband peak-peak	um pp	alternative
41	Vibration Sensor #6 Narrowband F1 peak-peak	um pp	alternative
42	Vibration Sensor #6 Narrowband F2 peak-peak	um pp	alternative
43	Vibration Sensor #6 DC Bias Voltage	V	alternative
44	Vibration Sensor #6 Phase F2	Deg	alternative

Table 7: EWM Parameter Table, Vibration Sensor #6

3.3.8 Endwinding Vibration – CH7

The following parameters are calculated from channel 7

CH ID	Calculation Type	Unit	Remarks
48	Vibration Sensor #7 Wideband peak-peak	um pp	alternative
49	Vibration Sensor #7 Narrowband F1 peak-peak	um pp	alternative
50	Vibration Sensor #7 Narrowband F2 peak-peak	um pp	alternative
51	Vibration Sensor #7 DC Bias Voltage	V	alternative
52	Vibration Sensor #7 Phase F2	Deg	alternative

Table 8: EWM Parameter Table, Vibration Sensor #7

3.3.9 Endwinding Vibration – CH8

The following parameters are calculated from channel 8

CH ID	Calculation Type	Unit	Remarks
56	Vibration Sensor #8 Wideband peak-peak	um pp	alternative
57	Vibration Sensor #8 Narrowband F1 peak-peak	um pp	alternative
58	Vibration Sensor #8 Narrowband F2 peak-peak	um pp	alternative
59	Vibration Sensor #8 DC Bias Voltage	V	alternative
60	Vibration Sensor #8 Phase F2	Deg	alternative

Table 9: EWM Parameter Table, Vibration Sensor #8

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4 Hardware & Software Requirements

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The UDL-8000 monitoring system used for Endwinding Vibration monitoring can be equipped with up to 7 hardware modules, providing a system with up to 56 analogue input channels.

For the complete monitoring, the following equipment is required for the acquisition:

- 1x UDL-8000 Controller
- 1x or 2x Hardware Module M8001
- 1x Software Module EWM
- UDL-Configurator Software for the configuration of the system
- UDL-Monitor Software for instant data presentation on a windows computer
- UDL-DAQ Software (optional) for direct data acquisition control of the rotor flux measurement

For automatic long-term trending and data storage, the UDL-DataServer is required. The UDL-DataServer offers continuous data recording simultaneously over multiple devices across an ethernet network (LAN/WAN). All data is stored within an SQL database and are presented on a windows-based application software. Further Details about the functions of the rotor flux monitoring within the UDL-DataClient can be found within the documentation of the UDL-DataServer.

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5 Hardware Module M8001

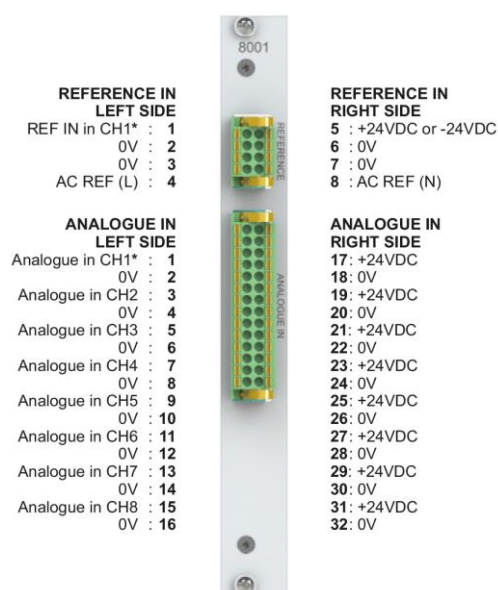
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5.1 Module Description

For the measurement of the Endwinding vibrations, the interface module M8001 is used. The Module has the following key features:

- Reference / Trigger input +/-24V or 240VAC Line with +24VDC or -24VDC Power supply
- Selection of RAW input signal for every vibration channel
- Selection of 1x Integrated input signal for every vibration channel
- Selection of 2x Integrated input signal for every vibration channel
- Selection of DC input signal for every vibration channel
- +24VDC, 100mA Supply voltage for every vibration sensor.

5.2 Module Overview and Technical Specifications



Analogue Reference Input

Function	Description
Input Range	+/-24V
Input Impedance	100 kOhm

AC reference Input

Input Range	50..300Vrms
Input Impedance	10MOhm

Vibration Sensor Input

Input Range	+/-20V
Input Sensitivity	100mV/g
Input Impedance	100kOhm

Terminals

Function	Description
Section	0.25 .. 1.5mm ²
Max Voltage	250VAC
Max Current	8A

Module

Function	Description
Width	4TE (20.32mm)
Height	4 HU (177.8mm)
Power Consumption	24V, ~100mA (without Load on 24VDC Outputs)

Figure 5: Technical Specifications of the M8001

5.3 Module Function Overview

The M8001 includes 2 reference inputs with different voltage ranges one for AC Voltage up to 300Vrms with optical insulation and a second one with an input range of +/-30V, typically used for signals from a proximity probe.

Each vibration channel has a selectable conditioning module interface, allowing to either use the DC input, RAW signal input of the sensor, 1x integrator or 2x integrator. The integrators natural frequency is 159.2Hz.

5.4 Module Terminal Connections

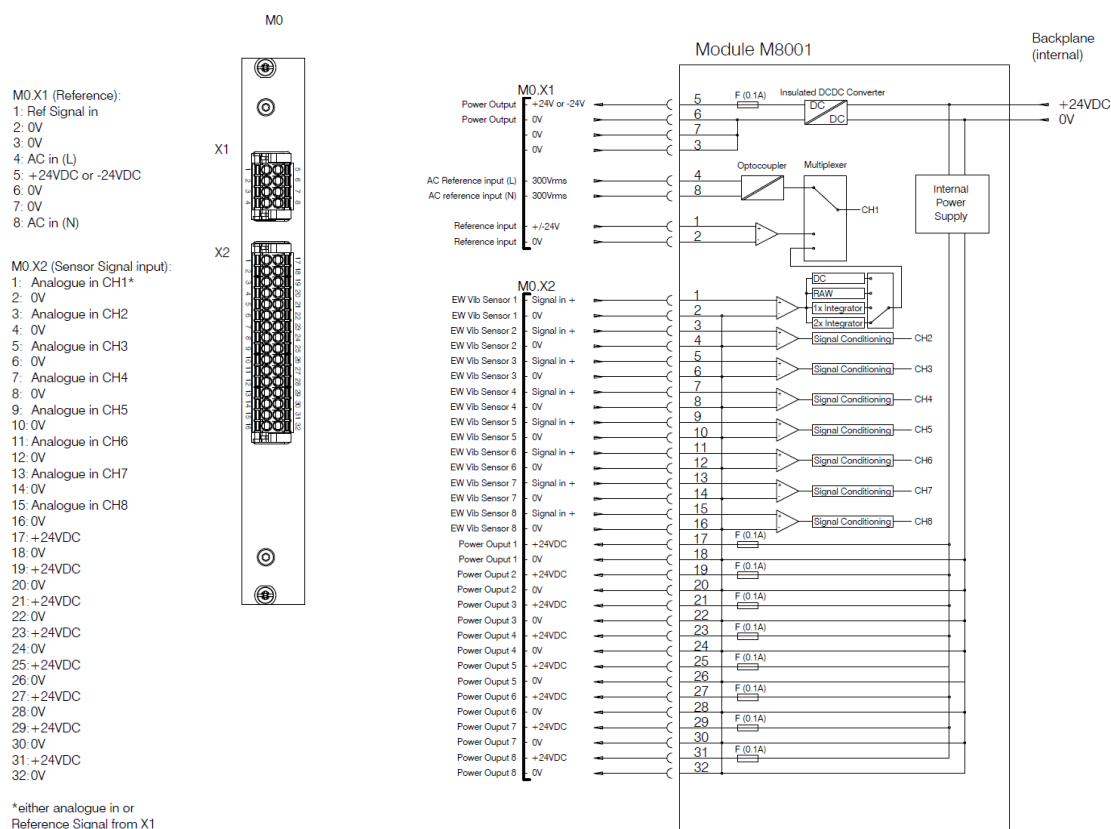


Figure 6: M8001 Terminal Connections

6 Acquisition Module Configuration

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The main acquisition configuration is supplied by a template which can be loaded under “Acquisition Modules” → “Change” → button “Load” (EWM).

Whenever possible, do not change the advanced acquisition parameter settings, unless it is known what should be done. In any doubts, please contact Sparks Instruments for advice for any changes of the Advanced Acquisition Settings

6.1 Advanced Acquisition Module Configuration

Figure 7: UDL-Configurator – Advanced Acquisition Module Configuration

The above configuration will acquire the input voltages with a sampling Rate of 10'240 Samples/second. The Acquisition is started as soon 20'480 Samples are ready from the Analogue Digital Converter. If a trigger signal is used, activate the trigger setting and the phase of the F2 vibration signal is determined based on the reference signal

Parameter	Description
Module	Reserved Parameter
Level	Threshold Level, the way of direction is determined by the “mode”
Min Level	Min Level determines if a reference signal is valid
Mode	Defines the edge control of the trigger. Generally, this parameter is only used on generators with change their sensor of rotation. However, in case the pulse of the reference sensor is negative, use falling edge to trigger the system
Denoising Tf	Filter Parameter Tf
Denoising Ts	Filter Parameter Ts

Table 10: Advanced – Acquisition parameters

6.2 Basic Acquisition Module Configuration

Within the basic acquisition module configuration, the main acquisition parameters can be defined.

Each Software module has its application specific parameters.

Acquisition Modules

No.	Type	Description	Used Modules
✓ 0	INT	Internal Controller Functions	
✓ 1	EWM	8 Ch. Endwinding Vibration Monitoring	M0
✓ 2	FLM	Rotor Flux Monitoring (Cylindrical)	M1
✓ 3	SUI	Shaft Voltage / Current Monitoring	M2
✓ 4	PAM	3 Phase Power Analyzer	M3
✓ 5	AIS	4x 16 Channel 4-20mA Input	M5

Buttons: Change, Save, Set to Default

Basic | Advanced

Basic Settings:

- Freq. 1: 50
- Freq. 2: 100
- AI Interface: 2x_int
- HW_ChMode: 8Channel
- Reference Source: none
- ☐ Use SensorCheck

Figure 8: EWM Module specific parameters

Parameter	Description
Freq 1	Defines the F1 Frequency, typically the rotation frequency of the machine, 25/30 or 50/60Hz
Freq 2	Defines the F2 Frequency, typically the Network Frequency of the power grid, 100/120Hz
HW CH mode	Selection of the type of signal conditioning <u>1x Ref + 7 Channels</u> Use the Reference Signal to Channel 1, and Channel 2-8 as Vibration Signals <u>8 Channel</u> Use all 8 vibration channels
Reference Source	Selection of the Reference source: <u>None</u> No reference source is used <u>AC Reference</u> Use the AC input terminals, supporting reference voltages up to 300Vrms <u>LV Reference</u> Use the LV Reference input with an input range of +/-30Vpp
Use Sensor Check	Activate the Sensor Check / Bias Voltage measurement. This is only applicable for sensors which provide a DC bias voltage, and for sensors where the Bias Voltage is not OK, the alarming is deactivated.

Table 11: Basic – Acquisition parameters

6.3 Alarm Configuration

By default, the following alarms are configured, note that the channel id needs to be calculated based on the acquisition module number.

CH ID	Calculation Type	Alarm Mode	Threshold AL1 low lvl	Delayed	Threshold AL2 low lvl	Delayed
2	Vibration Sensor #1 Narrow Band F2	Above	200um	Yes, 10s	300um	Yes, 10s
10	Vibration Sensor #2 Narrow Band F2	Above	200um	Yes, 10s	300um	Yes, 10s
18	Vibration Sensor #3 Narrow Band F2	Above	200um	Yes, 10s	300um	Yes, 10s
26	Vibration Sensor #4 Narrow Band F2	Above	200um	Yes, 10s	300um	Yes, 10s
34	Vibration Sensor #5 Narrow Band F2	Above	200um	Yes, 10s	300um	Yes, 10s
42	Vibration Sensor #6 Narrow Band F2	Above	200um	Yes, 10s	300um	Yes, 10s
50	Vibration Sensor #7 Narrow Band F2	Above	200um	Yes, 10s	300um	Yes, 10s
58	Vibration Sensor #8 Narrow Band F2	Above	200um	Yes, 10s	300um	Yes, 10s

Table 12: Default Alarm Configurations

6.4 Sensor OK Configuration

For the Sensor OK monitoring, the DC Bias Voltage Channel is used. By default the channels are not used for alarming and need to be activated depending if the channel is used or not.

CH ID	Calculation Type	Mode	Under Limit	Upper Limit
3	Vibration Sensor #1 Narrow Band F2	Within	5V	7V
11	Vibration Sensor #2 Narrow Band F2	Within	5V	7V
19	Vibration Sensor #3 Narrow Band F2	Within	5V	7V
27	Vibration Sensor #4 Narrow Band F2	Within	5V	7V
35	Vibration Sensor #5 Narrow Band F2	Within	5V	7V
43	Vibration Sensor #6 Narrow Band F2	Within	5V	7V
51	Vibration Sensor #7 Narrow Band F2	Within	5V	7V
59	Vibration Sensor #8 Narrow Band F2	Within	5V	7V

Table 13: Default Sensor OK Configurations

6.5 4-20mA Output Configuration

The 4-20 mA outputs are typically configured for the F2 Narrow Band Vibration

4mA = 0um peak-peak 20mA = 500um peak-peak

6.6 MIMIC Visualization Configuration

Use one of the templates representing the machine and it is recommended to use the following channels:

CH ID	Calculation Type	Si Notation	Digits
2	Vibration Sensor #1 Narrow Band F2	no	0
10	Vibration Sensor #2 Narrow Band F2	no	0
18	Vibration Sensor #3 Narrow Band F2	no	0
26	Vibration Sensor #4 Narrow Band F2	no	0
34	Vibration Sensor #5 Narrow Band F2	no	0
42	Vibration Sensor #6 Narrow Band F2	no	0
50	Vibration Sensor #7 Narrow Band F2	no	0
58	Vibration Sensor #8 Narrow Band F2	no	0

Table 14: Default Mimic Channels

6.6.1 Local Visualization Mimic example

As the visualization is fully customizable, the graphics below show an example of a possible visualization layout:

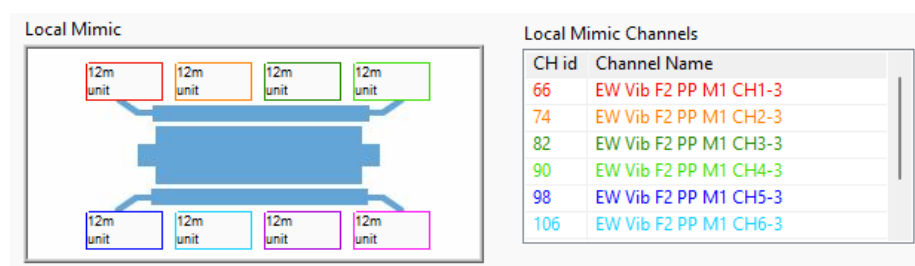


Figure 9: EWM Example of the standard local visualisation mimic

6.6.2 External Visualization Mimic example

A similar visualization layout can be used to present the mimic within the UDL-Monitoring Software.

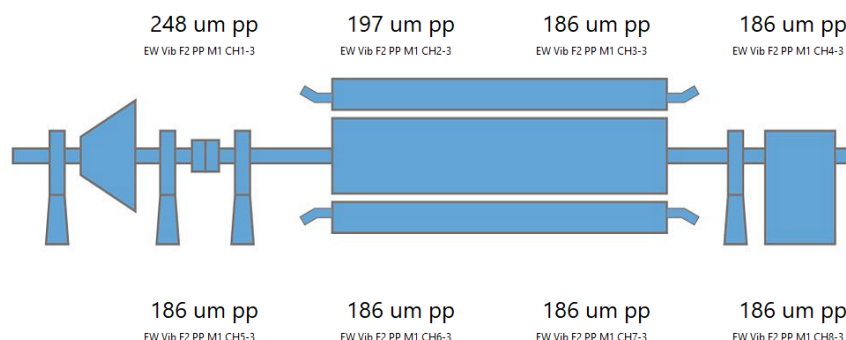


Figure 10: EWM Example of the standard external visualisation mimic

6.7 Data Recording

In order to avoid excessive data recording which will occupy a lot of disk space, it is recommended to use the following recording options.

6.7.1 Data Recording based on alarm

It shall be evaluated, if in case of an alarm other acquisition parameters should also be recorded. Typically, this is especially required, if the data other acquisition modules are linked together with the Endwinding Monitoring.

Figure 11: Typical recording configuration for alarm-based recording

Whenever an alarm of the specific acquisition module is active, 5 recordings with an interval of 10 minutes are saved. The counter for the number of recordings is restarted once all of the recorded data are saved.

6.7.2 Data Recording based on Time interval

In order to avoid a lot of recordings of the same data, a time intervalled recording shall be activated. The time intervalled recording will save only the raw data with the highest magnitude within the defined time interval. This type of recording shall be activated for the shaft voltage and for the shaft current (in case both functions are used)

The shown channel ID 66 refers to the Narrowband F2 Peak-Peak Magnitude value of the vibration channel 1 on Module 2. Add for every parameter required a time intervalled recording

Figure 12: recording configuration for time interval-based recording of vibrations

Parameter	Description
Channel ID	Define the channel id of the Narrowband F2 Peak-Peak Value
Max/min	Define the "memory mode" of the interval. Data are memorized if a new parameter value is larger (max) or smaller (min) of the previous data
Intervall hour	Define the time interval for the recording interval.
Condition	Define, if the data shall be acquired only while a parameter condition is met, e.g. record data if the machine runs at a minimum active power.
Channel ID	Define the channel id of the condition parameter
Value	Define the threshold of the condition parameter

Table 15: Basic – time interval-based recording.

7 Acquisition Module Data Presentation

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The measured Endwinding vibrations are acquired simultaneously over one input module M8001 and is shown on the is shaft voltage and shaft current signal is acquired simultaneously and is visualized as time signal on the top left graph of the data window. Below the time signal graph is the spectrum of each vibration sensor shown.

By selecting the vibration sensor at the top of the window, the raw data signal of the F1 and F2 frequency is presented within the graph on the right side.

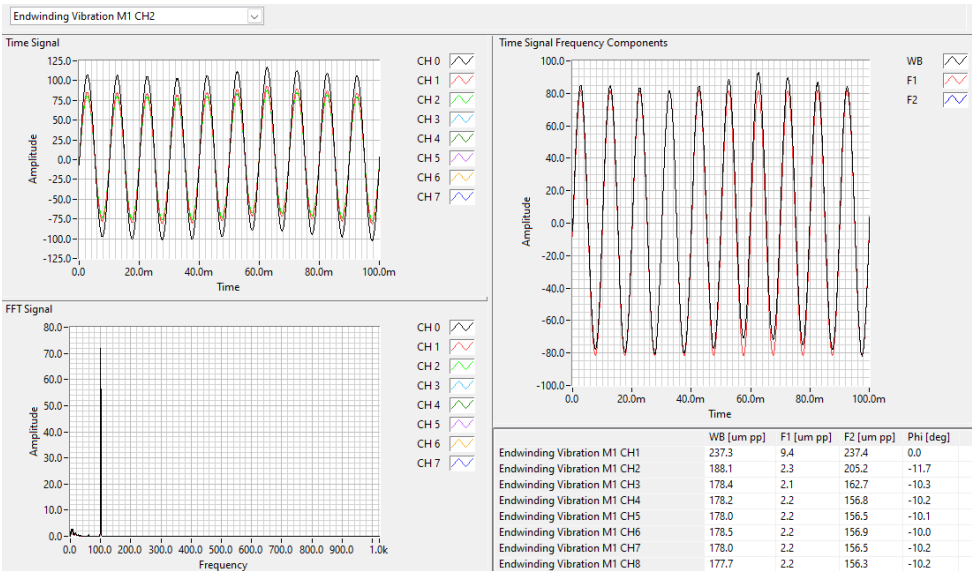


Figure 13: EWM Acquisition Module Data Presentation

At the bottom right the vibration data is shown for each channel.

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8 UDL-DataClient

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This chapter covers the information for the visualization of the measured data within the centralized data server / client software UDL-DataClient.

While the basic version of the UDL-DataClient presents only one visualization at a time, the UDL-DataClient Pro supports multi window data presentation while the content and the operation of the windows remain the same.

The measured shaft voltage and shaft current values are updated once the complete acquisition module is finished, and the update rate depends on the number of used modules

8.1 Typical Window Layouts

While the window layout depends greatly on the used monitor resolution, the number of windows presented at the same time also on the operator's preference. The layouts shown within this manual shall give some ideas about the possibilities provided by this software.

8.1.1 Layout for the UDL-8000 Pro

Screen Resolution: 1280 x 800 - WXGA

Using the touchpanel PC for data visualisation allowing to use the benefit of multiple data presentation. However, generally data analysis will then be performed on a connected Desktop computer with a larger screen.

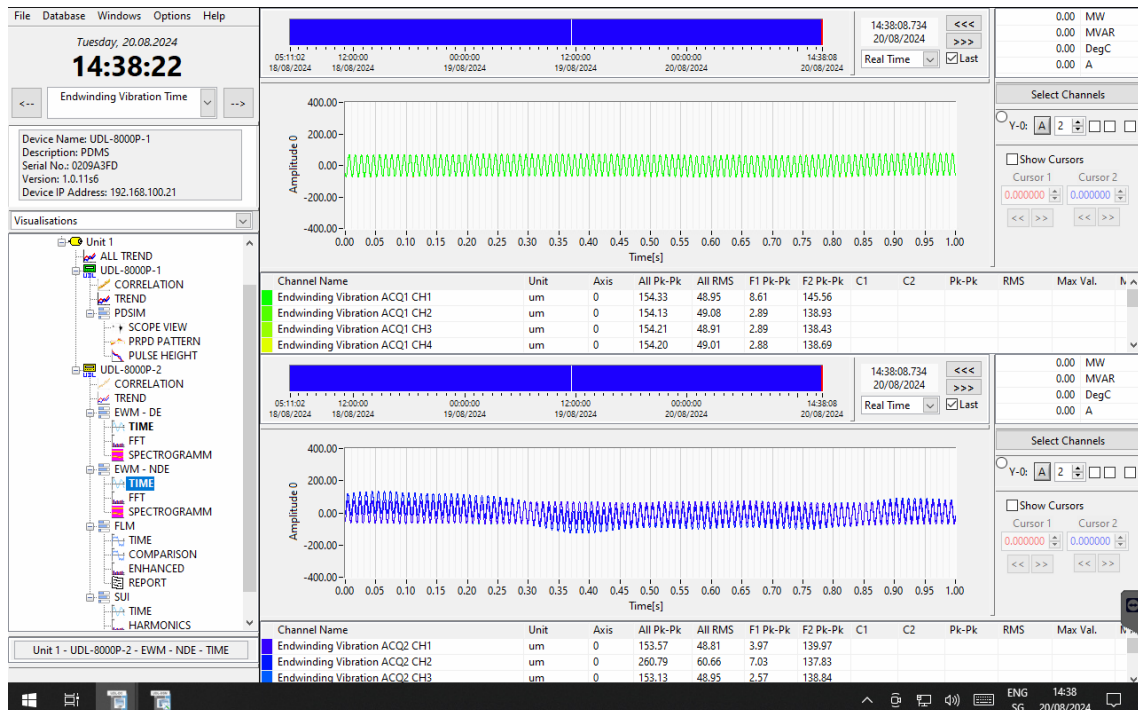


Figure 14: UDL-8000 Pro local data visualisation (Endwinding Vibration Timesignal)

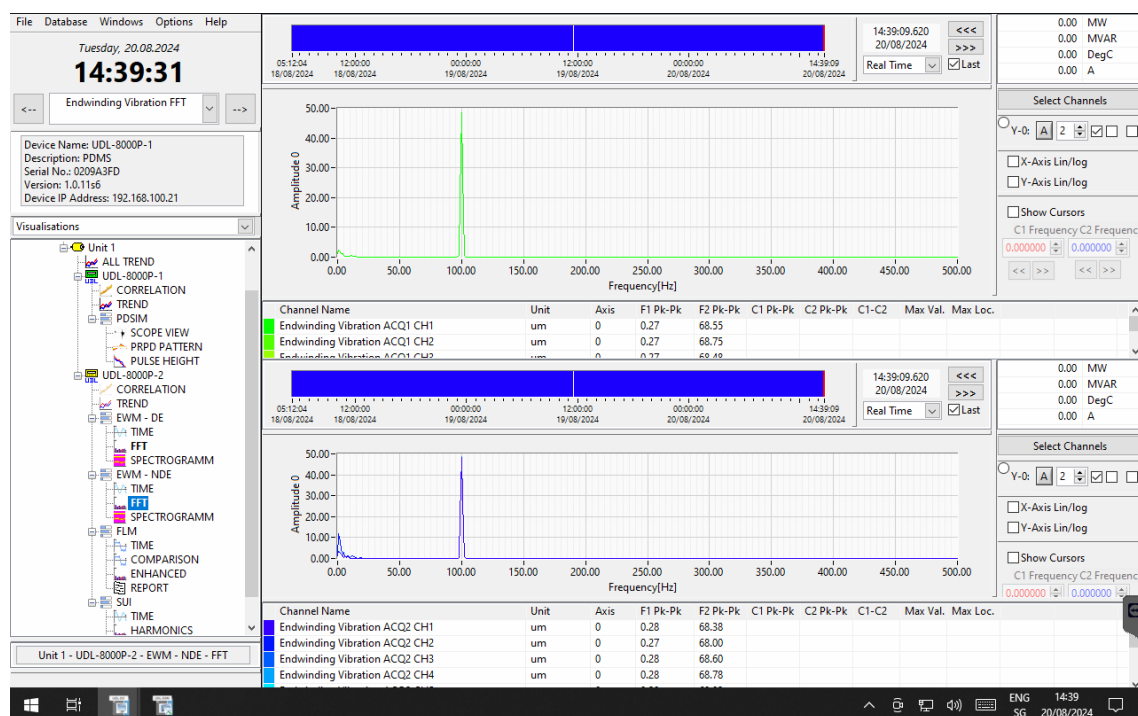


Figure 15: UDL-8000 Pro local data visualisation (Endwinding Vibration FFT)

As with the limited screen size, the time series data (trend) is placed as a separate view

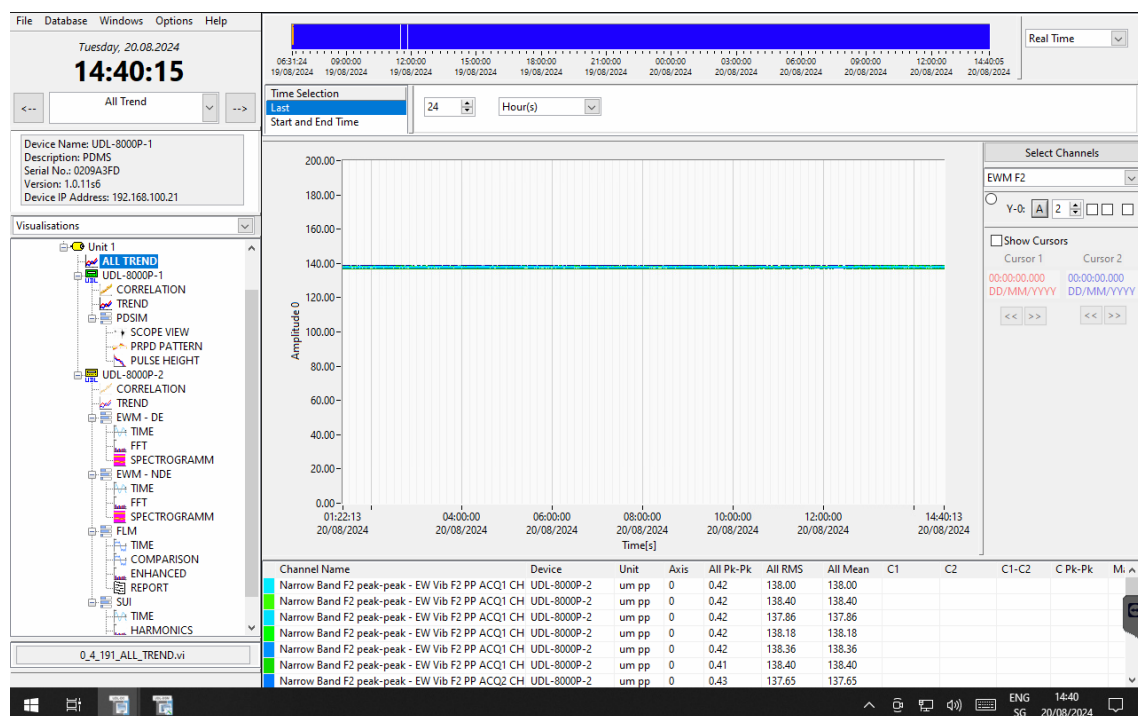


Figure 16: UDL-8000 Pro local data visualisation (Trend)

8.1.2 Layout for Desktop Computers

Screen Resolution: 2560 x 1440 – WQHD - recommended

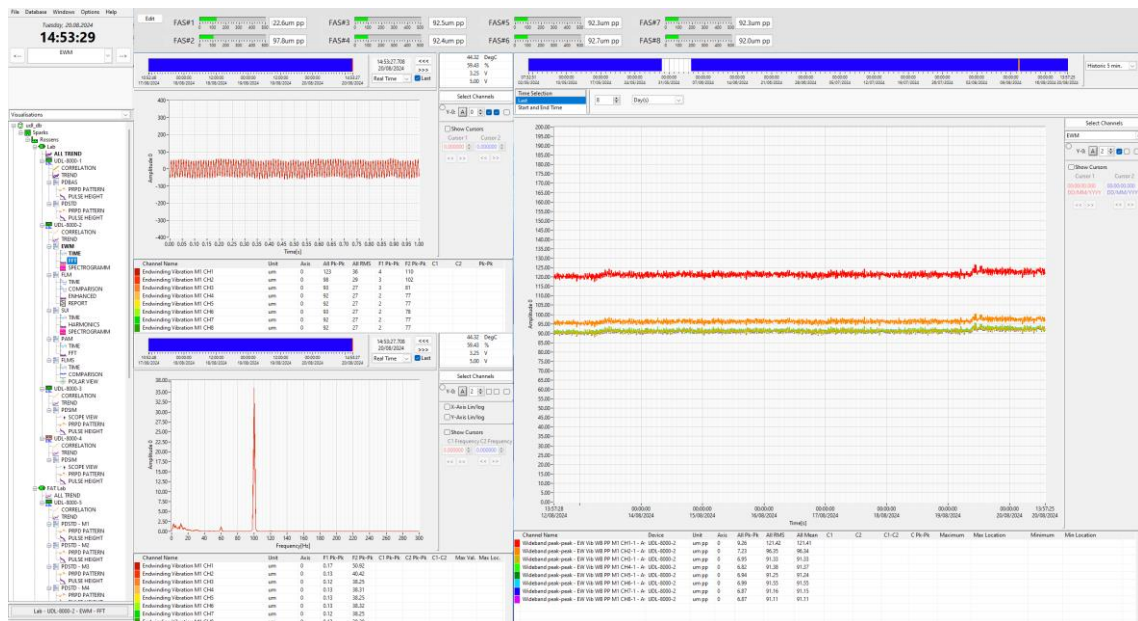


Figure 17: UDL-DataClient desktop data visualisation (EWM & Trend)

8.2 Data Visualizations

The functions, use and configuration of overview pages and trend are common for all types of acquisition modules and are described in the general user manual of the UDL-DataClient. The Update Rate of the windows depend on the number of acquisition modules used.

8.2.1 TIME (Endwinding Vibration)

The Time view shows the raw data of the Endwinding vibrations at the defined acquisition time.

The visualization is separated into 3 parts:

Window Part	Description
Top	The Top Part contains the time selection of the shown dataset
Middle	In the middle the selected data is presented
Bottom	At the bottom of the window, calculated results are shown

Table 16: Separation of visualisation information

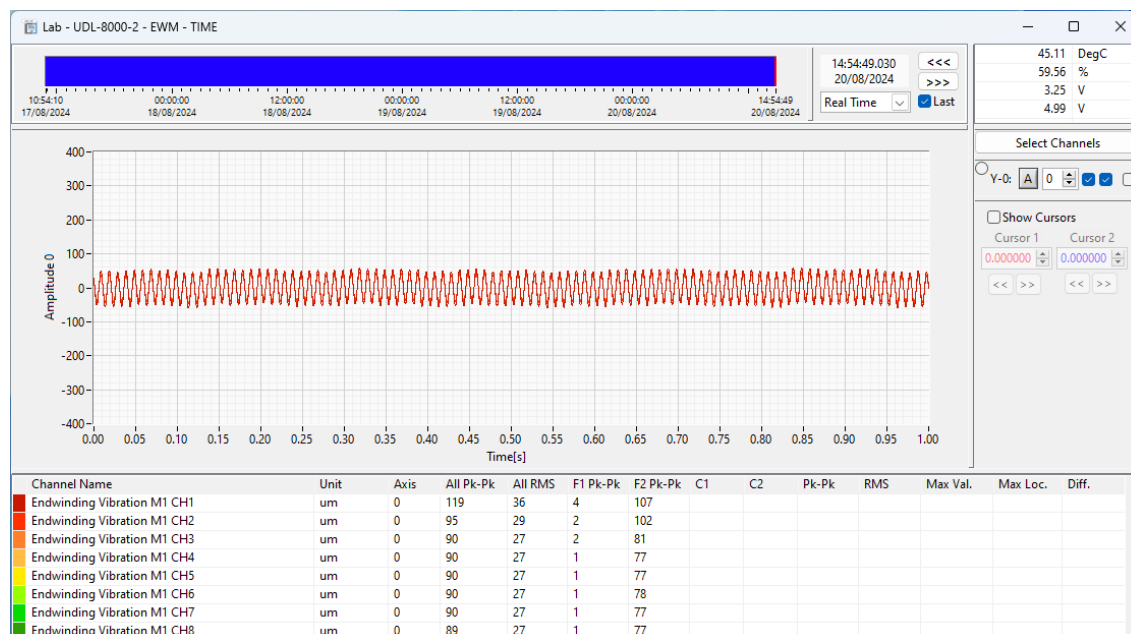


Figure 18: Time Data Presentation

8.2.1.1 Time Selection

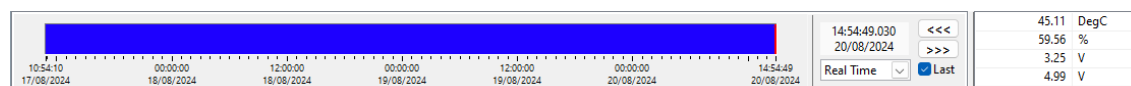


Figure 19: Time Selection

The blue bar shows all the available data records within the database, and the specific dataset can be picked by moving the red cursor at the time of interest.

The time selection in the middle allows to select the time more precisely as

Element	Description
Time Stamp	Enter the timestamp of interest manually. It is also possible to copy/paste the timestamp from another window or from a cursor timestamp. Right click into the timestamp field and assign the timestamp to the “master timestamp 1” or “master timestamp 2” in order to select the dataset of multiple windows with one single time definition.
Button left / right	Jump one record to the left (earlier) or right (later)
Data table selection	Choose between Realtime Data- and Historic Datasets
Last dataset	Select the last data record

Table 17: Time Selection parameters

At the very right side of the time selection view are the operating parameters shown. Up to 4 parameters can be assigned to the “recording header” which will be shown on every raw data visualisation window.

8.2.1.2 Data Presentation

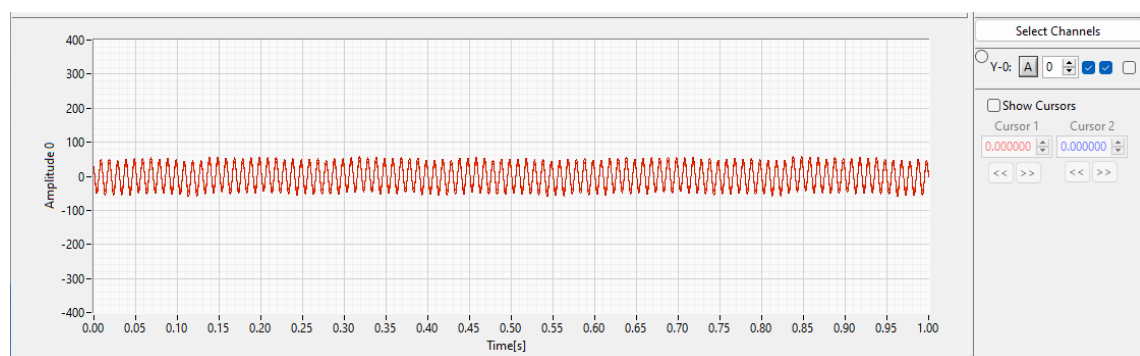


Figure 20: Endwinding vibration data Presentation

With the button “select channels” one or more vibration channels are selected.

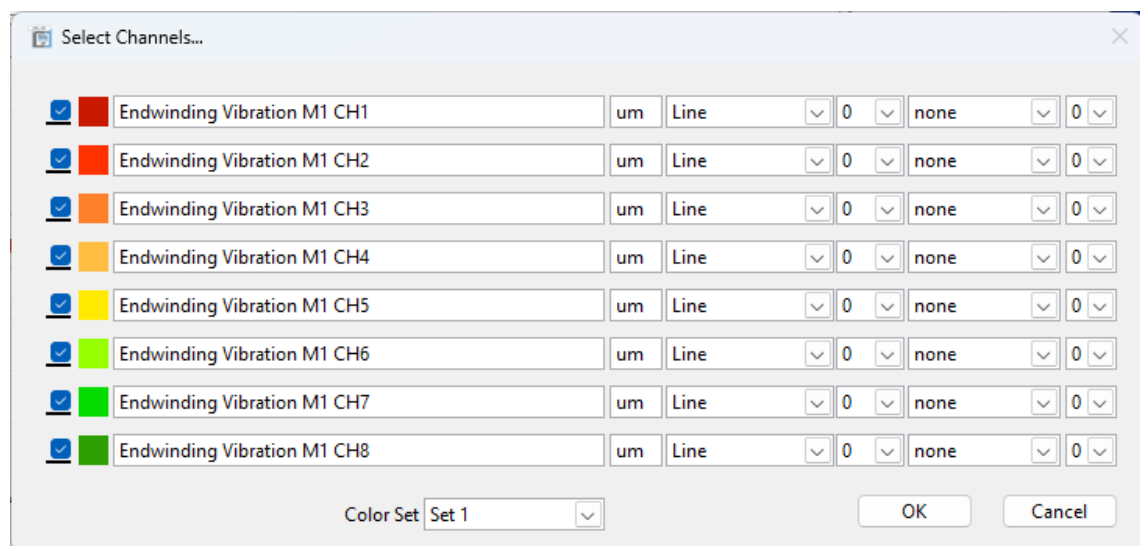


Figure 21: Channel Selection

Mark the Checkbox to activate the channel, click on the color box to change the color of the trace. Select the line type, the line thickness and sample points if wanted. At the very right side, assign the trace to the specific axis, this is especially used, whenever data with different scaling's are shown in the same graph. At the bottom of the window, a new color set can be assigned. Press the “OK” button to accept new changes and close the window.

At the right side of the graph are the settings for the individual used axis, press the little circle next to the “A” button to enlarge the axis configuration

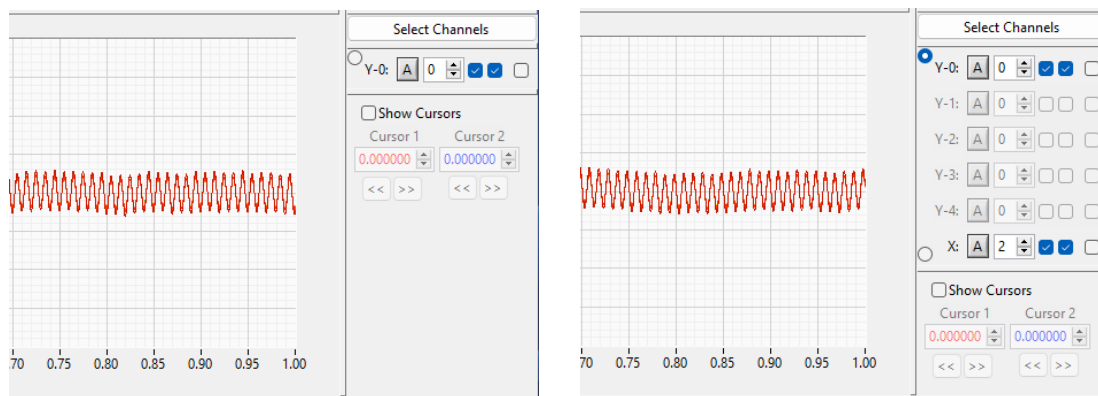


Figure 22: Axis Configuration

Depending on the assigned channels to the traces, more axis can be configured. Press the little “A” button to autoscale the specific axis. The number is used to select the number of digits in the axis and also in the calculation result table. The checkboxes next to it, allows to activate the major and minor grid lines. The checkbox at the very right is used to show the data either as floating point (unchecked) or in Si notation (checked). Si notation allows to automatically convert any number into k, m, M instead of exponents. It is also possible to manually adjust the axis range by entering the minimum and maximum value of the specific axis. Press the round circle at the bottom of the axis configuration to minimize this view.

Below the axis configuration 2 cursors can be activated in order to read out values of the shown traces. Mark the checkbox to activate the cursors:

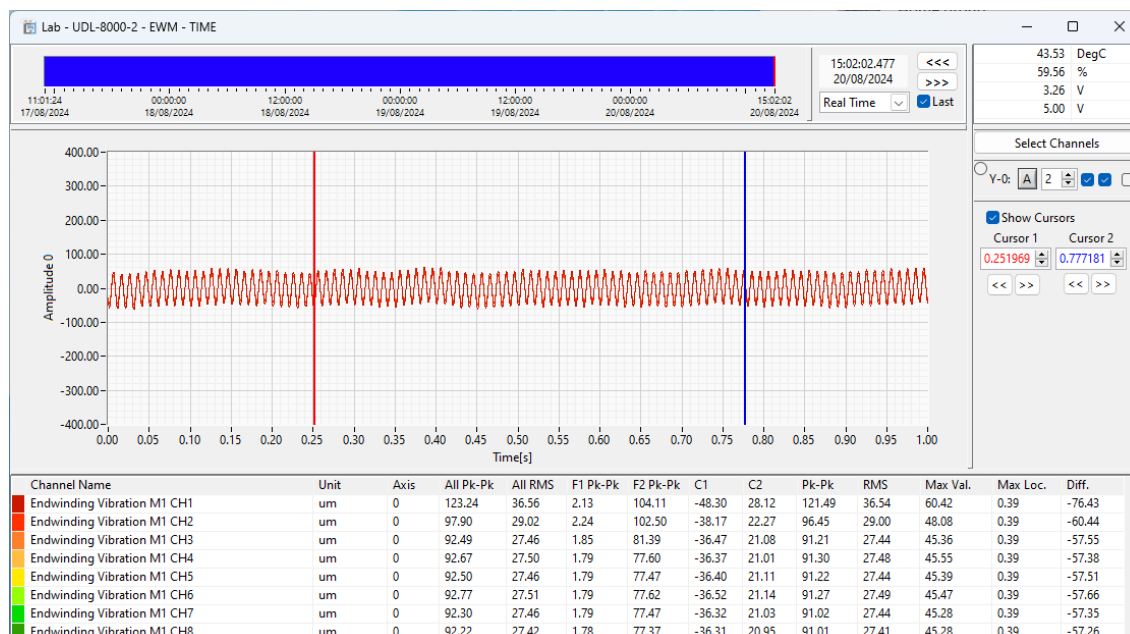


Figure 23: Reading out datapoints with cursors.

8.2.1.3 Calculated Results

At the bottom of the visualisation window are the results calculated from the shaft voltage and shaft current signal shown.

Channel Name	Unit	Axis	All Pk-Pk	All RMS	F1 Pk-Pk	F2 Pk-Pk	C1	C2	Pk-Pk	RMS	Max Val.	Max Loc.	Diff.
Endwinding Vibration M1 CH1	um	0	121.53	36.54	2.14	104.04							
Endwinding Vibration M1 CH2	um	0	96.66	29.00	1.61	102.26							
Endwinding Vibration M1 CH3	um	0	91.45	27.44	1.42	81.21							
Endwinding Vibration M1 CH4	um	0	91.54	27.49	1.41	77.54							
Endwinding Vibration M1 CH5	um	0	91.36	27.44	1.42	77.42							
Endwinding Vibration M1 CH6	um	0	91.72	27.49	1.43	77.57							
Endwinding Vibration M1 CH7	um	0	91.35	27.44	1.40	77.41							
Endwinding Vibration M1 CH8	um	0	91.24	27.40	1.41	77.31							

Table 18: Calculated Results without cursors

If the cursors are activated, the calculation results table is showing calculated values between the 2 cursors

Channel Name	Unit	Axis	All Pk-Pk	All RMS	F1 Pk-Pk	F2 Pk-Pk	C1	C2	Pk-Pk	RMS	Max Val.	Max Loc.	Diff.
Endwinding Vibration M1 CH1	um	0	121.53	36.54	5.43	108.41	49.69	-46.86	120.79	36.58	61.16	0.30	96.55
Endwinding Vibration M1 CH2	um	0	96.66	29.00	1.61	102.26	39.55	-37.03	95.99	29.03	48.69	0.30	76.58
Endwinding Vibration M1 CH3	um	0	91.45	27.44	1.42	81.21	37.39	-35.20	90.90	27.47	46.12	0.30	72.59
Endwinding Vibration M1 CH4	um	0	91.54	27.49	1.41	77.54	37.43	-35.10	91.07	27.52	46.13	0.30	72.53
Endwinding Vibration M1 CH5	um	0	91.36	27.44	1.42	77.42	37.35	-35.08	90.91	27.47	46.05	0.30	72.43
Endwinding Vibration M1 CH6	um	0	91.72	27.49	1.43	77.57	37.38	-35.16	91.24	27.53	46.24	0.30	72.54
Endwinding Vibration M1 CH7	um	0	91.35	27.44	1.40	77.41	37.49	-35.09	90.79	27.47	45.99	0.30	72.58
Endwinding Vibration M1 CH8	um	0	91.24	27.40	1.41	77.31	37.37	-34.98	90.74	27.44	45.97	0.30	72.35

Table 19: Calculated Results with cursors results

8.2.2 FFT

The FFT view shows the spectrum of the Endwinding Vibration signal.

The handling of the visualization is done in the same way as the TIME view. Refer to the chapters before for details of the usage.

The visualization is separated into 3 parts:

Window Part	Description
Top	The Top Part contains the time selection of the shown dataset
Middle	In the middle the selected data is presented
Bottom	At the bottom of the window, calculated results are shown

Table 20: Separation of visualisation information

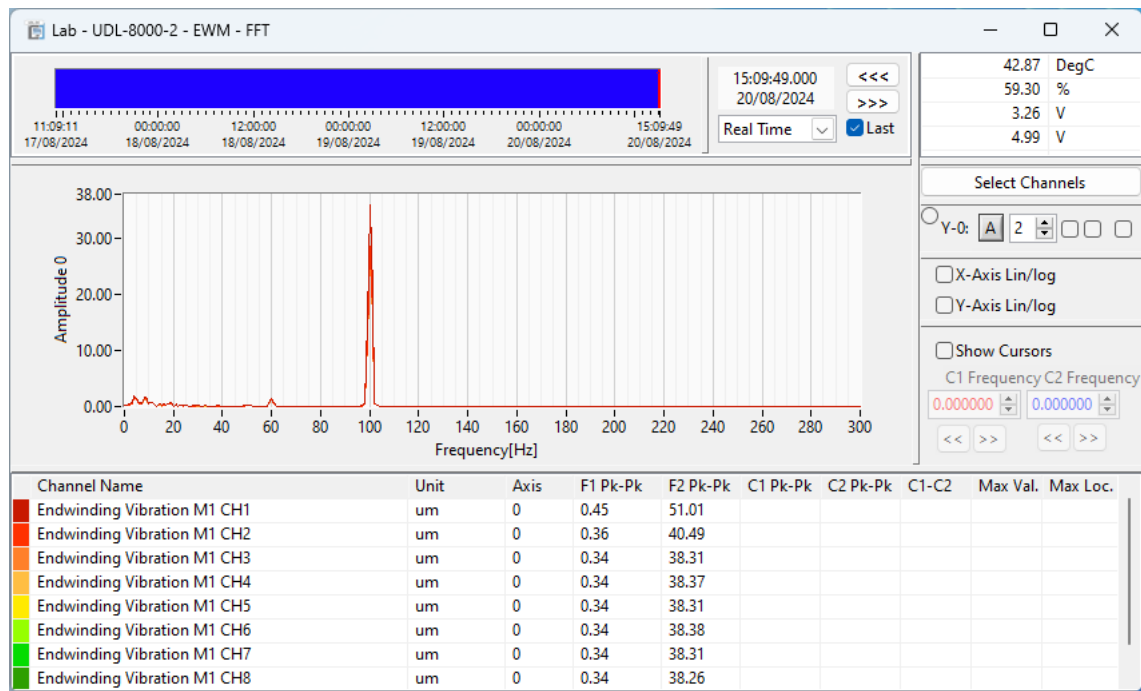


Figure 24: Spectrum of the Endwinding Vibration signal

8.2.3 Spectrogram

The spectrogram is used to show the Spectrum (FFT) over time.

The visualization is separated into 4 parts:

Window Part	Description
Top	The Top Part contains the time selection of the shown dataset range
Middle left	The Spectrogramm graph
Middle right	Color coding of the spectrogram, cursor activation
Bottom	Values at the cursor position

Table 21: Separation of visualisation information

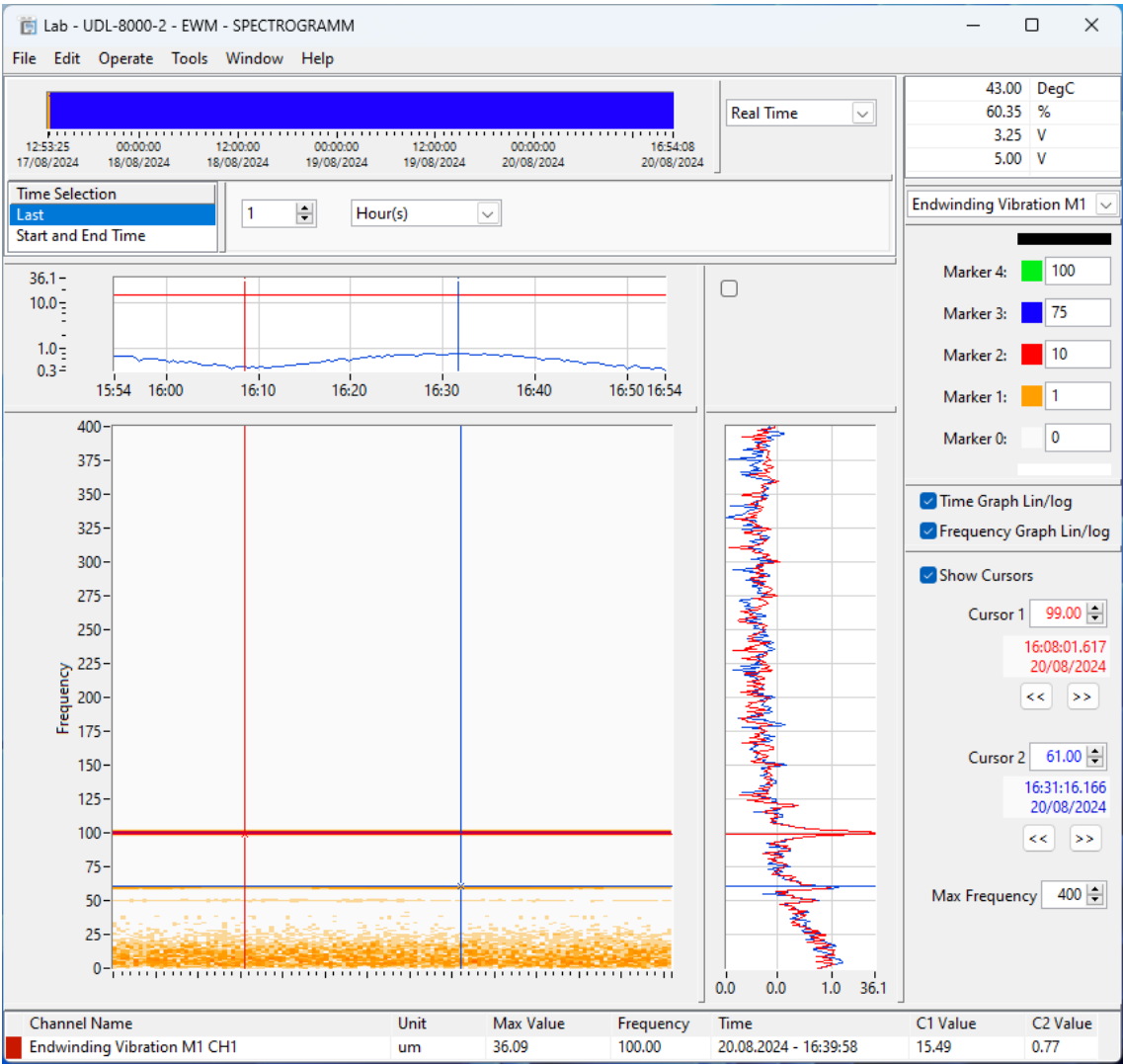


Figure 25: Spectrogram of the Endwinding Vibrations

8.2.3.1 Time Selection

The top blue bar, represents all the available data within the database, blue represents a dataset and at the times where no data is available the area is kept white.

Below the blue bar, 2 modes are available to select the data frame:

Parameter	Description
Last	Show the last x seconds/hours/days.
Start / End Time	Define a start and end time of the data

Table 22: List of Time selections

Under normal operation, the data is usually selected as last “week” or last “month” this is to show any progress over the measured values. Be aware when selecting large time frames, as every single FFT needs to be processed with the software, and long time range selection might take a long time to load.

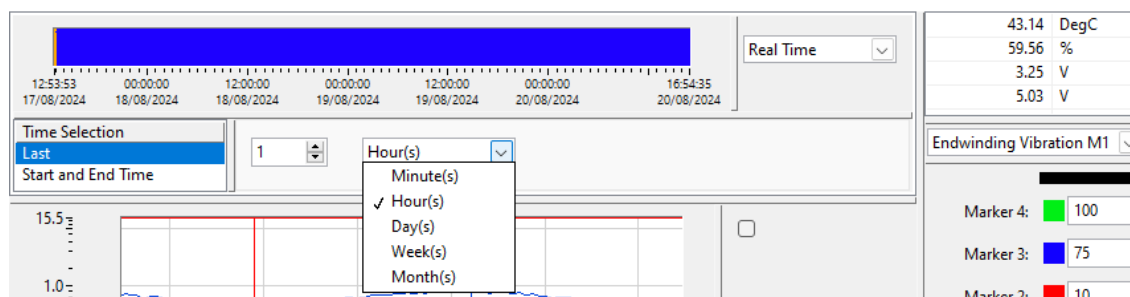


Figure 26: Time Selection - last

It is also possible to select a specific time range, by choosing “start and End time and further the timestamps

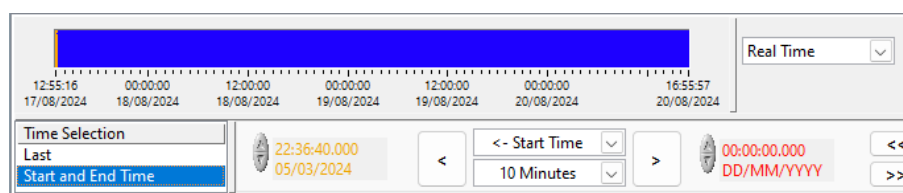


Figure 27: Time Selection – Start – End Time

Enter the times manually at the time stamp fields or use the cursor buttons to move the start or end times by the time defined within the pull down menu. Use the buttons at the very right to zoom in or out. It is also possible to select the timeframe by moving the cursors within the blue bar as shown below

8.2.3.2 Data Presentation

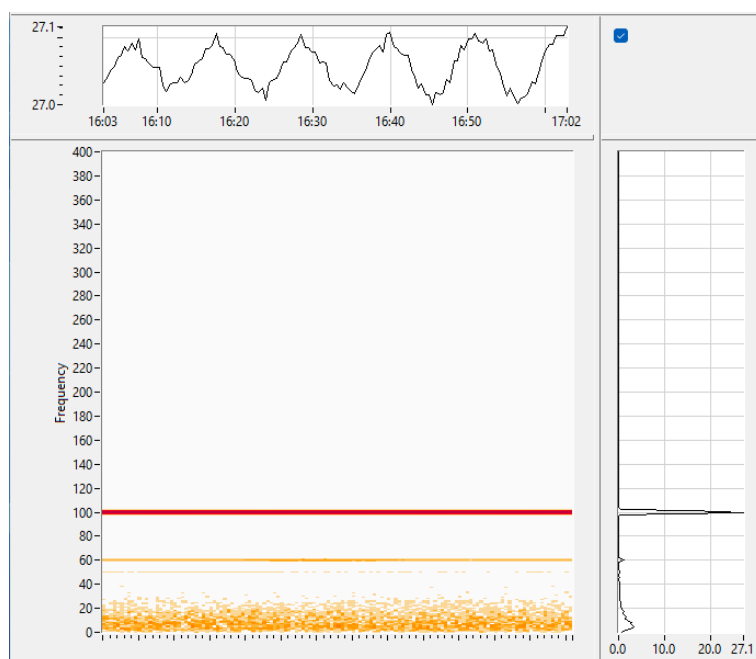


Figure 28: Spectrogram Data

In the center the spectrogram graph is shown, with the selected time range in the X-Axis and the frequency in the Y-Axis. The Z-Axis is shown in color and represent the amplitude.

At the top of the spectrogram, and additional graph is showing the overall enveloped signal over the entire time frame, while at the right side of the spectrogram, the overall envelope of all frequencies is shown.

At the top right side, the channel can be selected, choose between shaft voltage and shaft current.

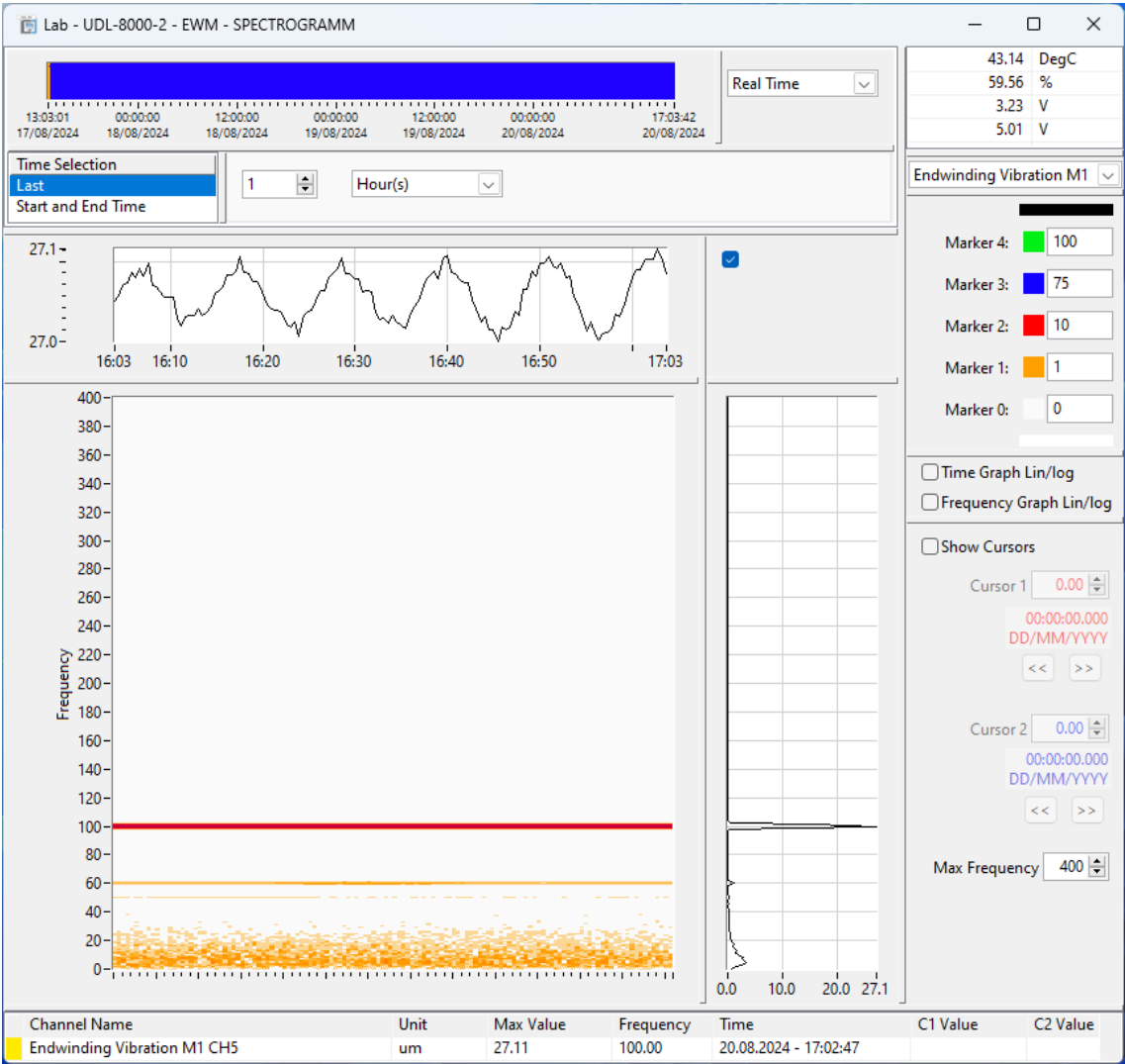


Figure 29: Selection of the channel

Below the channel selection the color coding of the spectrogram can be defined. Use the marker 0 up to Marker 4 to define the color and the associated value. Below and above the marker colors, two additional color bars are available. These are used to set a color of values outside the marker values.

Below the markers, the overall graphs at the top and the right can be configured for linear or logarithmic scale.

Below that, the cursors can be activated, there are 2 cursors available to read our values within the spectrogram

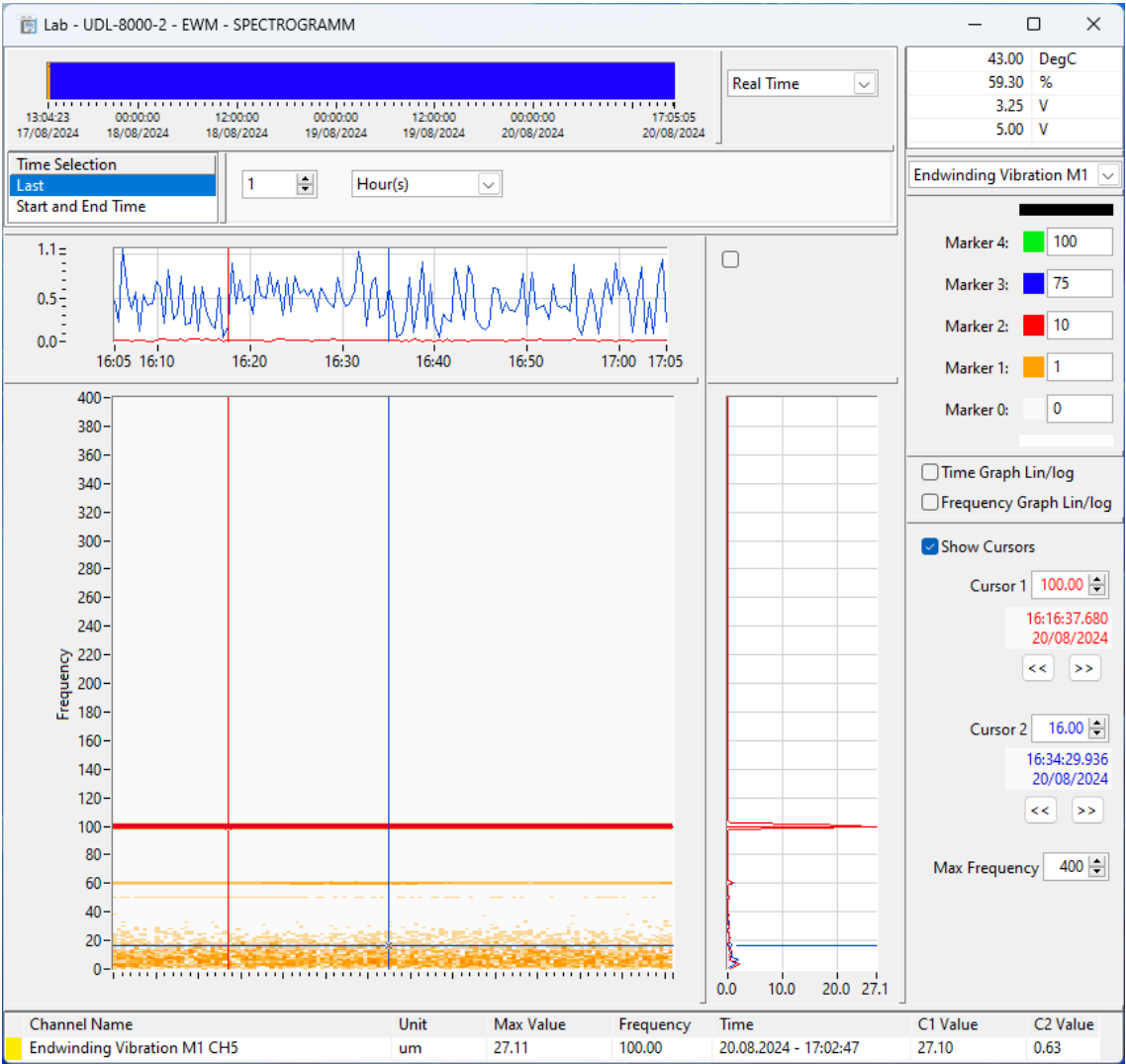


Figure 30: Using Cursors within the spectrogram

When the cursors are activated, the overall graphs at the top and at the right side of the spectrogram will show the information from the cursors

The “Max Frequency” will define the maximum frequency used for the calculation of the spectrogram.