DVS TECHNOLOGY GROUP

Process Monitoring with HRI® & HRIexpert®

Training overview

Day 1

- Machining procedures
- HRI® process monitoring
- HRI® parameters
- HRI® visualization
- Practical exercises

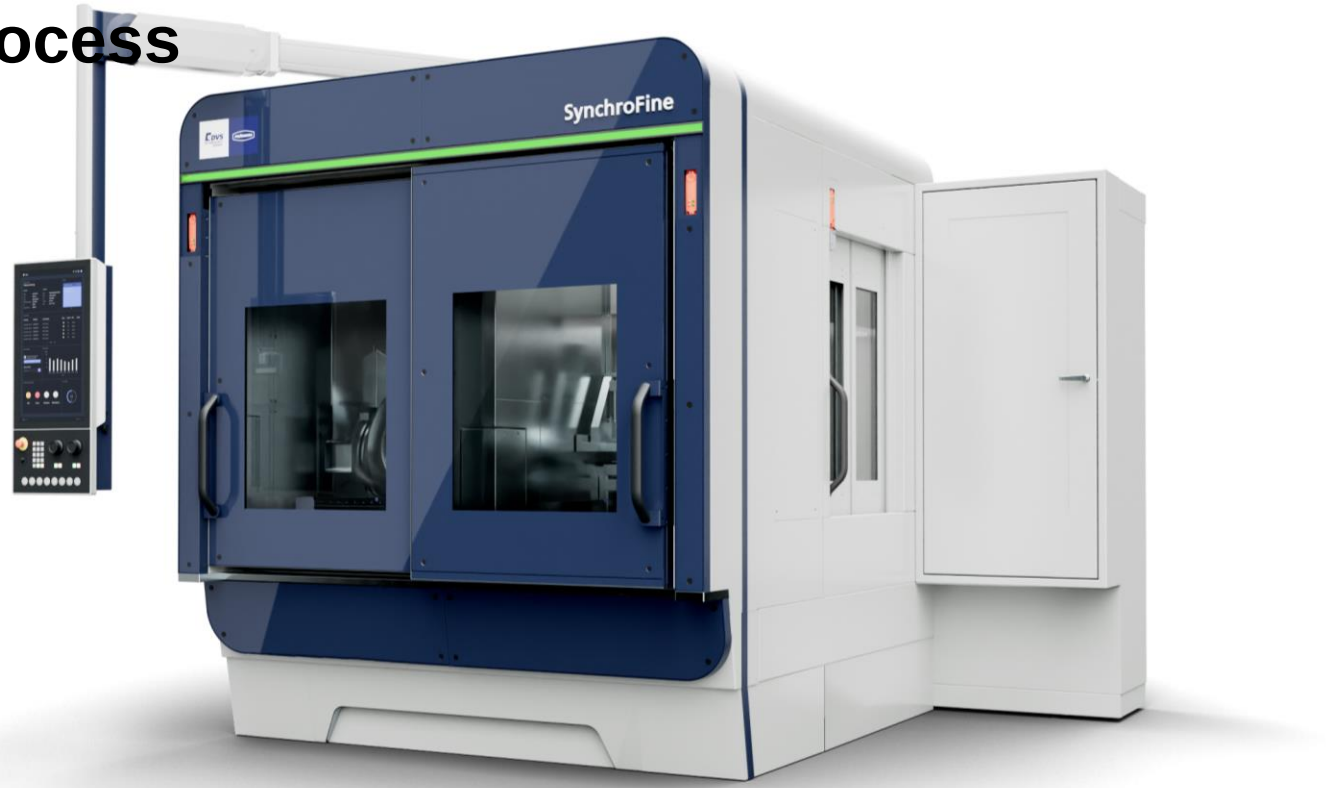
Day 2

- HRI® Settings
- Process Monitoring HRIexpert®
- HRIexpert® Visualization
- Practical Exercises

Day 3

- Software tool HRI® analyze+
- Joint data analysis
- Known phenomena
- Further development
- Index

Machining process gear honing Synchro Fine



Description – SynchroFine®

The **high-performance gearing honing machine SynchroFine®** is a self-loading machine which picks up the workpiece using the clamping system, aligns this electronically, checks the tolerance range and moves the work-piece into the machining station. The machine works using the hobbing method.

By utilizing individual drives, the machine is excellently adapted to the requirements of tooth honing. The angular and linear adjustment possibilities allow the tool to be adjusted continuously to the workpiece.

The feed rate of the workpiece axes is continuously adjustable, allowing it to be adapted optimally to the respective workpiece, the material thickness to be removed and the respective tolerance range of the toothing as well as to the material. The position and speed of the feed axes can be freely programmed by the user as an NC axis.

Short machining times and the automatic loading system make the machine particularly suitable for use as an automatic processing unit for large quantities.

As standard, the machine is equipped with a CNC control made by Bosch Rexroth MTX as well as with a SERCOS interface. Error messages are displayed in plain text on the CNC monitor, and language can be selected.

The drive torques of tool and workpiece are designed for an operationally safe and high performance of the machine.

A tailstock can be used during the machining of long workpieces It stabilizes the workpiece and permits oscillation of the Z-axis without becoming loose from the workpiece.

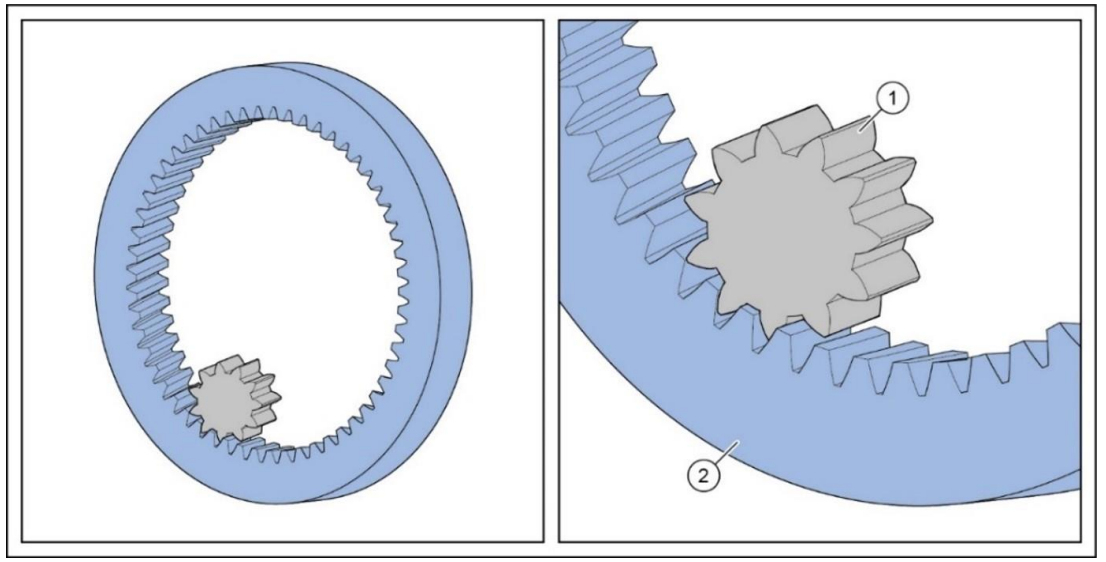
Machining process gear honing

Honing is based on a relative movement caused by the cross-axis angle between a helical or straight-toothed workpiece (1) and a helical-toothed tool (2) in the meshing area.

The speeds of the tool and the workpiece are proportional to their respective numbers of teeth.

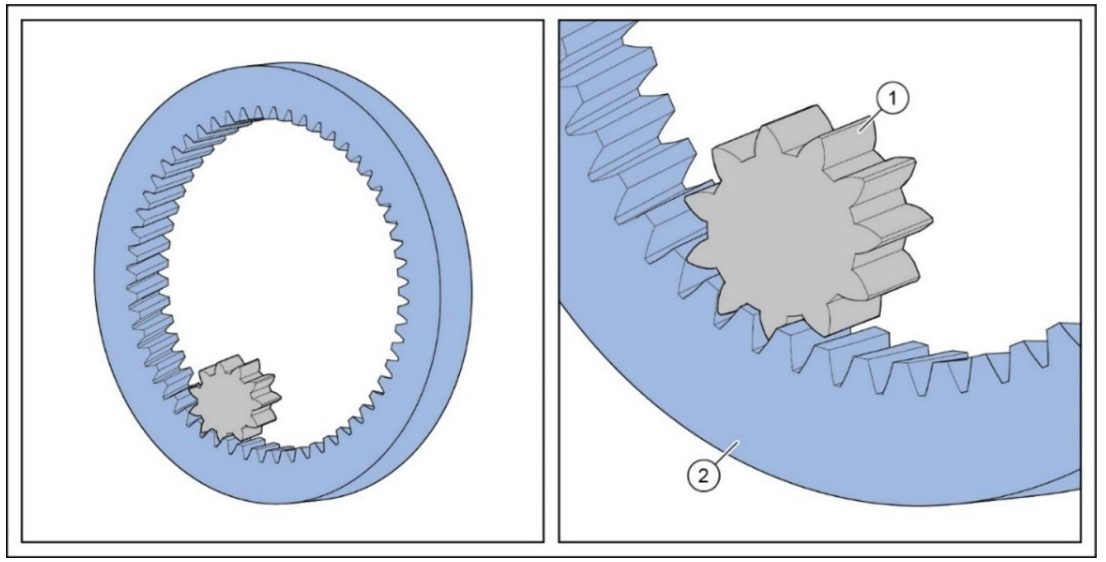
(1) Workpiece

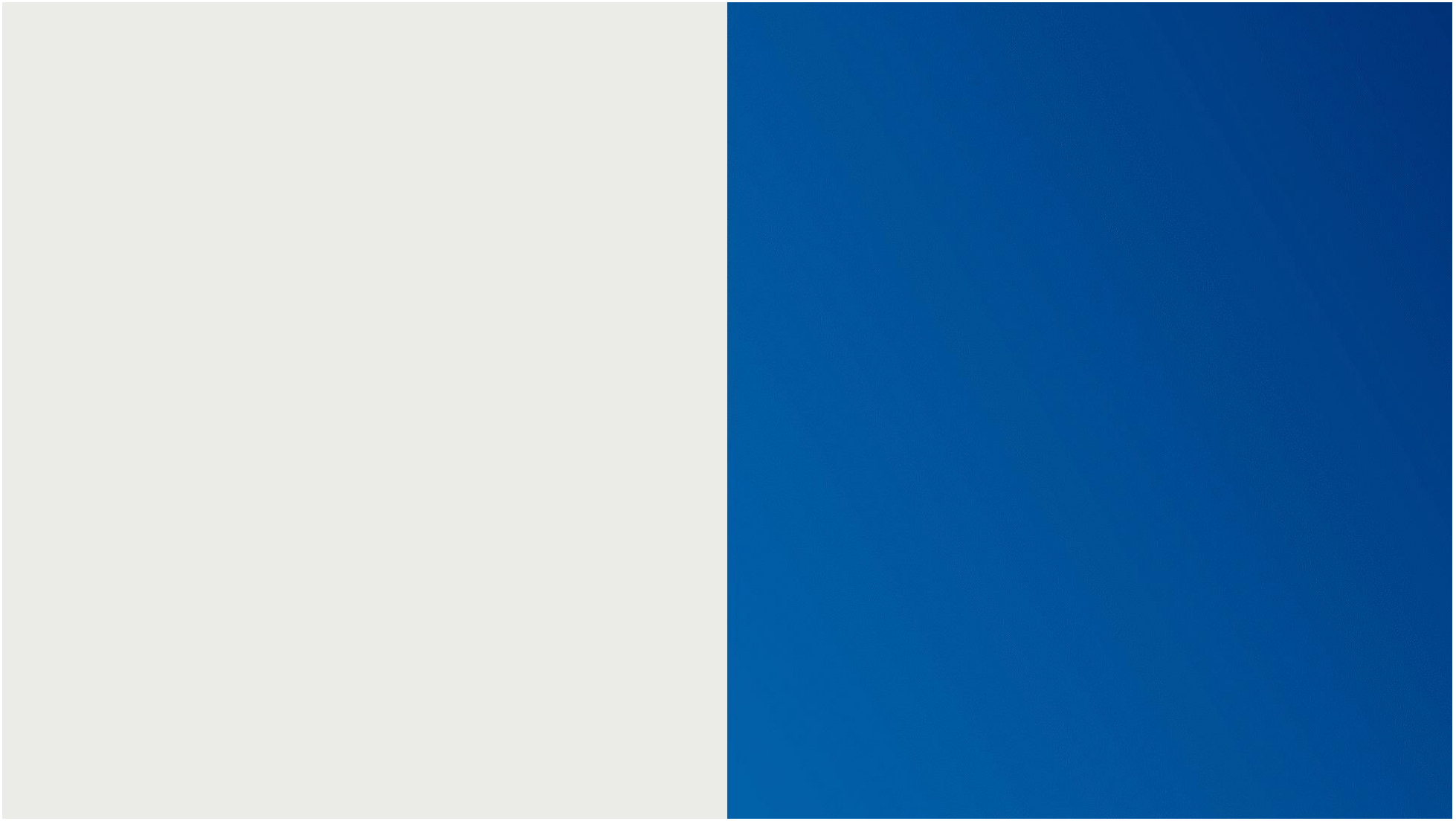
(2) Honing ring tool



Machining process gear honing

The depth of cutting on both tooth flanks is specified precisely through a continuous, precisely defined rotational speed displacement in both positive and negative direction. The direction of rotation does not change during machining of the two tooth flanks. Workpieces whose tooth width exceeds the width of the honing tool can be machined over their whole width if an oscillation movement of the Z axis is also incorporated.





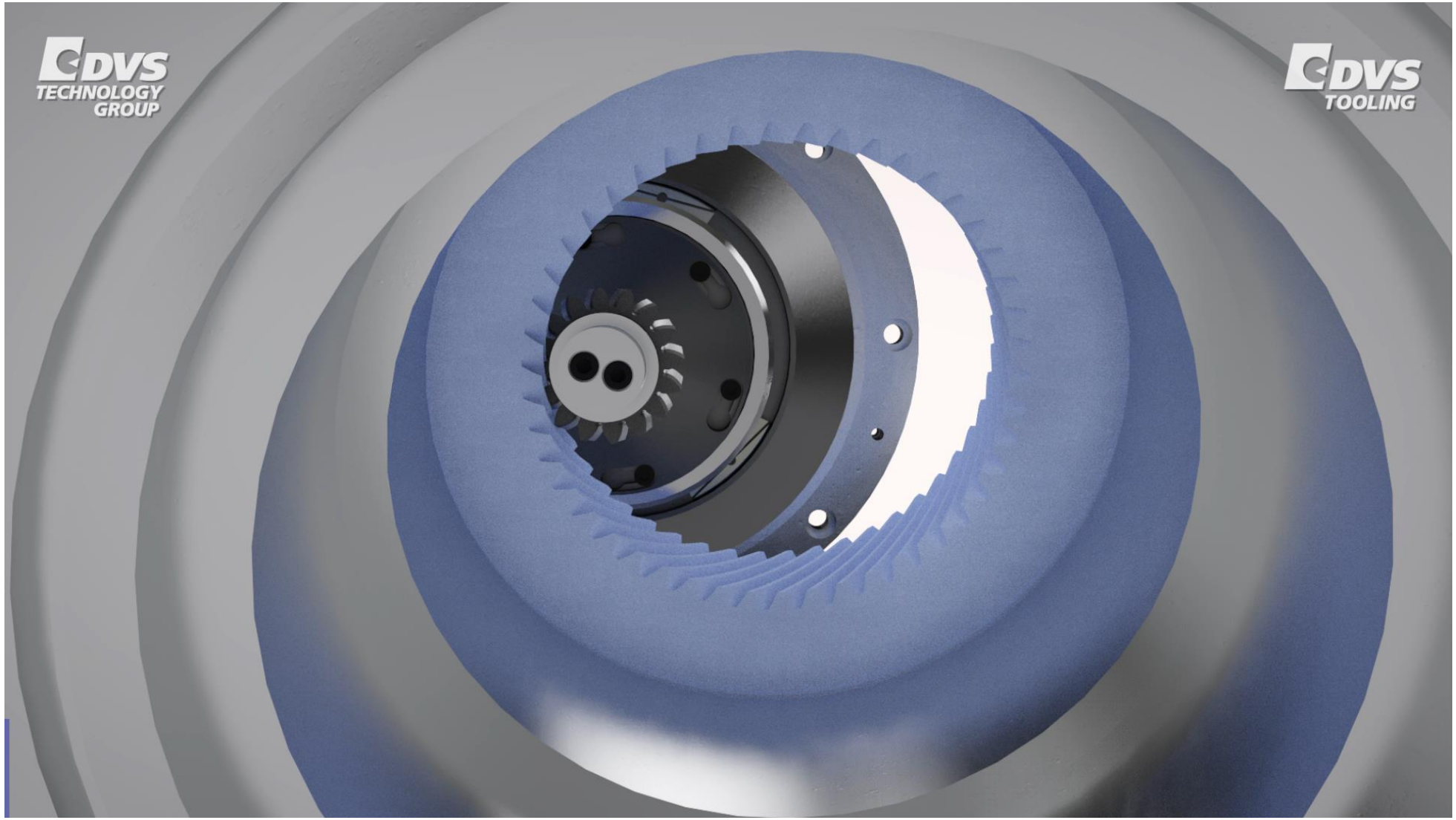
Machining process Dressing the tool

Two dressing tools are available in a magazine for correcting tool wear (honing ring). These tools are collected by the clamping fixture in separate intervals and fed into the honing tool. The tooth flanks and the head area of the tool are dressed separately.

Due to the tool wear, the final dimension of the honed parts changes continuously. The size of the tolerance range for the gearing defined in the drawing deter-mines the dressing frequency.

Experience shows that a dressing process is required every 40 - 50 workpieces. This interval is stored in the automatic program and is followed until an approximate 5 mm increase in the honing ring diameter has been reached. The tool change is then indicated on the display.

Approx. 0.1 mm is worked off the tool per dressing cycle. This is automatically followed by a program correction of the axial distance.



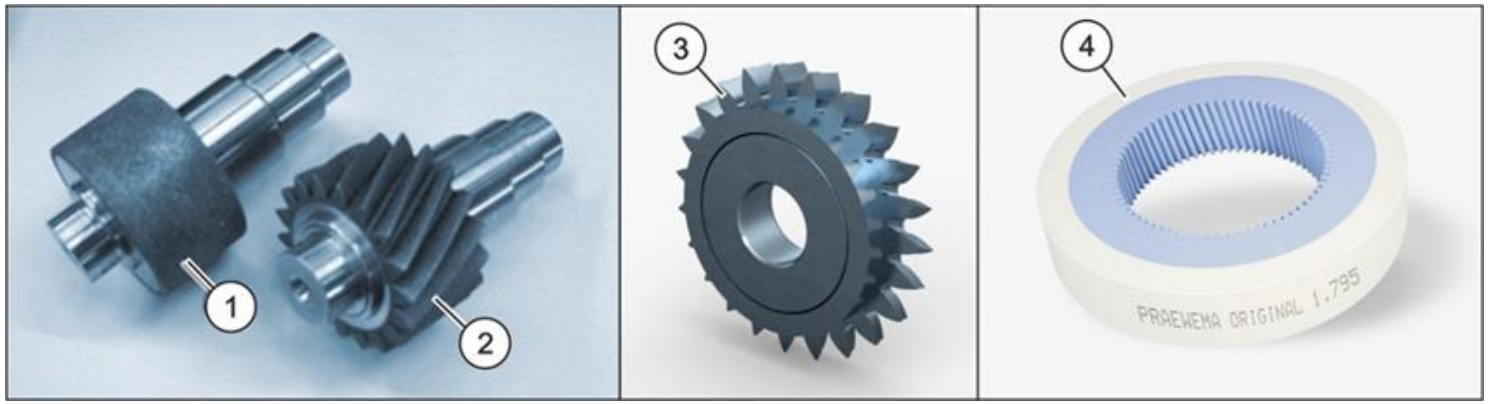
Machining process gear honing

1 Head dresser - Diamond Dressing Ring (DDR)

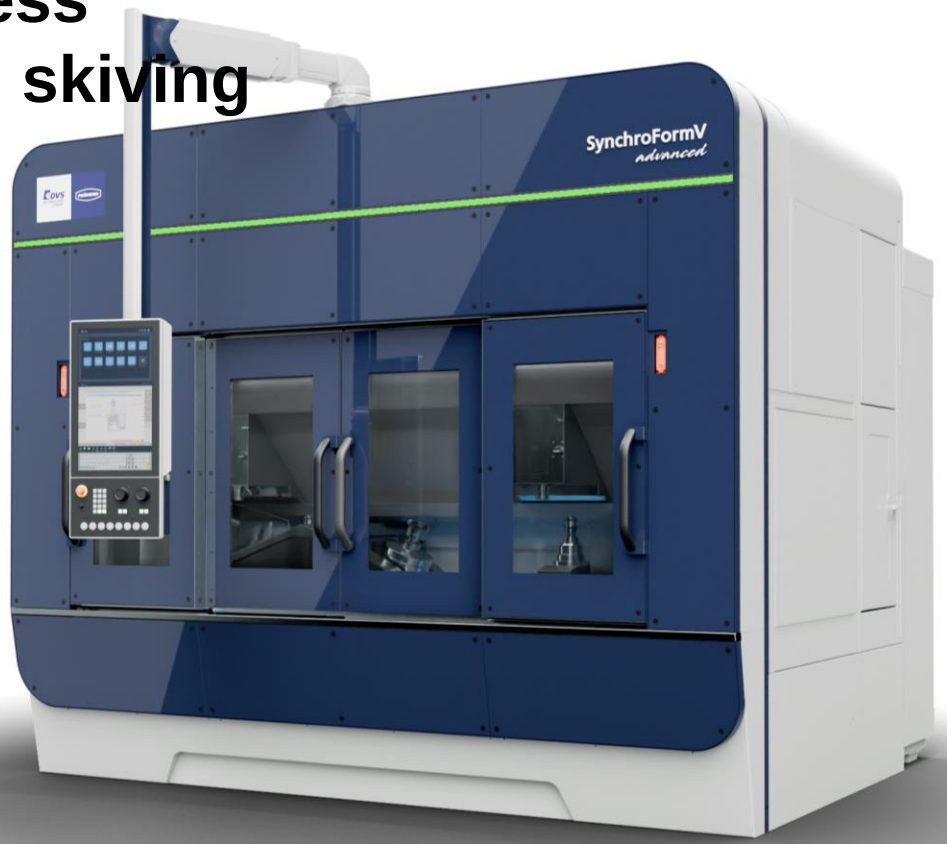
2 Gearing dresser - Diamond Dressing Gear (DDG)

3 Gearing dresser - Vario Speed Dresser (VSD)

4 Ceramic honing ring



Machining process gear honing and skiving Synchro Form



Description – Synchro Form

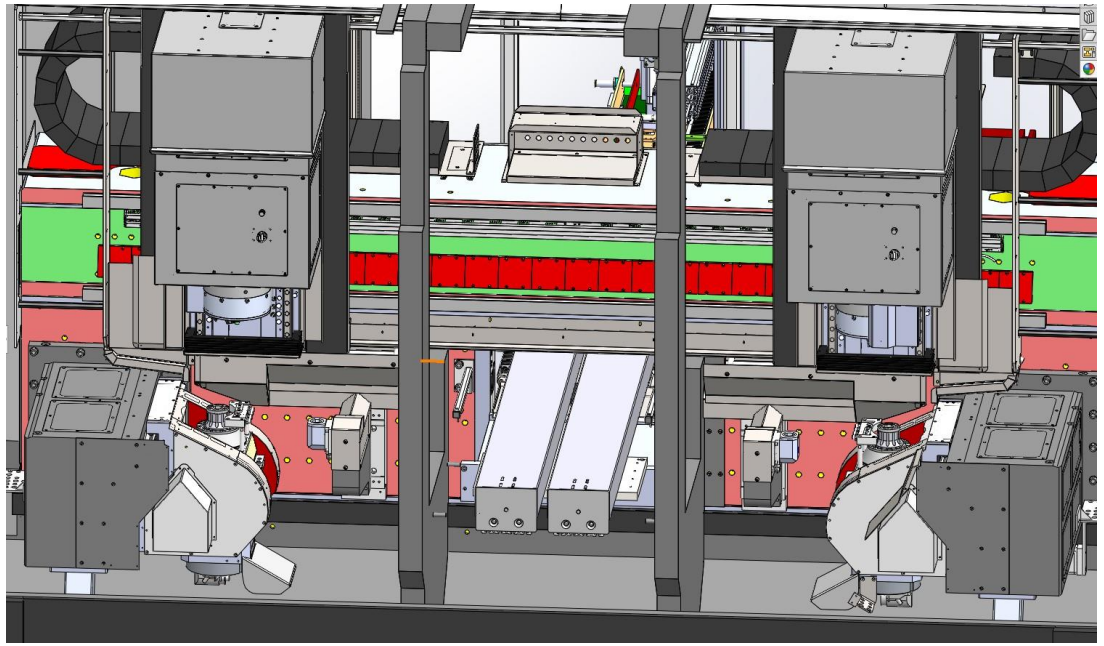
The **CNC gearwheel finishing machine type SynchroForm®** has been designed for making gears and subsequent deburring.

The machine is loaded/unloaded by the shuttle fitted in the center. On the shuttle carriage the workpiece raw part and finished part racks are mounted. There are two shelves on the shuttle for the dressing tools for internal honing.

The machine has the symmetric structure.

For machining the toothing of the workpieces, one power skiving module each is placed on the left and right outside. Two disk-type turrets are permanently installed next to each of the power skiving modules for deburring the workpiece.

The two workpiece spindles are equipped with a suitable seat flange for holding a chucking device. The workpiece spindles are electronically coupled to the milling spindles.



Work sequence – Synchro Form

Various machining processes such as skiving (soft machining) and internal gear honing and hard turning (hard machining) are carried out on the machine.

The raw parts are separated on the conveyor belt in the machine to the pickup position. A gantry with two grippers for raw and finished parts is mounted on the loading portal. The blank gripper takes the workpiece from the pick-up position on the conveyor belt, moves it to the shuttle and places it on the blank tray. The shuttle moves forward with the raw part into the machining area of the machine. The two workpiece spindles alternately move to the blank and finished part storage areas on the shuttle carriage and take over or transfer workpieces to the storage areas.

Soft processing:

- The respective workpiece spindle takes the blank from the blank storage on the shuttle and clamps it externally.
- The workpiece spindle moves with the workpiece for skiving to the skiving module for skiving the gearing.
- Then to the turning station to remove the resulting burr.
- After machining, the respective workpiece spindle with the finished part moves back to the pick-up position on the shuttle and transfers the finished part to the finished part storage.

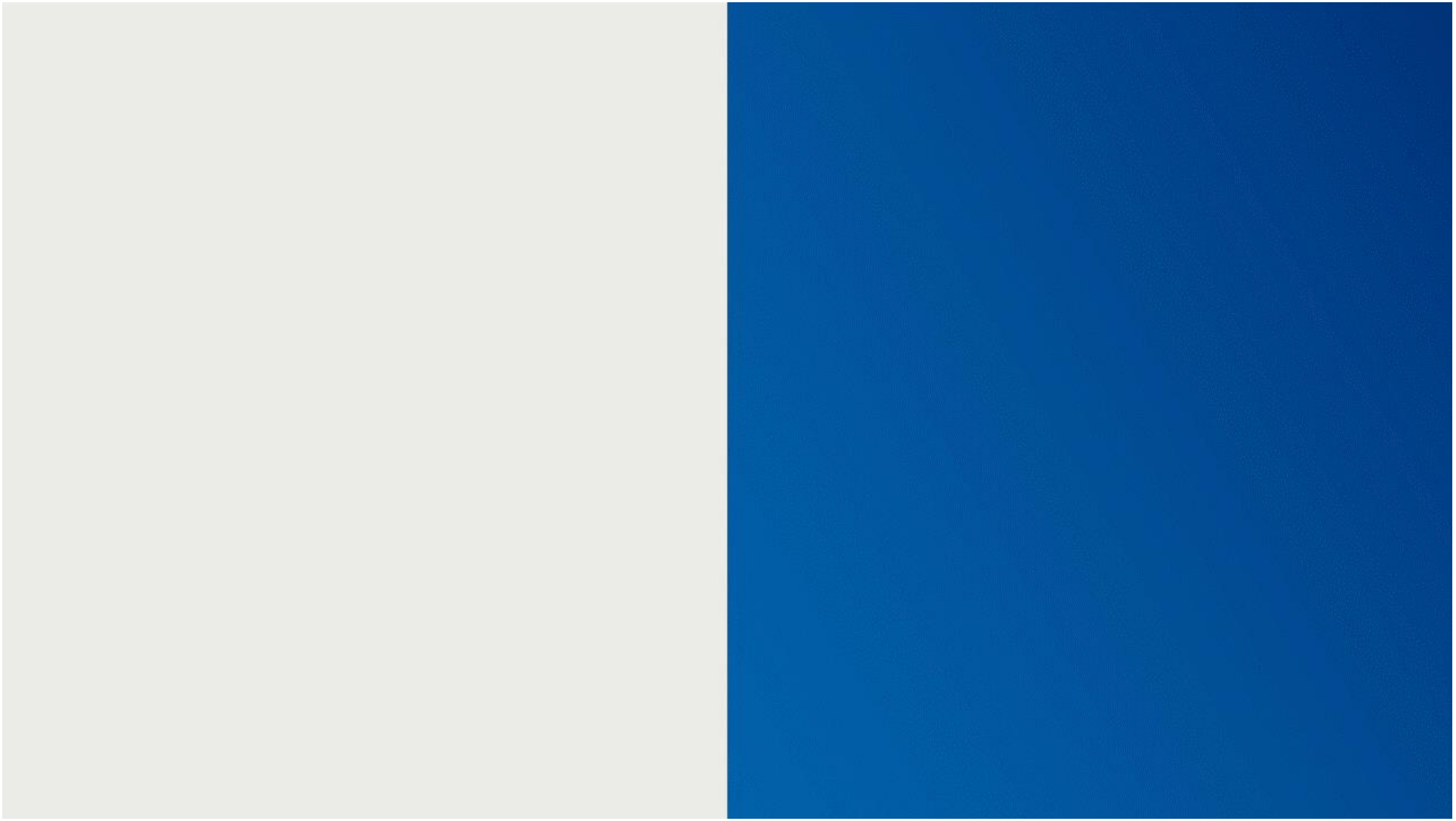
Work sequence – Synchro Form

Hard machining:

- The workpiece spindle C1+C2 takes the hardened workpiece, clamps it on the outside and moves it to the positioning device. There the gearing is centered on an initiator.
- The workpiece spindle moves with the raw part to the rollchecker. Here the raw part is checked using a two-flank rolling test to see whether it meets the requirements.
- Internal honing of the internal gearing takes place on the gear skiving module.
- The workpiece spindle moves with the workpiece to the turning station for hard turning of the inner seat.

After machining, the respective workpiece spindle moves with the finished part back to the pick-up position on the shuttle carriage and transfers the finished part to the finished part storage.

The shuttle carriage moves the finished part out of the machine to the rear. The gripper of the loading gantry takes the finished part from the rest of the shuttle carriage, moves it to the conveyor belt and places it on an empty pallet. The conveyor belt continues to cycle.



Process monitoring HRI®

Process monitoring HRI®

What does HRI® mean?

HRI® stands for Hybrid Reactive Index.

HRI® reflects the process in a value.

An index that is created by combining three process parameters using a formula. This index enables a unitless representation of the process.

HRI® reflects the hole process in a value.

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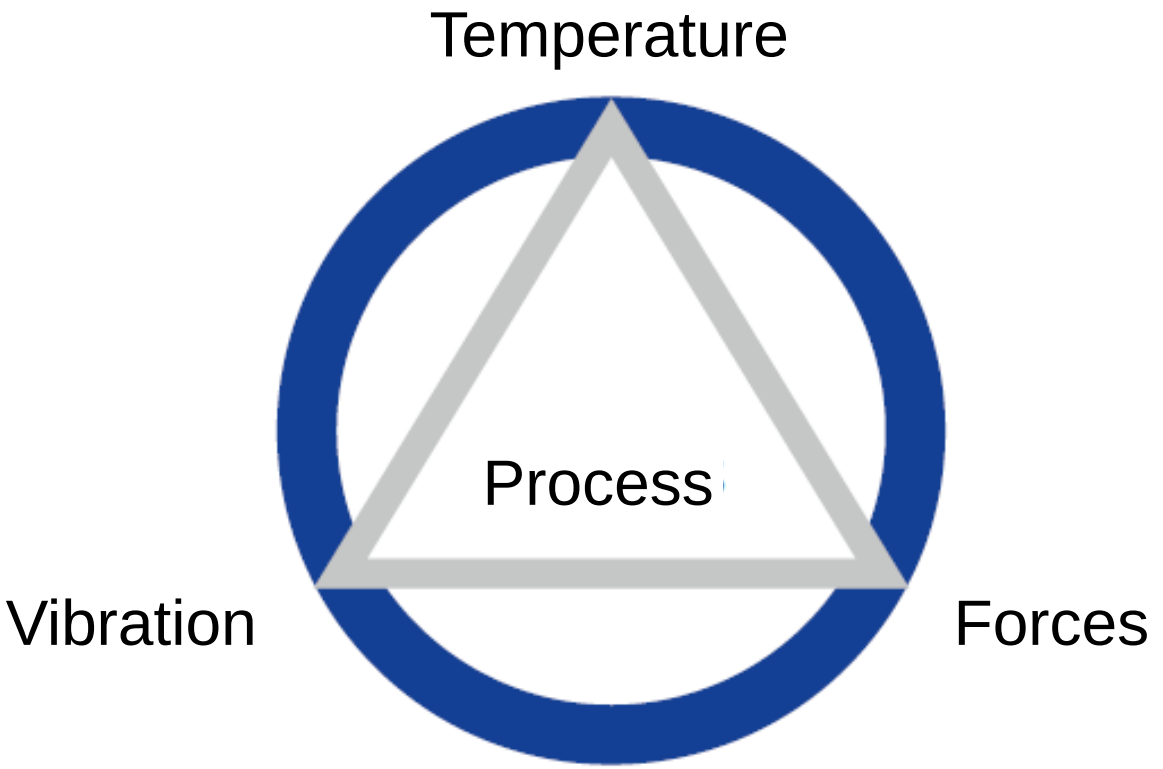


Process monitoring HRI®

What offers HRI®?

The HRI® process monitoring system provides comprehensive control over every step of the machining process.

Separate limits can be defined for each process step, each axis and each sensor.

By implementing the extended status, limit violations and error reactions are displayed in plain text on the HMI.

A feed limiter allows precise process control.

Component identifiers, such as data matrix codes, can also be recorded for efficient tracking.

What should be done with HRI®?

The implementation of HRI aims to use only high-quality parts (no raw or bad parts) in assembly to ensure a trouble-free production process.

The application also includes the early detection of tool breakages and the continuous monitoring of process and input quality.

The implementation of preventive maintenance ensures that potential problems are proactively addressed and rectified.

Development HRI

2017

HRI 1.0
Fully integrated into the
HoningHMI interface

2019

HRI 2.0 HRIanalyze+
HRI is a stand-alone app.
Recording of
vibration spectra
HRIanalyze+ analysis tool

2022

HRI 3.0
HRI works as a
web application

2025

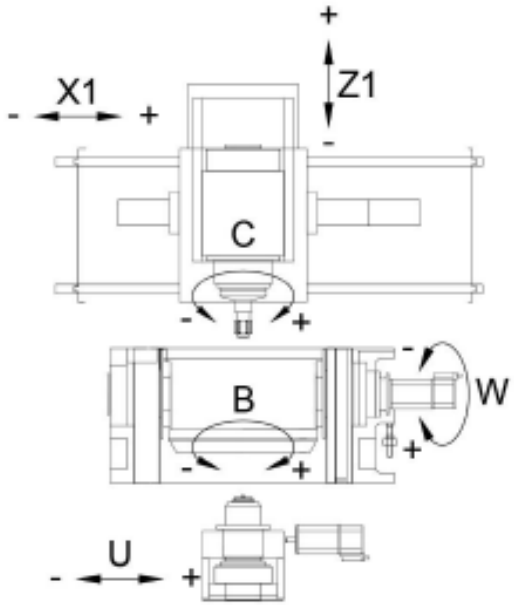
HRI®satellite
DVSEdge with web panel
as retrofit kit for
older machines
HRIanalyze
as a web application

Process monitoring HRI®

With this process values is the HRI® calculated?

Synchro Fine:

- Temperature from the B - axis und C - axis
- Current / forces from the B - axis, C - axis, X - axis and Z - axis
- Values from the vibration sensor B - axis, C - axis and U - axis.

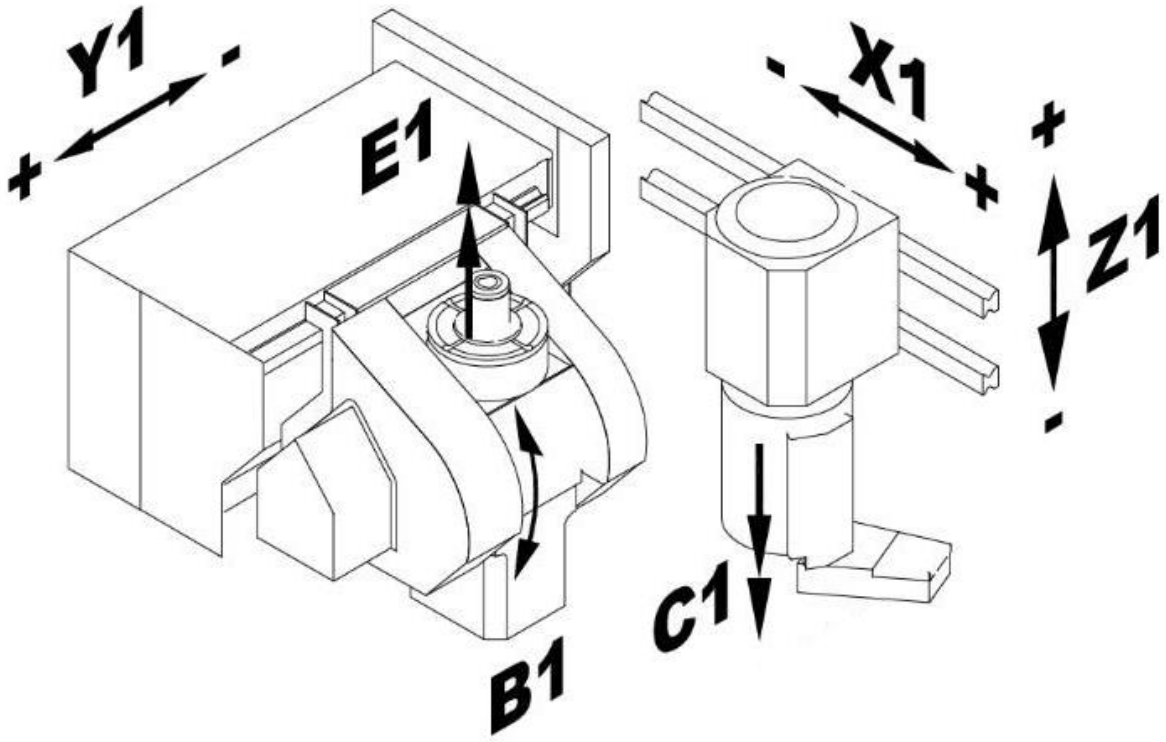


Process monitoring HRI®

With this process values is the HRI® calculated?

Synchro Form:

- Temperature from the C – axis und E – axis
- Current / forces from the C – axis and E – axis [X – axis, Y - axis (skiving) and Z – axis in process]
- Values from the vibration sensor C – axis and E – axis.



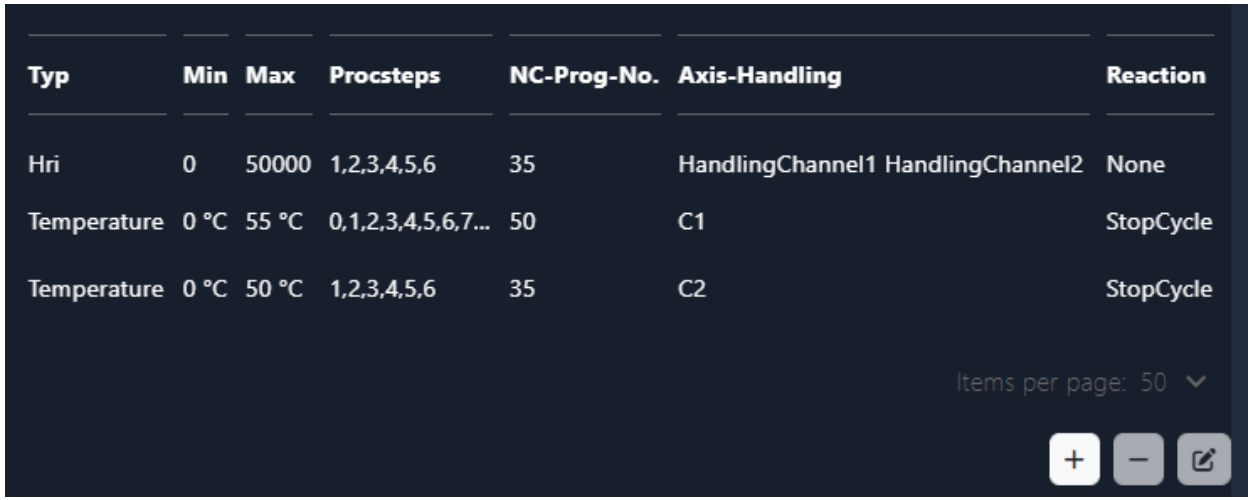
HRI® values

HRI® values

Temperature

The temperature can be monitored. Changes in the temperatures of the tool spindle (B axis or E axis) and the workpiece spindle (C axis) have a negative effect on the quality of the workpieces. The higher temperatures cause a change in the length and height of the spindles.

The temperature sensors are installed in the motors and the individual values are provided as parameters by the BOSCH Rexroth control or the Siemens control.



Typ	Min	Max	Procsteps	NC-Prog-No.	Axis-Handling	Reaction
Hri	0	50000	1,2,3,4,5,6	35	HandlingChannel1 HandlingChannel2	None
Temperature	0 °C	55 °C	0,1,2,3,4,5,6,7...	50	C1	StopCycle
Temperature	0 °C	50 °C	1,2,3,4,5,6	35	C2	StopCycle

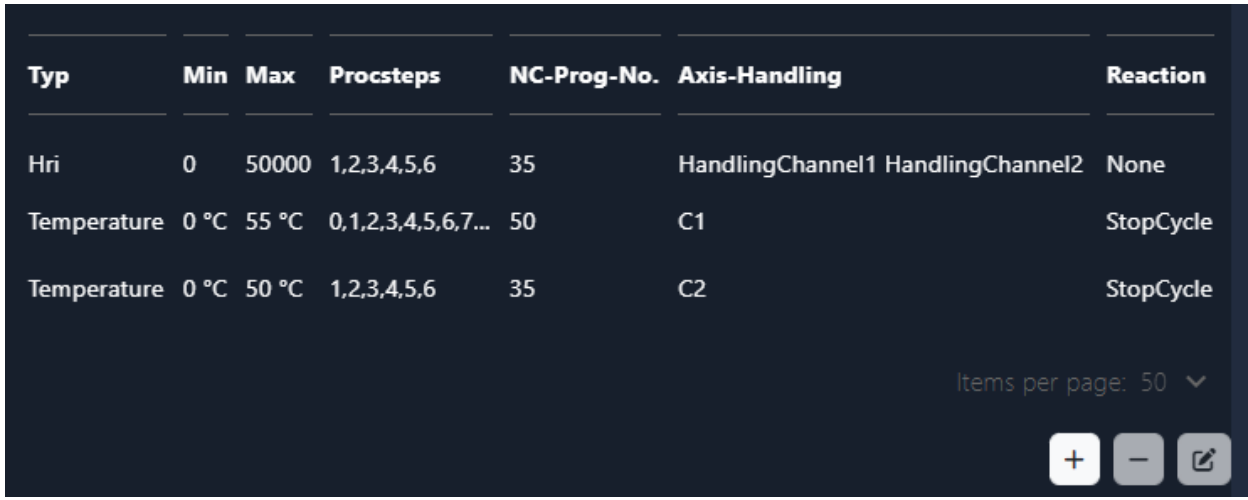
Items per page: 50

HRI® values

Temperature

The temperature can be monitored individually. If the set value is exceeded, the corresponding error response is triggered.

In the example, the machine is stopped with "StopCycle" if the limit value of 50°C or 55°C is exceeded.



Typ	Min	Max	Procsteps	NC-Prog-No.	Axis-Handling	Reaction
Hri	0	50000	1,2,3,4,5,6	35	HandlingChannel1 HandlingChannel2	None
Temperature	0 °C	55 °C	0,1,2,3,4,5,6,7...	50	C1	StopCycle
Temperature	0 °C	50 °C	1,2,3,4,5,6	35	C2	StopCycle

Items per page: 50

HRI® values

Temperature at HRI®

An offset is subtracted from the recorded values and then squared. Temperature changes are considered more.

Typ	Min	Max	Procsteps	NC-Prog-No.	Axis-Handling	Reaction
Hri	0	50000	1,2,3,4,5,6	35	HandlingChannel1 HandlingChannel2	None
Temperature	0 °C	55 °C	0,1,2,3,4,5,6,7...	50	C1	StopCycle
Temperature	0 °C	50 °C	1,2,3,4,5,6	35	C2	StopCycle

Items per page: 50

HRI® values

Currents / forces

The current values are recorded from the axes that are involved in the process. These correspond to the process forces. The individual values are summed up squarely. In this way a better signal / noise ratio is achieved.

The current values are provided as parameters by the BOSCH Rexroth control or the Siemens control. The values are percentages of the nominal current.

Typ	Min	Max	Procsteps	NC-Prog-No.	Axis-Handling	Reaction
Hri	0	50000	1,2,3,4,5,6	35	HandlingChannel1 HandlingChannel2	None
Force	0 %	120 %	3,7,4,10,9	50	C1,C2	StopCycle
ForceAvg	20	60	1,2,3,4,5,6	35	X2,Z2	SPC

Items per page: 50

HRI® values

Currents / forces

In addition to recording the individual forces, HRI also offers the option of monitoring the average value of these forces. This average value is calculated at the end of the machining process and enables monitoring of both a minimum and a maximum range.

This monitoring is crucial in order to identify any deviations in force behavior during the process and to react at an early stage if necessary.

Typ	Min	Max	Procsteps	NC-Prog-No.	Axis-Handling	Reaction
Hri	0	50000	1,2,3,4,5,6	35	HandlingChannel1 HandlingChannel2	None
Force	0 %	120 %	3,7,4,10,9	50	C1,C2	StopCycle
ForceAvg	20	60	1,2,3,4,5,6	35	X2,Z2	SPC

Items per page: 50

HRI® values

Currents / forces

However, it is important to note that there is no direct contact between the workpiece and the tool at the start of the machining process. In this phase, monitoring for an absolute minimum value would not make sense, as this does not provide any meaningful information.

The absolute minimum value at the beginning does not differ from the value that would occur after a tool breakage. It is therefore advisable to activate monitoring for an average value.

Typ	Min	Max	Procsteps	NC-Prog-No.	Axis-Handling	Reaction
Hri	0	50000	1,2,3,4,5,6	35	HandlingChannel1 HandlingChannel2	None
Force	0 %	120 %	3,7,4,10,9	50	C1,C2	StopCycle
ForceAvg	20	60	1,2,3,4,5,6	35	X2,Z2	SPC

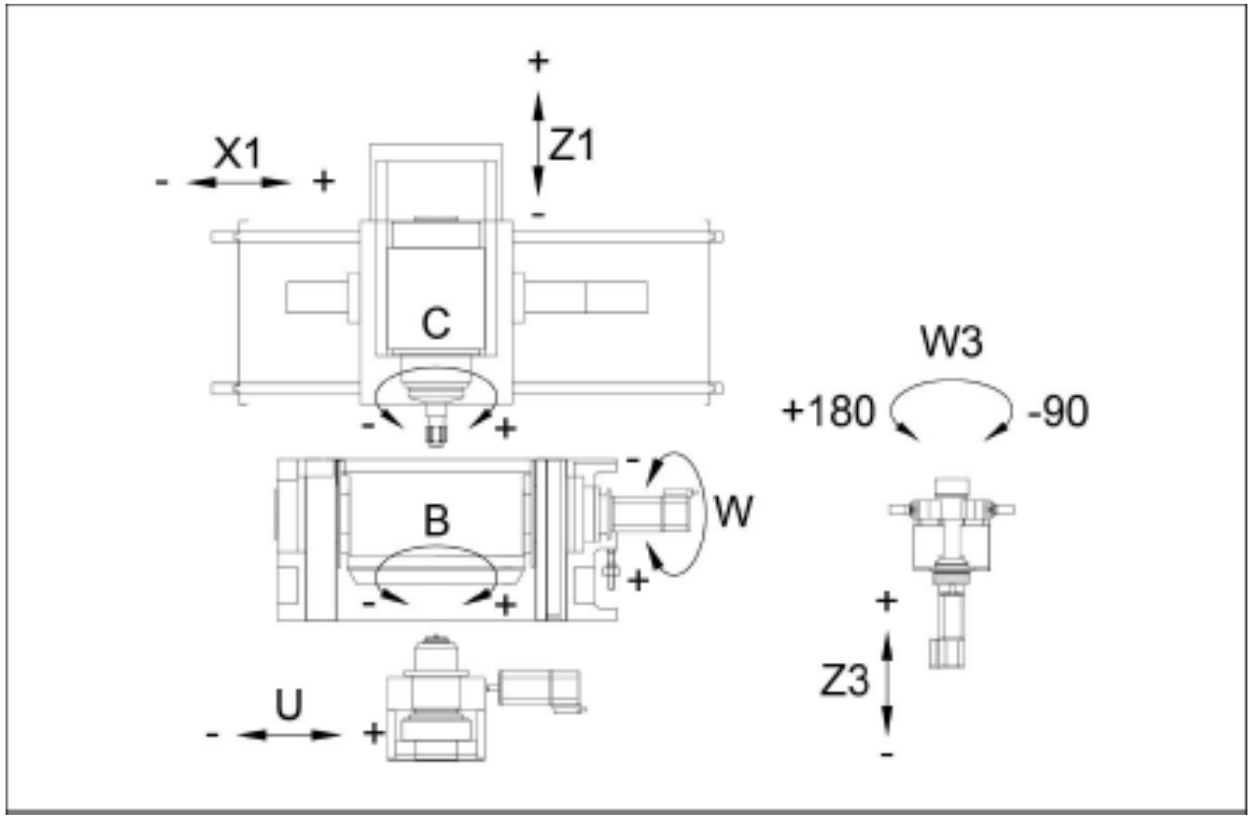
Items per page: 50

HRI® values

Currents / forces - Synchro Fine

From the following axis are the forces measured at the Synchro Fine machines:

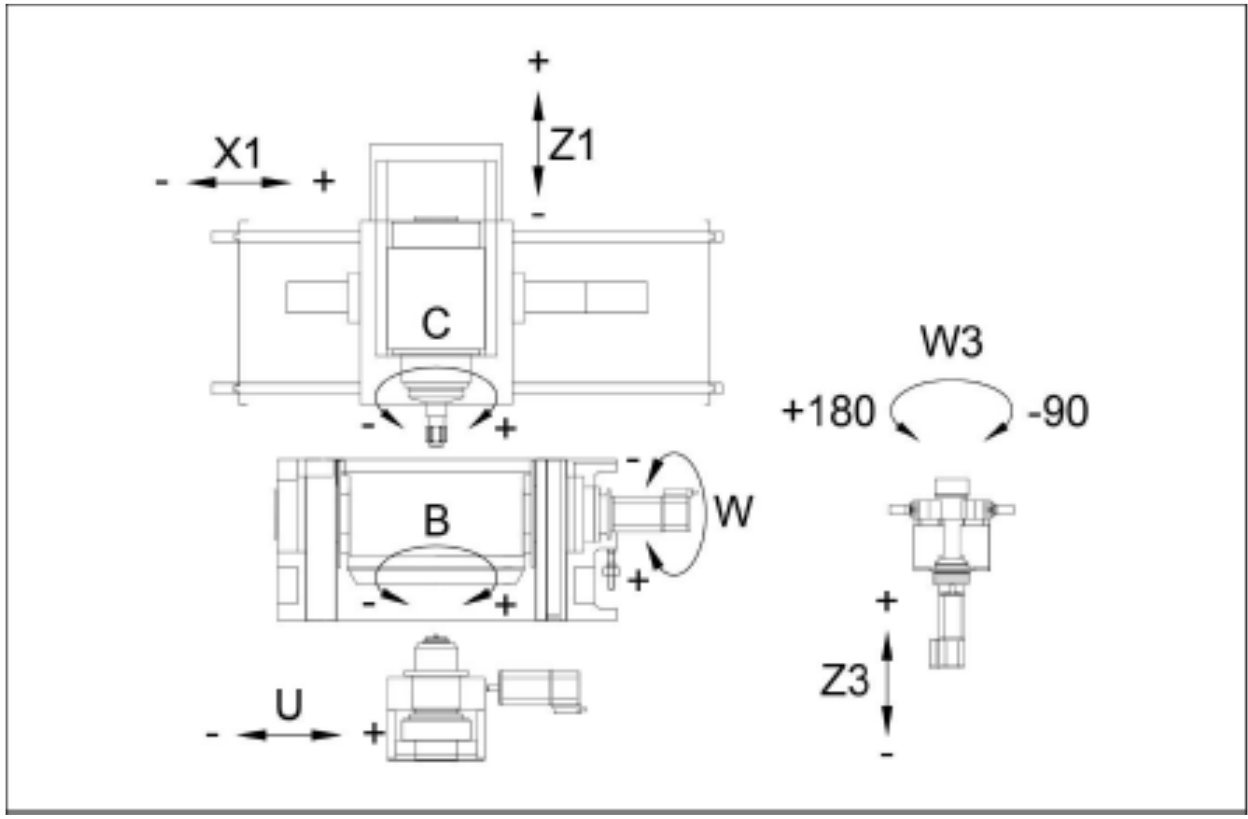
- B-axis (Tooling spindle)
- C-axis (Workpiece spindle)
- X-axis (infeed axis)
- Z-axis (oscillating axis)



HRI® values

Currents / forces - Synchro Fine

It is possible that the motors may be briefly overloaded, e.g. during acceleration. With Bosch Rexroth controllers, measured values can exceed 100%. The spindles can be overloaded up to 350% and the linear axes up to 450%.



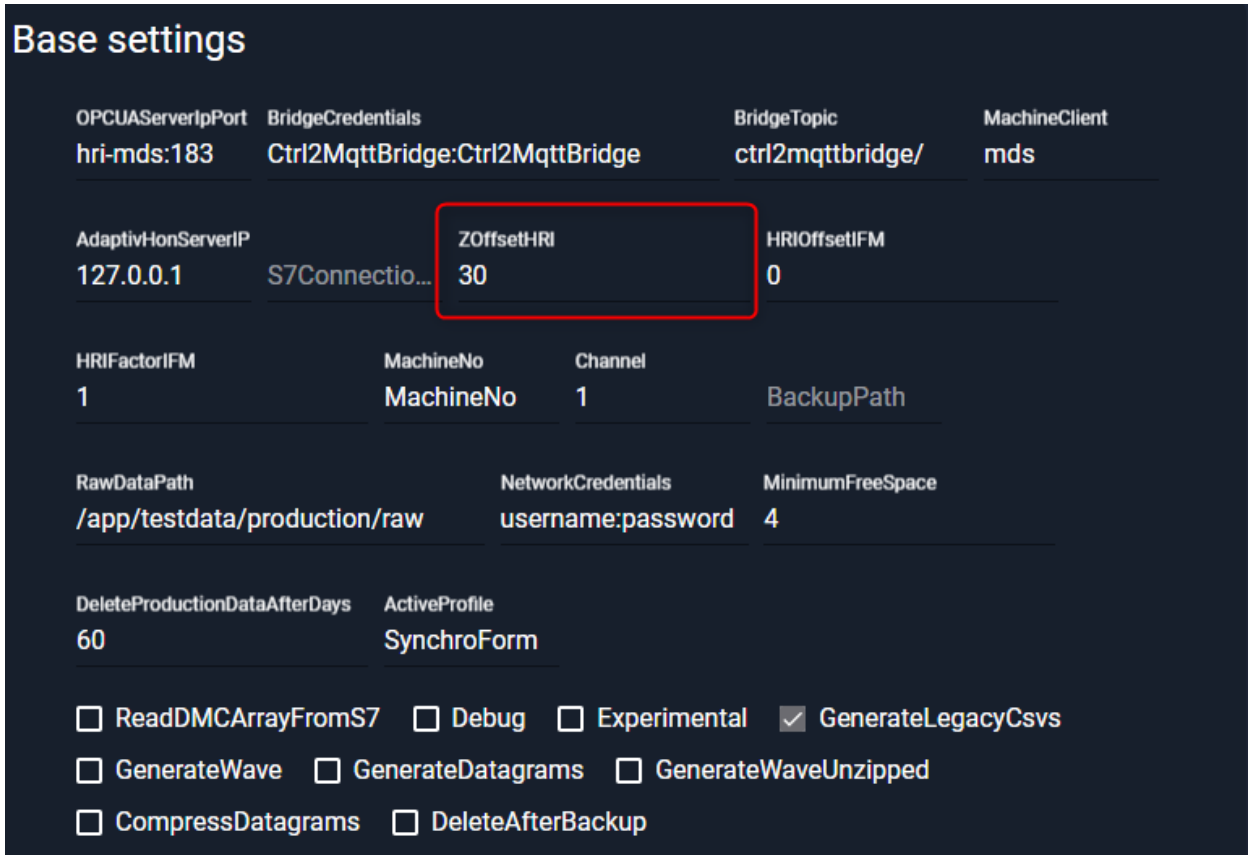
HRI® values

Currents / forces - Synchro Fine

By machines with activated tailstock HRI® calculated an Offset from 30%.

Because tailstock and Z-axis working against each other. The operation grade from machines with activated tailstock is about 30% higher than machines without tailstock.

The offset is adjustable in the settings.

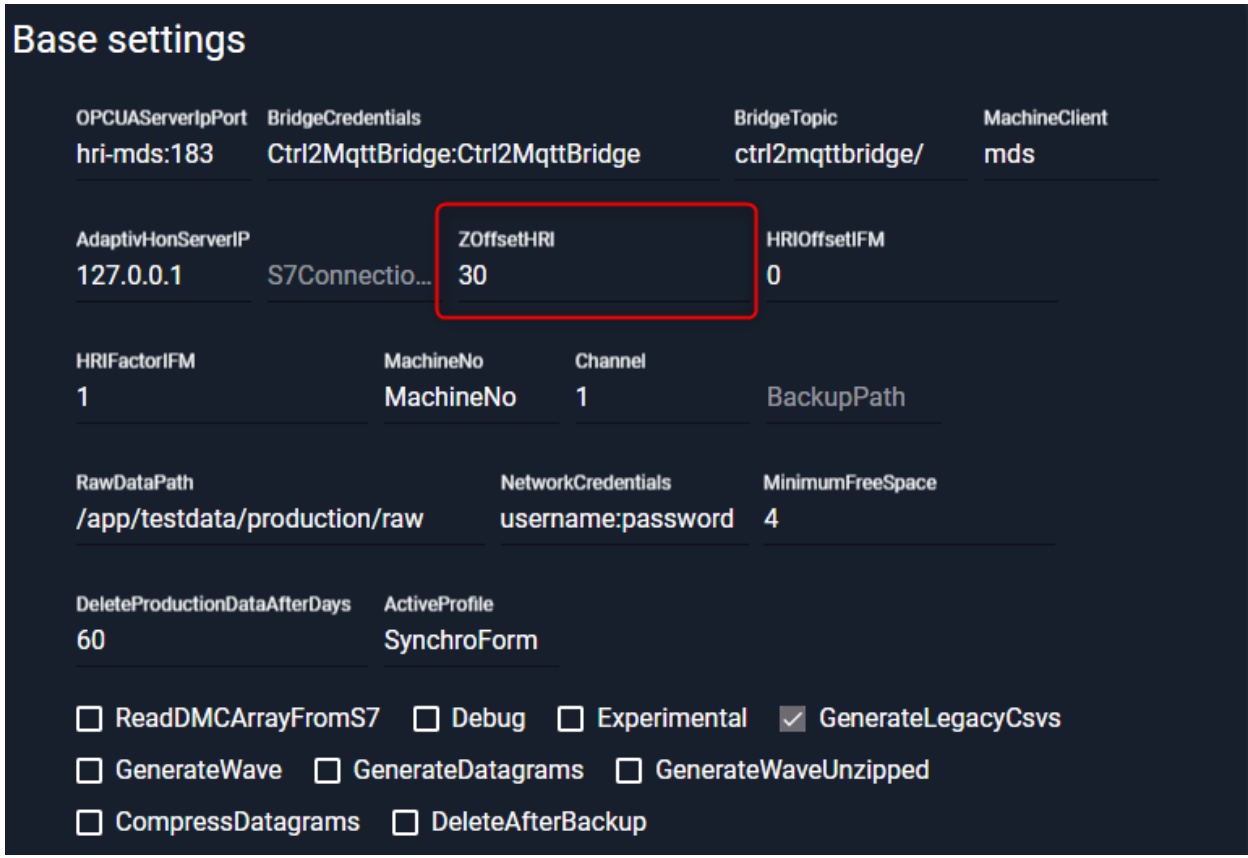


HRI® values

Currents / forces - Synchro Fine

If there is no offset, the Z axis is weighted too heavily int the calculation of HRI and changes in the other axes are not recognized.

When computing the Z-axis offset, results less than zero are not accepted and written to zero.



HRI® values

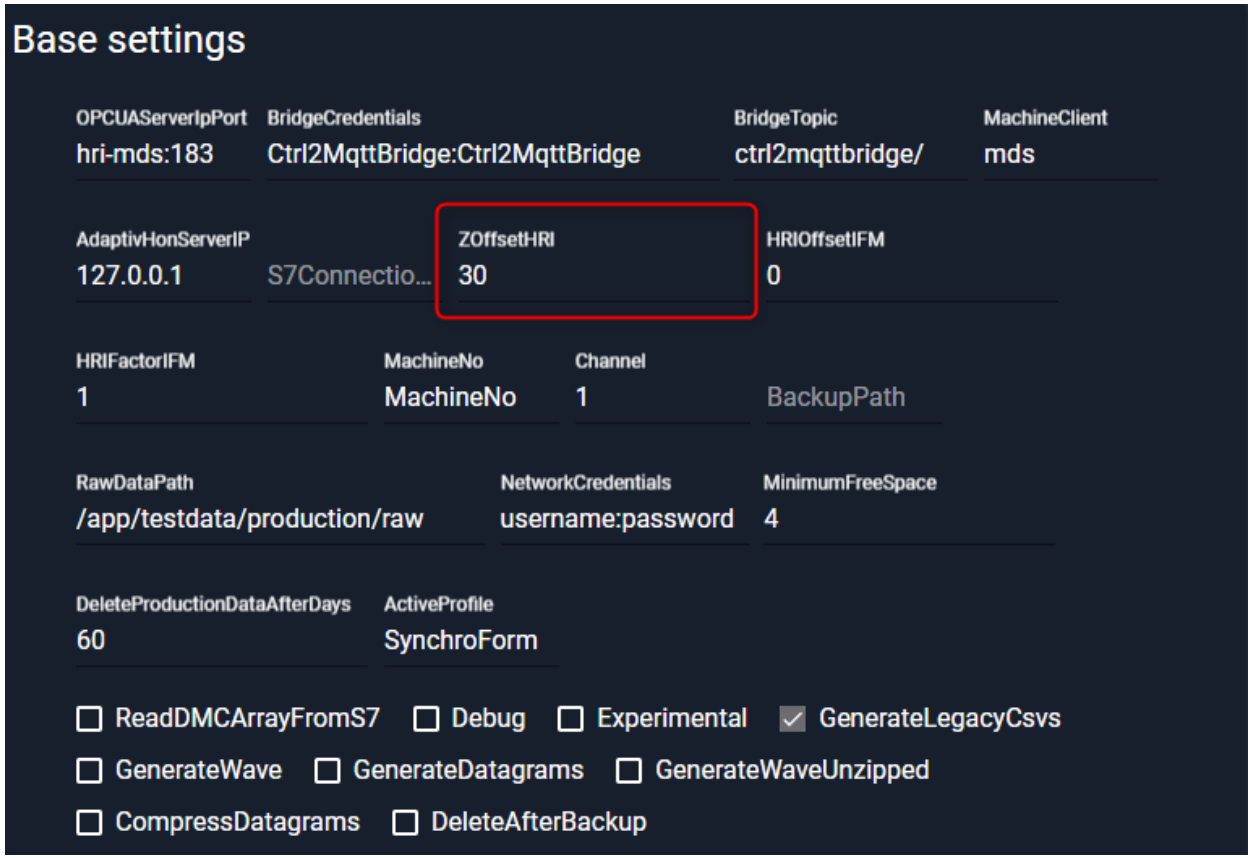
Currents / forces - Synchro Fine

Example of normal condition for Synchro Fine:

$$F_{HRI} = 1.269{,}07$$

Example for shaft honing without offset for Synchro Fine:

$$F_{HRI} = 3.297{,}07$$

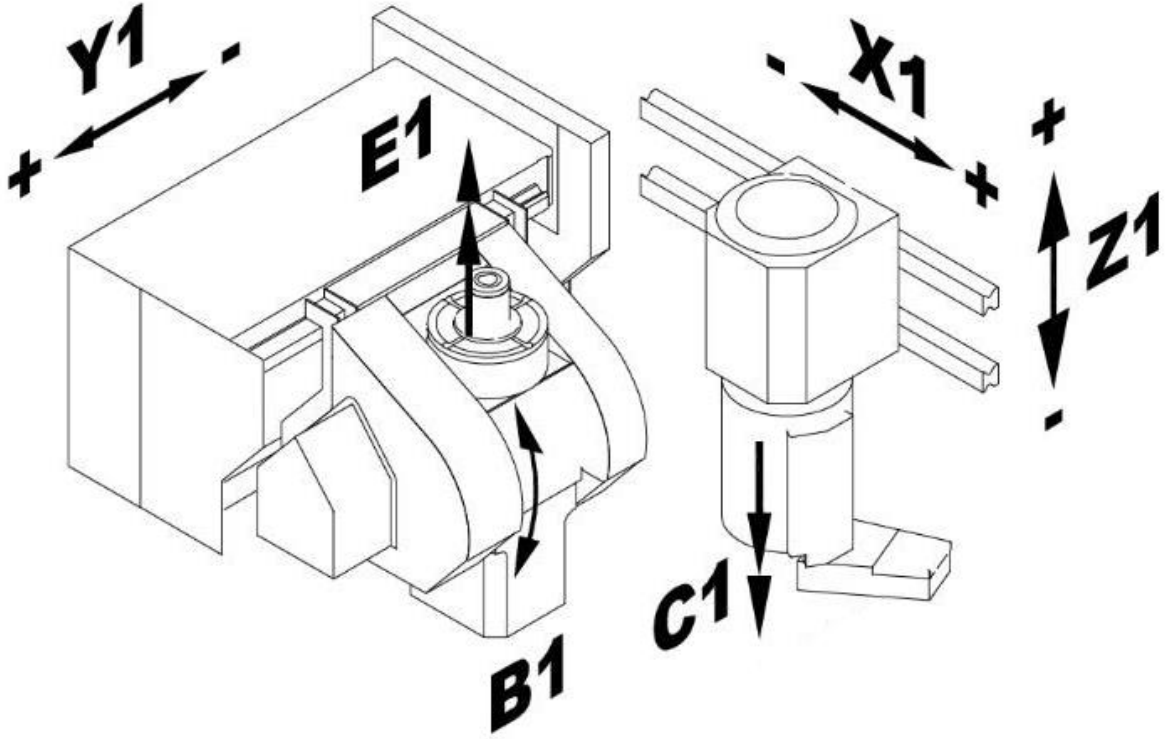


HRI® values

Currents / forces - Synchro Form

From the following axis are the forces measured:

- E – axis (Tooling spindle)
- C – axis (Workpiece spindle)
- X – axis (infeed axis, in process)
- Z – axis (oscillating axis, in process)
- Y – axis (infeed axis – only skiving, in process)

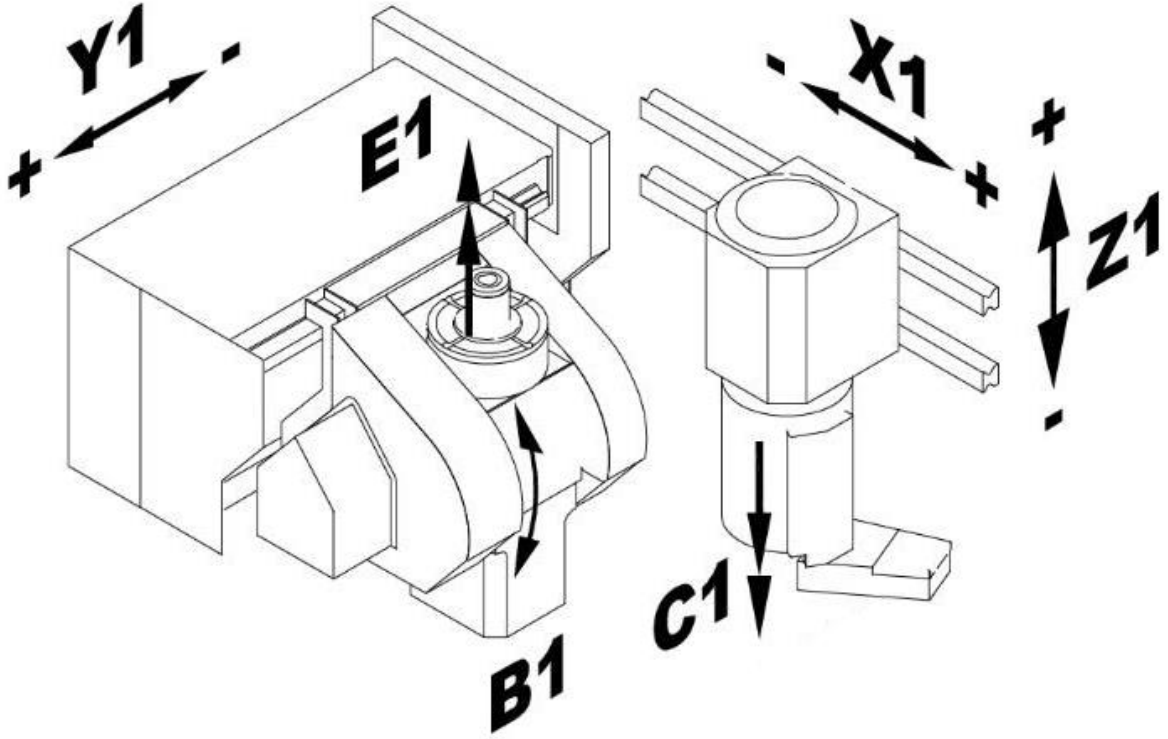


HRI® values

Currents / forces - Synchro Form

The motors can be briefly overloaded, particularly during acceleration processes. It is important to emphasize that the Siemens controllers do not record any measured values that exceed 100% of the nominal current. No measured values above 100% are transmitted to HRI.

When setting limit values, it must be ensured that no values above 100% are entered for machines with a Siemens controller. HRI would not trigger an error response for limits above 100% of the nominal current.



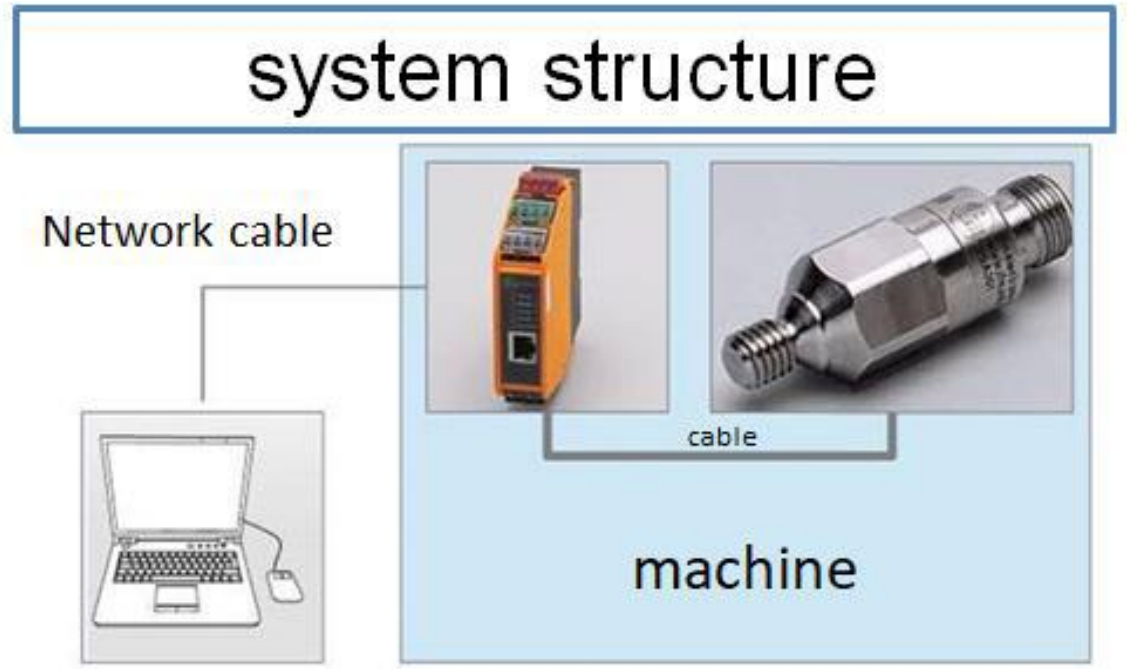
HRI® values

Vibration sensors

Sensors and evaluation units from the manufacturer IFM are installed to detect vibrations in the machine.

Präwema install three different vibration sensors from IFM. On the one hand single axis vibration sensors (VSA001 or VSA004) are installed as standard.

The picture shows an IFM VSA001.

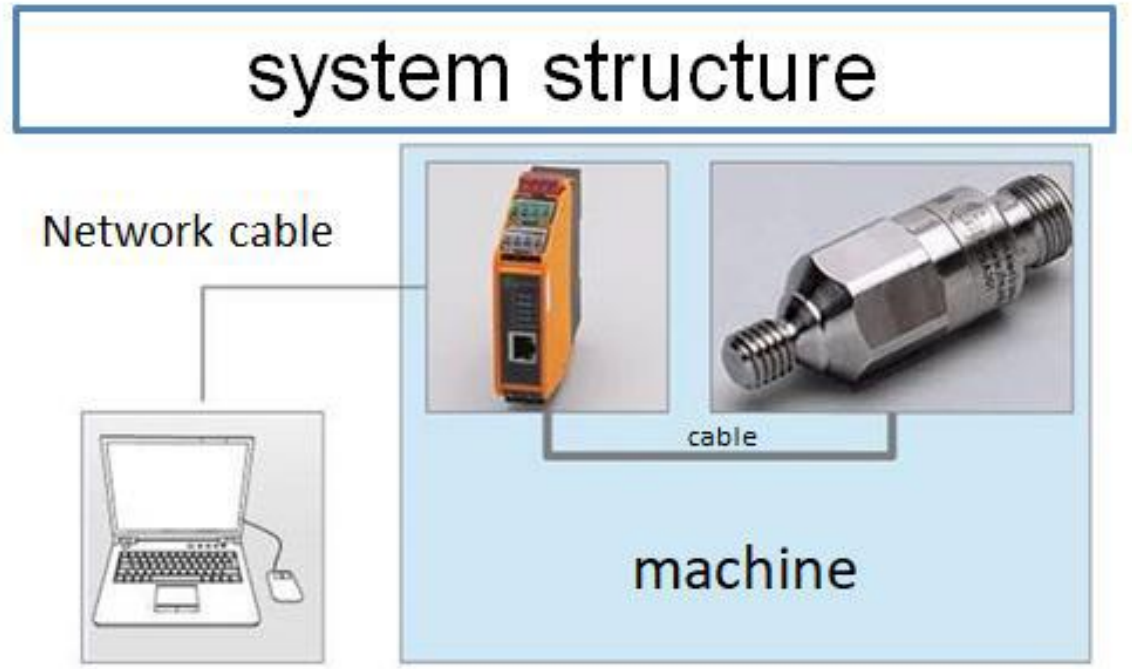


HRI® values

Vibration sensors

On the other side, IFM has been manufacturing a triaxial vibration sensor since 2022 (VSM10X).

This is installed on the tooling spindle of the Synchroform or on special request on the tooling spindle of the Synchrofine.

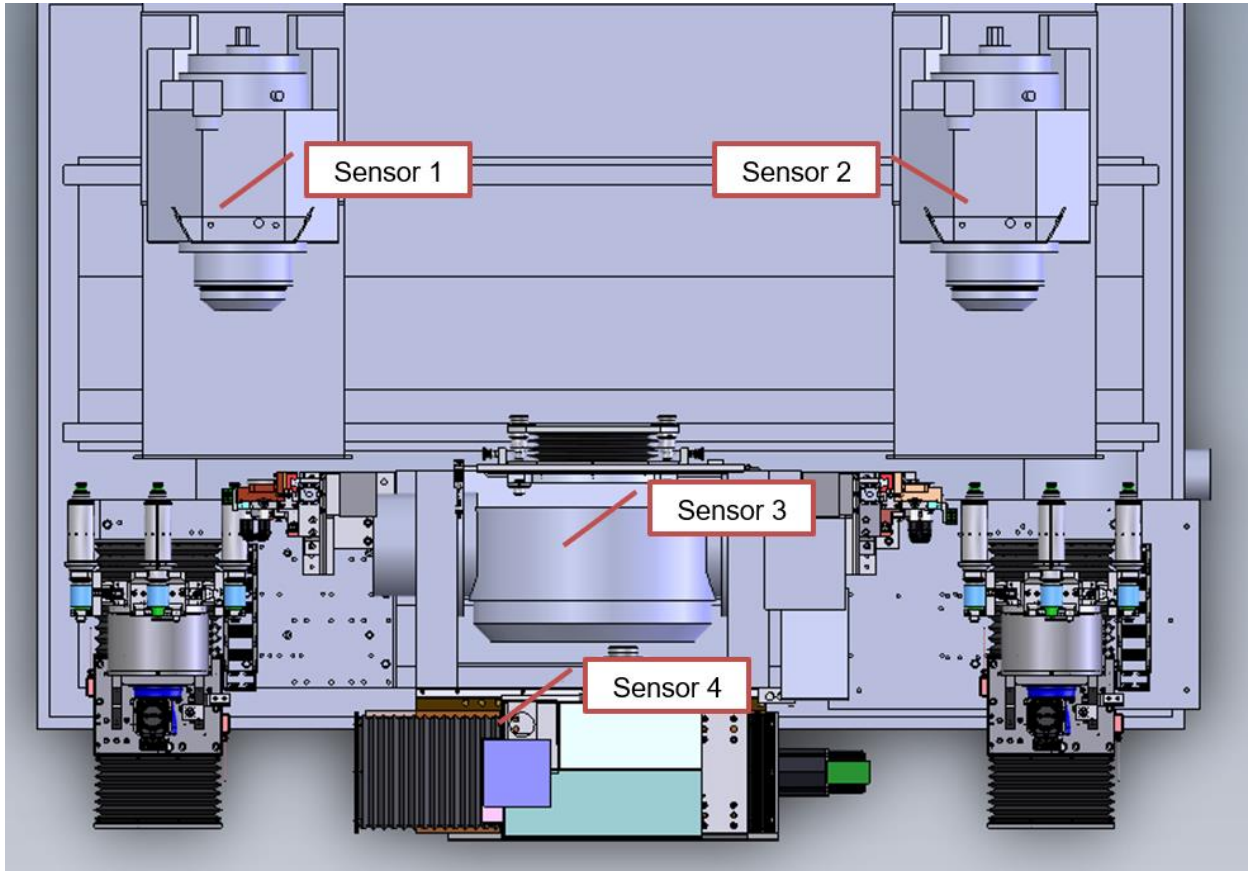


HRI® values

Vibration sensors Synchrofine

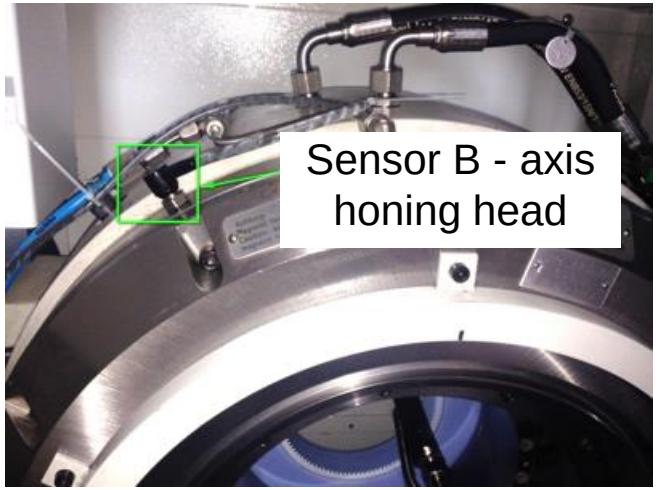
The vibration monitoring sensors are mounted on the following axles on external honing machines:

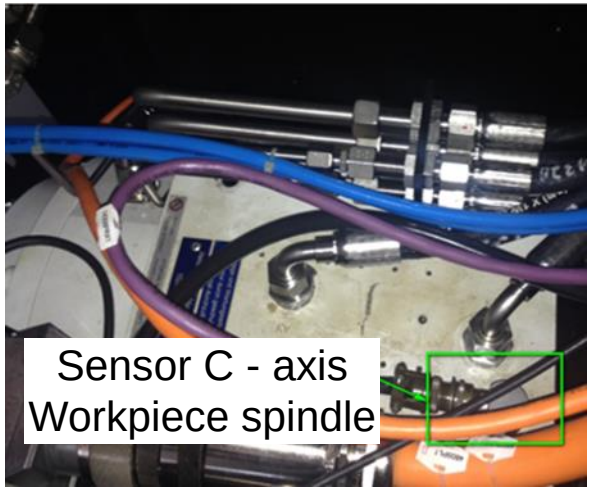
- B-axis (tooling spindle - sensor 3)
  Y-direction
- C-axis (workpiece spindle - sensors 1+2)
  Y-direction
- U-axis (tailstock - sensor 4)
  X-direction

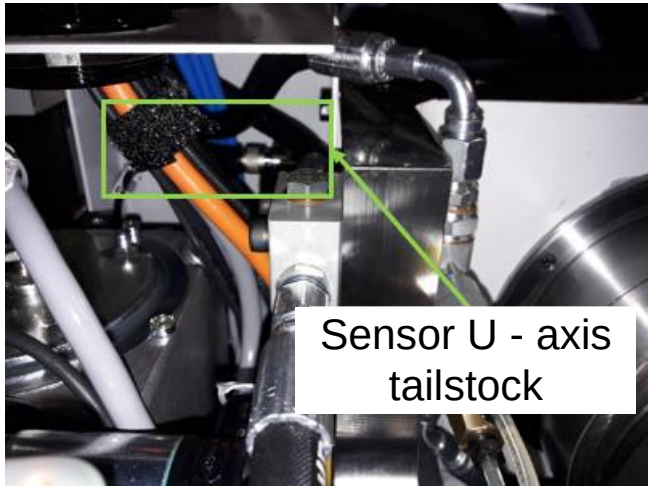


HRI® values

Vibration sensors Synchrofine







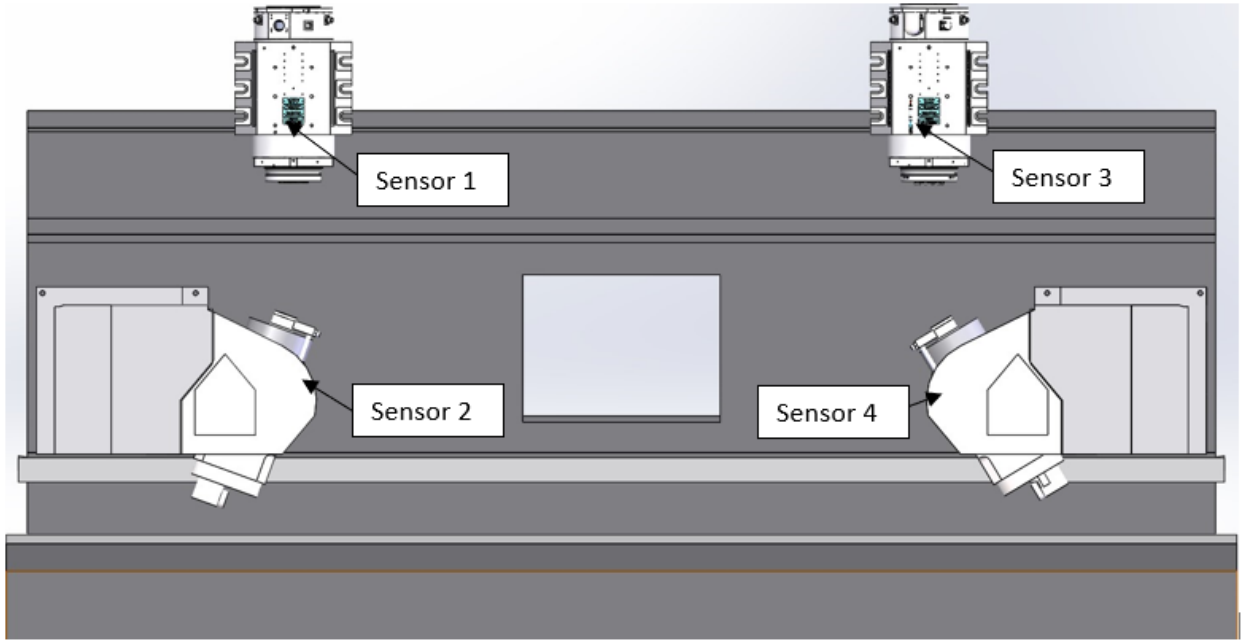
HRI® values

Vibration sensors SynchroForm

The vibration monitoring sensors are mounted on the following axles on external honing machines:

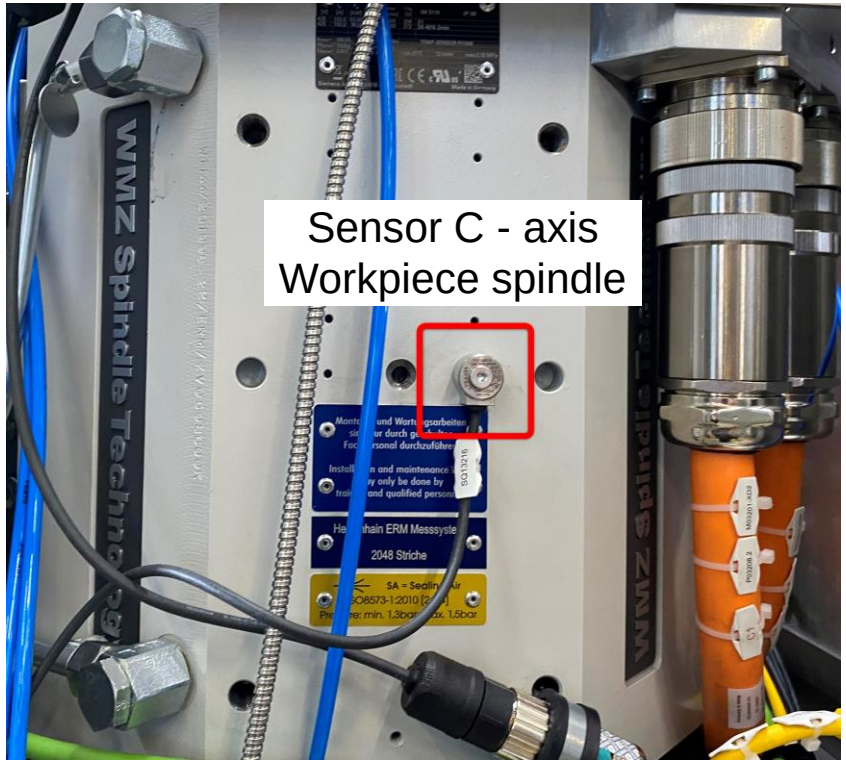
- E-axis (tooling spindle - sensor 2+4)
- C-axis (workpiece spindle - sensors 1+3)

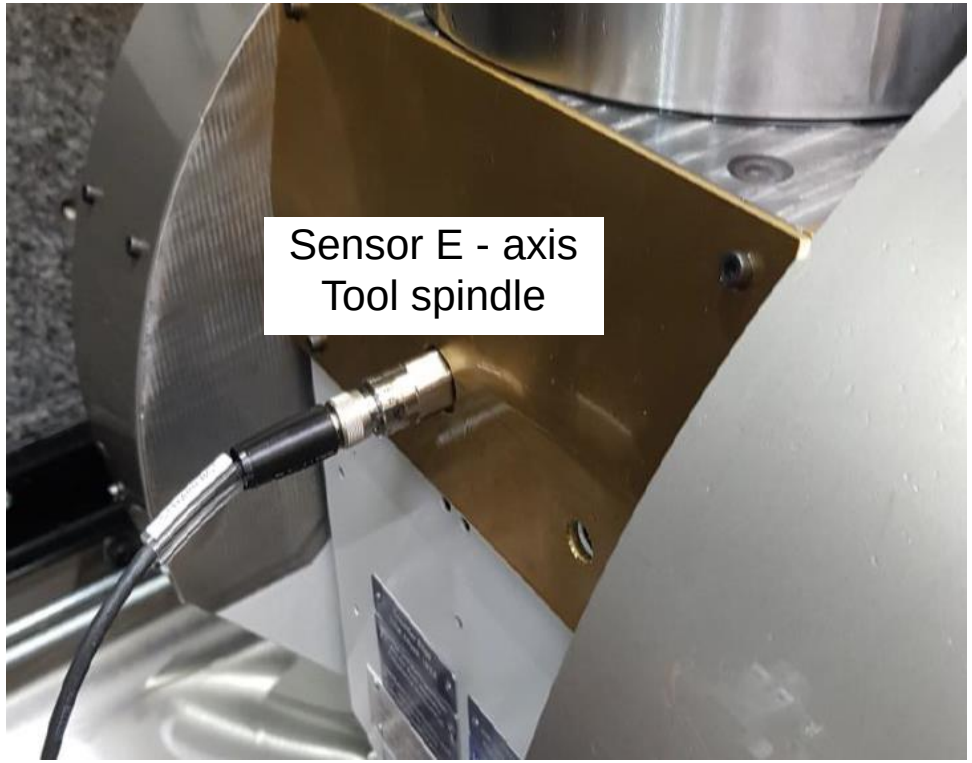
A three-axis vibration sensor was installed on the workpiece spindle.



HRI® values

Vibration sensors SynchroForm



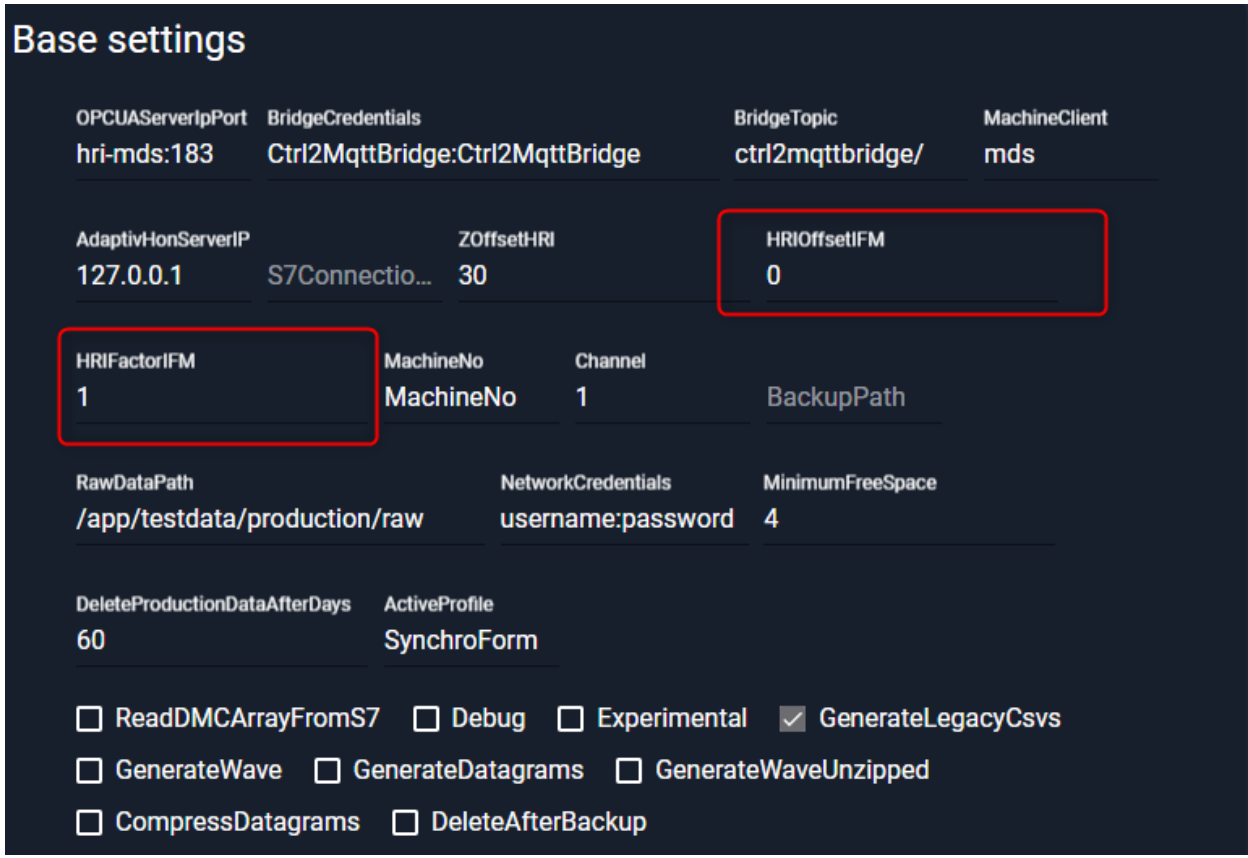


HRI® values

Vibration sensors

The data recorded by the individual vibration sensors is transmitted as raw data, with each sensor outputting its measured value in mg (thousandths of the acceleration due to gravity).

In order to emphasize the importance of the measured vibration values in the calculation of the HRI, specific adjustments have been implemented. These include an adjustable offset and factor, which are available in the basic settings. These adjustments make it possible to influence the proportion of vibration in the calculation of HRI and adapt it to specific requirements.



HRI® values

Vibration sensors

The default offset is 0 and the factor is 1.

The formula is:

$$VIB_{HRI} = (IFM - 0) * 1$$

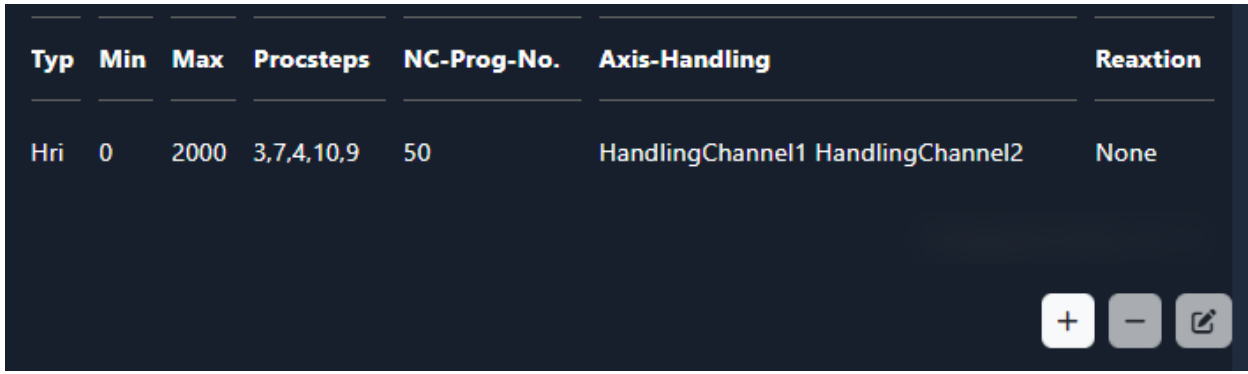
HRI® visualization

HRI® visualization

HRI® monitoring object

An HRI® monitoring object should always be created.

On the one hand, to set the scaling of the Y-axis in the diagram. On the other hand, because otherwise the secondary processes will also be recorded and the result of the HRI® calculation will be distorted. Due to the acceleration of the linear drives in the delivery processes, an HRI® value that is too high is calculated.



Typ	Min	Max	Procsteps	NC-Prog-No.	Axis-Handling	Reaxtion
Hri	0	2000	3,7,4,10,9	50	HandlingChannel1 HandlingChannel2	None

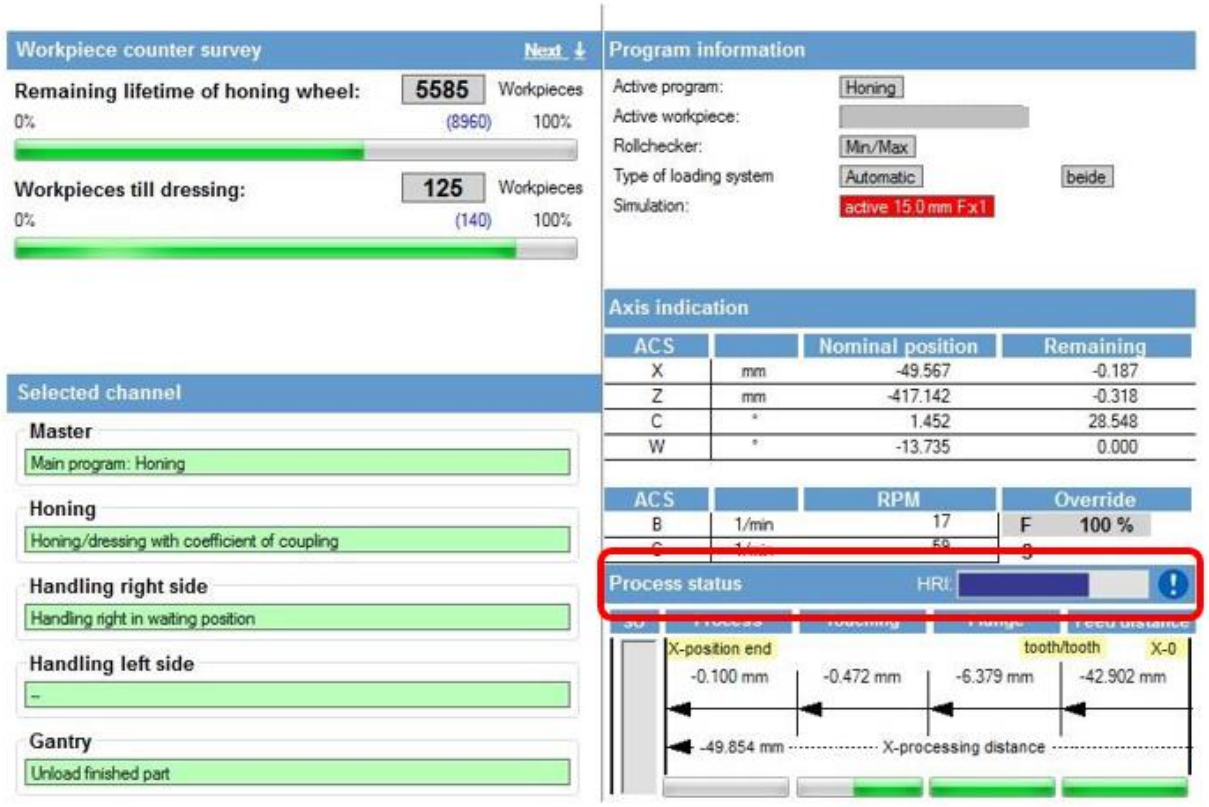
HRI® visualization

Honing HMI

The current HRI® value is displayed as a bar graph in the “Operate" window.

The value is scaled to 110% of the maximum HRI® value. If the set value is exceeded, the color changes from blue to red.

Currently, this function is only active for the Synchrofine.



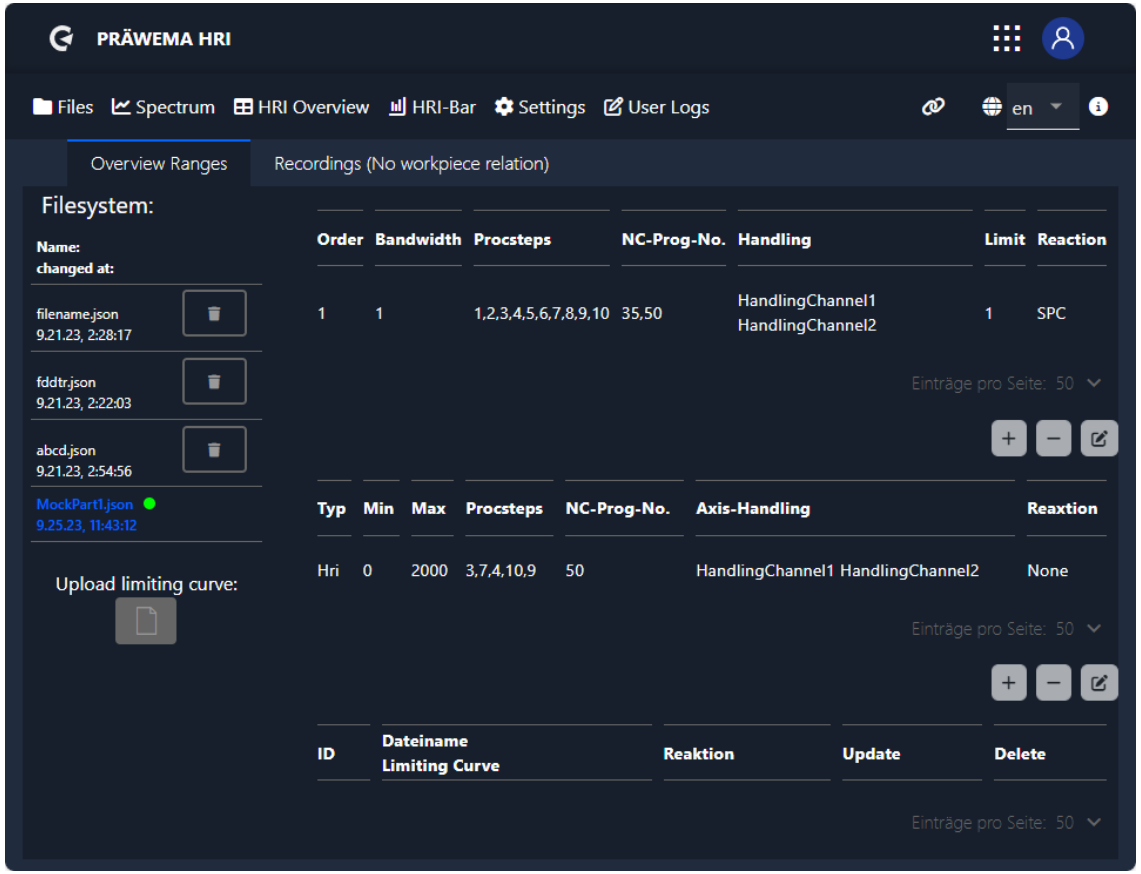
HRI® visualization

Overview of limit values

The programs present in the file system of the Honing HMI are loaded.

The current program is preselected.

Individual variables can be monitored, and error responses defined under diagnostic objects

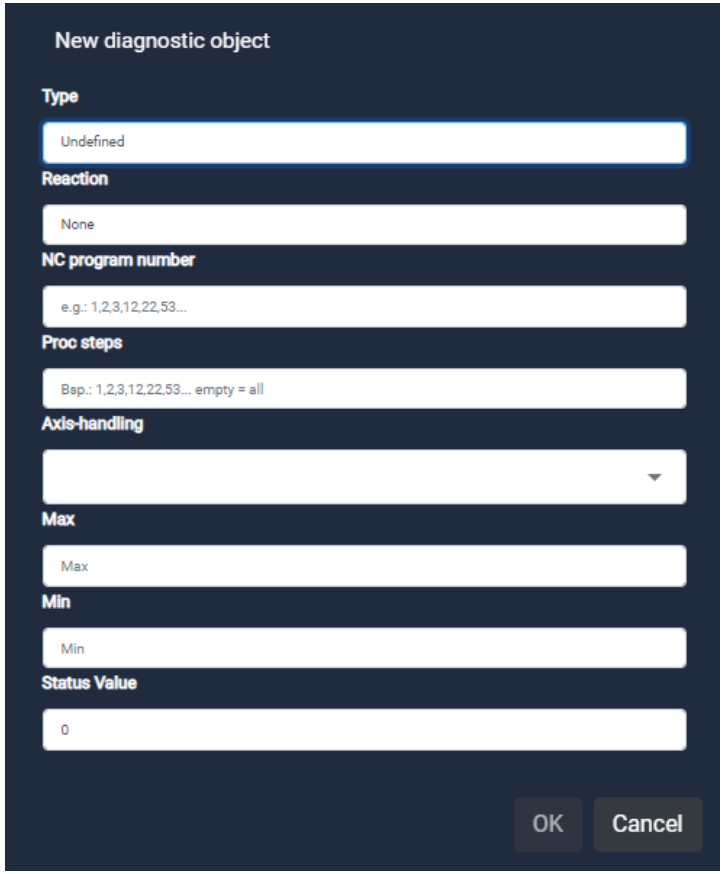


HRI® visualization

Edit Screen

An editing screen has been added since version 2.5. The limits are easier to set with the screen and the possibility of incorrect entries has been minimized.

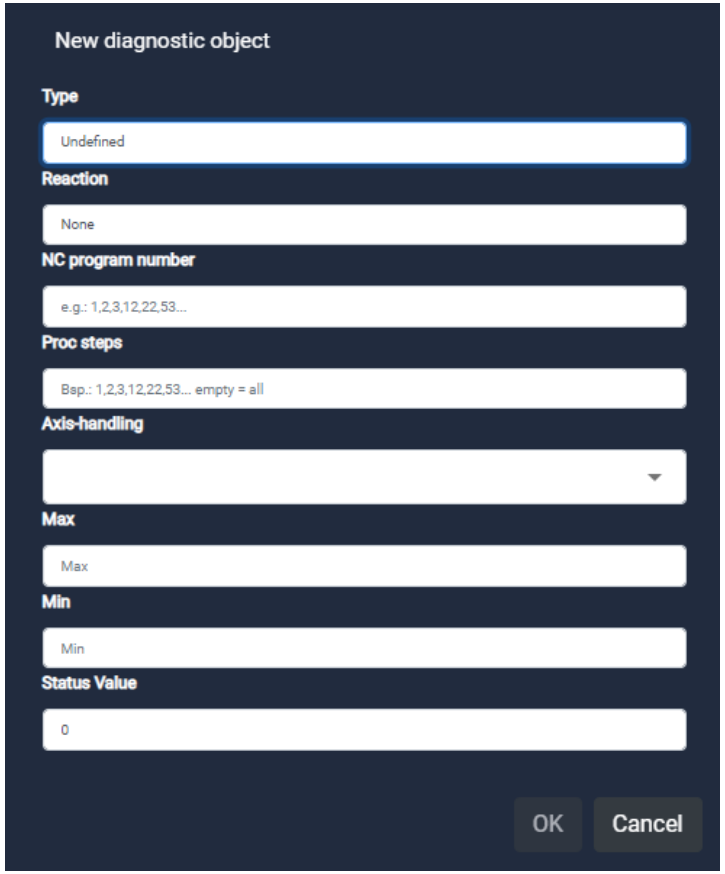
When HRI® is selected, only HandlingChannel 1 or HandlingChannel 2 can be selected.



HRI® visualization

HRI® monitoring object

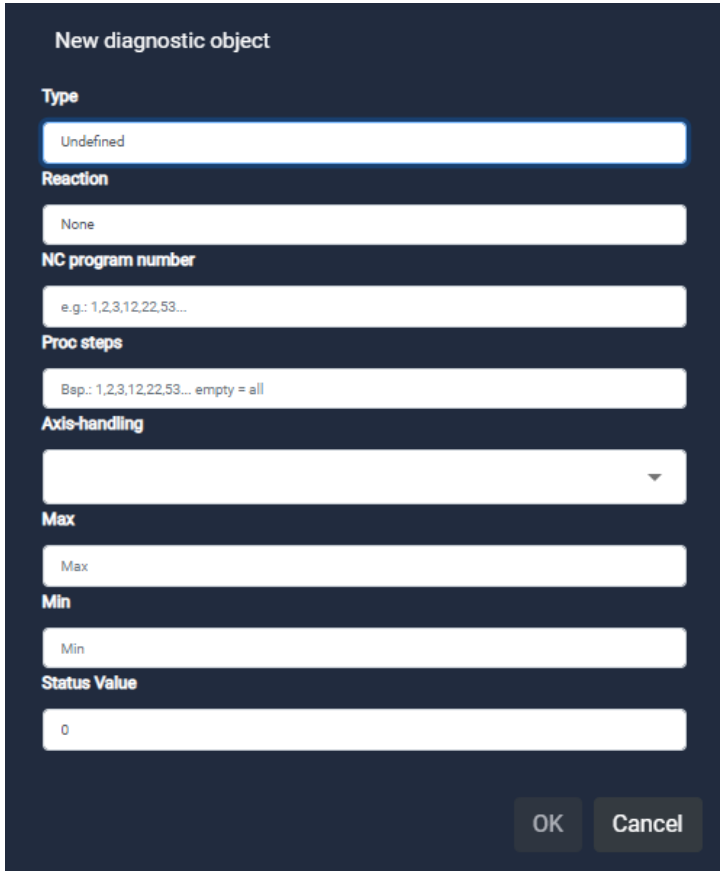
designation	description
Type	The variables can be selected here.
Reaction	Error reaction that is triggered, when the value is exceeded or not reached.
NC program number	NC program to be monitored.
Proc steps	Process steps to be monitored.



HRI® visualization

HRI® monitoring object

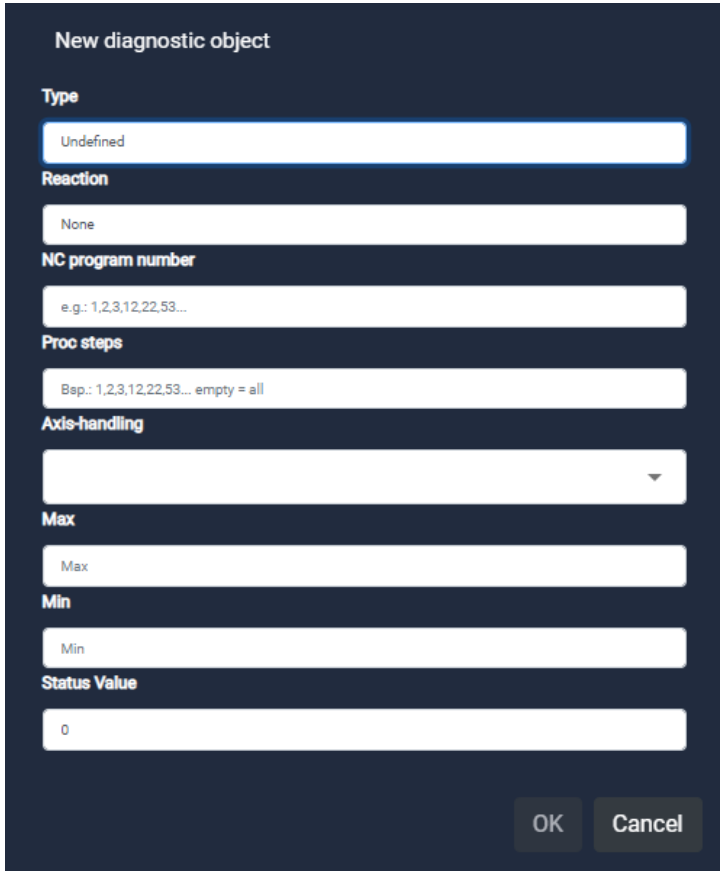
designation	description
Axis – handling	Axis or handling to be monitored.
Max	Maximum value that must not be exceeded in the process step.
Min	Minimum limit that must be reached in the process. Only possible with HRIAvg, HRI Integral and ForceAvg.



HRI® visualization

HRI® monitoring object

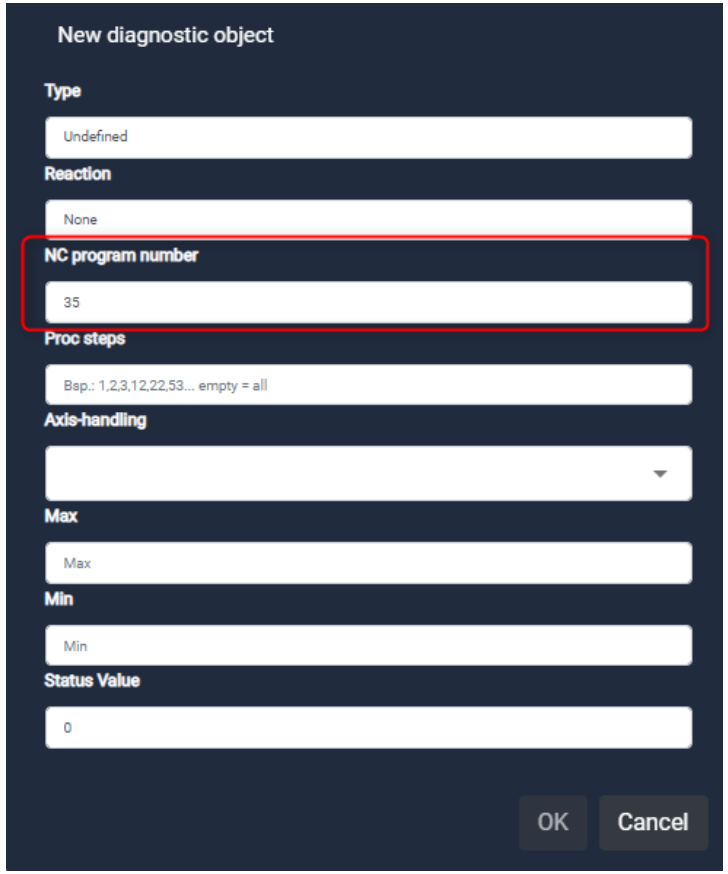
designation	description
Status Value	The status value is sent to the HoningHMI and displayed there for the ejected workpieces. This allows the operator at the machine to determine the reason why a workpiece was ejected.



HRI® visualization

NC program number

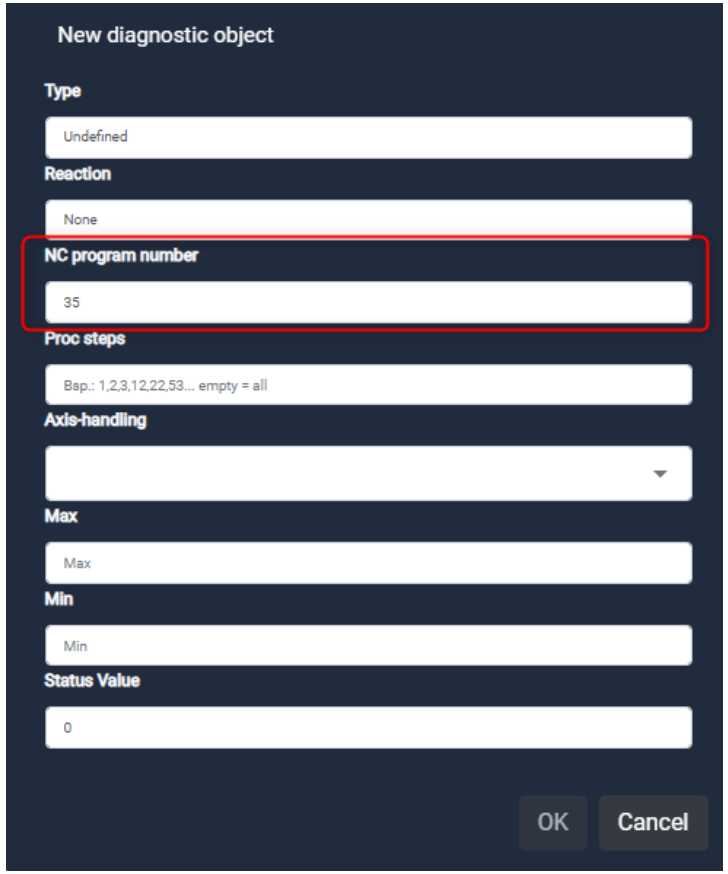
The table lists various NC program numbers that represent different subroutines. Each number represents a specific subroutine that performs a specific machining task, such as honing, profiling or calibrating.



HRI® visualization

NC program number

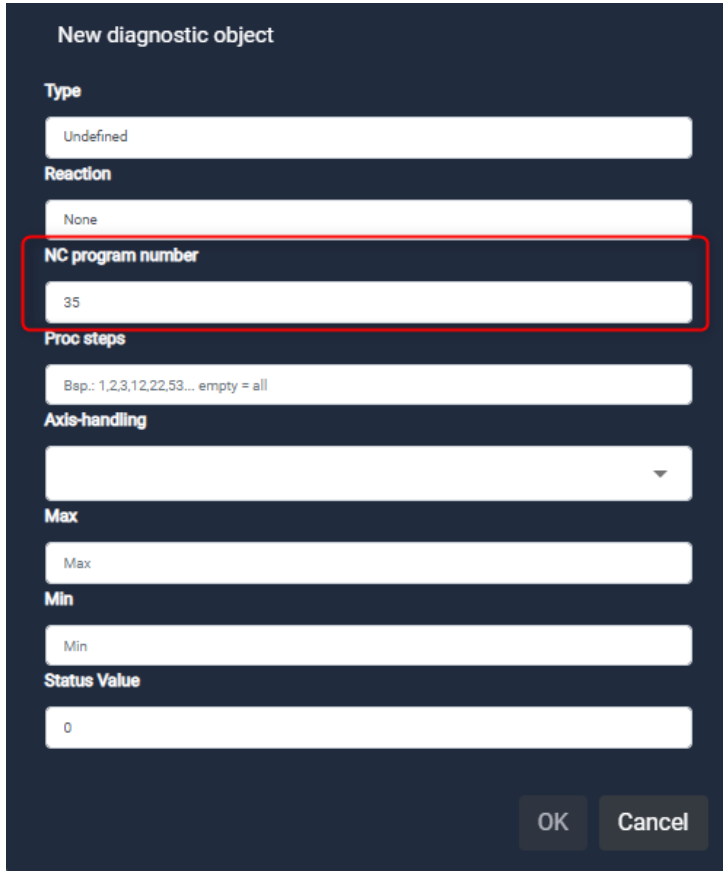
NC program number	
1	Footprint / KM 0 measurement
2-9	Other programs (turning, drilling, etc.)
21	Honring measuring head
22	Honring measuring gear
31	Profiling head
32	Profiling gear
33	Pre profiling only with Vario Speed Dresser



HRI® visualization

NC program number

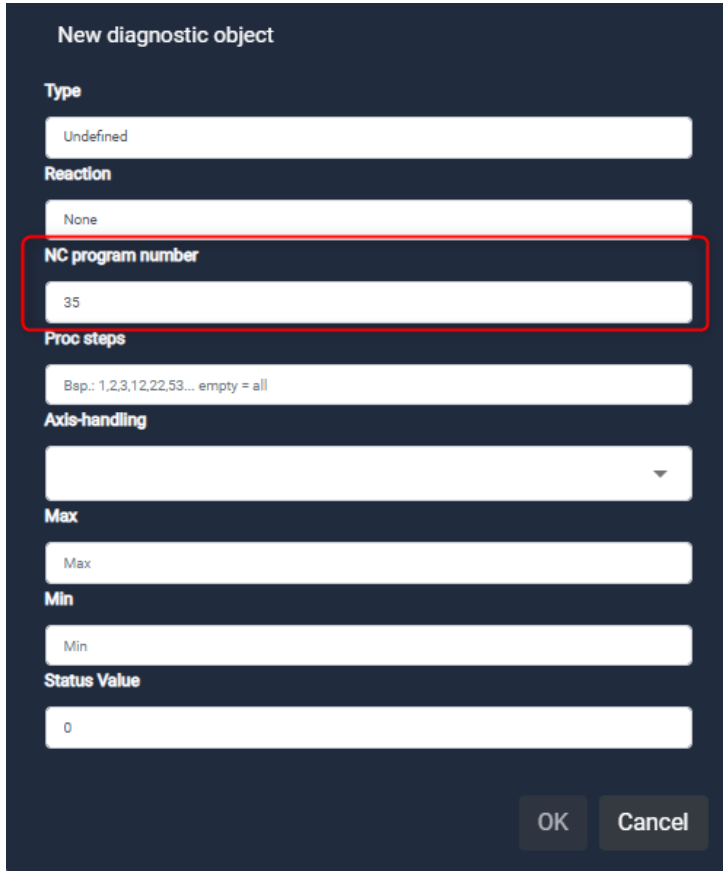
NC program number	
34	Profiling only with the Vario Speed Dresser
35	Skiving
36	reprofiling head circle
40	Omit workpiece measurement
41	Workpiece measure left
42	Workpiece measure right
50	Honing



HRI® visualization

NC program number

NC program number	
51	Dressing gearing with DDG
52	Dressing head circle
53	Dressing with Vario Speed Dresser
60	Calibrate



HRI® visualization

Honing machines – Proc steps

During honing, various program steps are carried out. Each of these steps, such as: touch distance, immersion distance and working distance, represents a specific process within the honing process.

HRI® visualization

Honing machines – Proc steps

Proc steps honing	
0	inactive
1	way from 0 to tooth-tooth position (rapid)
2	immersion distance (high feed of 1000 mm/min)
8	prehoning, at Nick in gray range
3	touching (1)
7	touching (2) (optional)
9	lift distance (optional)

HRI® visualization

Honing machines – Proc steps

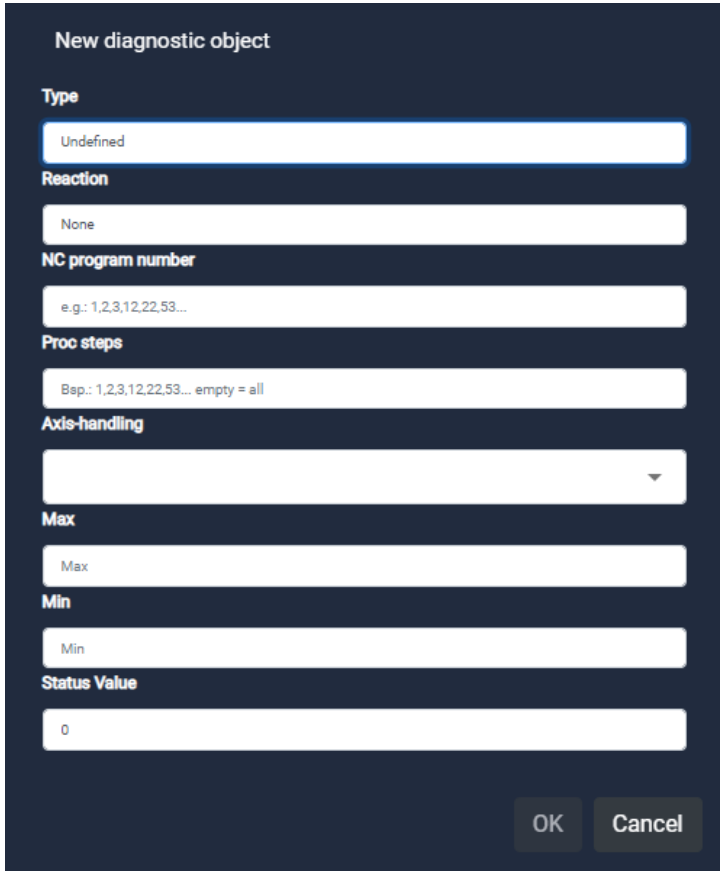
Proc steps honing	
4	working (1)
10	working (2) (optional)
5	spark out (residence time on end distance with oscillation)
6	retreat path
Proc steps dressing with VSD	
25	VSD cuts without correction
26	VSD cuts with correction

HRI® visualization

Skiving machine and other machines DVS Technology Group

With the gear skiving machine, each skiving stroke is considered a separate process step. If, for example, a workpiece is to be processed with 15 peeling strokes, the machine records 15 process steps accordingly.

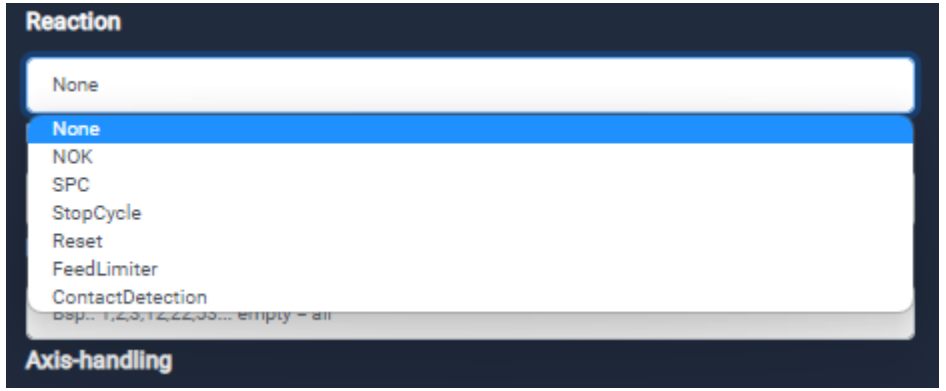
With other machines from the DVS Technology Group, the process steps are individually adapted to the processing of the machine.



HRI® visualization

Error reaction

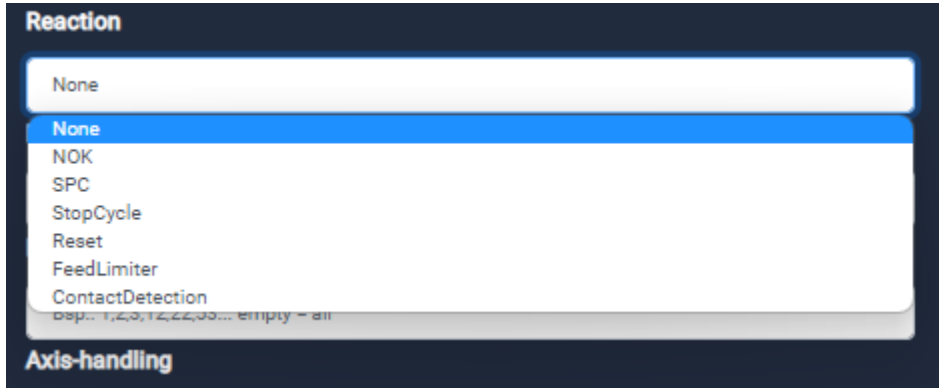
The following is a description of the error reactions that are triggered when certain values are exceeded or not reached. These error reactions could include various actions such as stopping the process, triggering an alarm or displaying a warning message to indicate deviations or problems in the machining process.



HRI® visualization

Error reaction

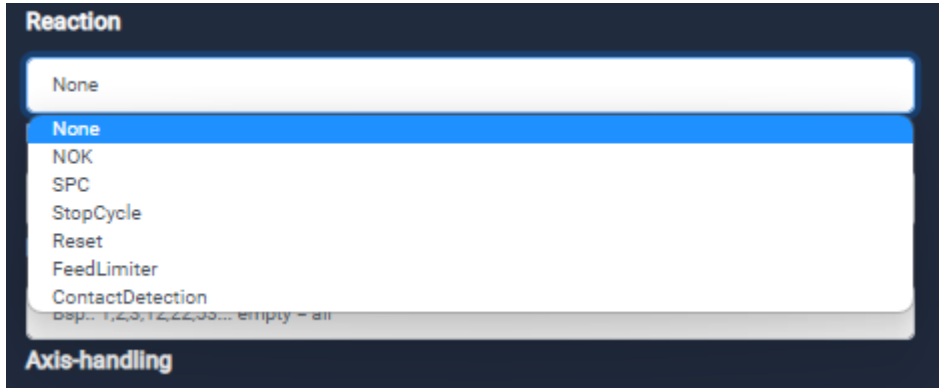
Error reaction	
None	No reaction from the machine.
NOK	The part is discharged as NOK part.
SPC	The part is discharged as SPC part.
StopCycle	The machine will be stop after the cycle.



HRI® visualization

Error reaction

Error reaction	
Reset	Emergency stop and retraction to X 0 position
Feed Limiter	Feed limitation from the infeed axis
Contact Detection	Contact Detection from the tooling to the workpiece



HRI® visualization

Error reaction Min.

If the average value of the honing process is not reached, the monitoring responds and the defined error reaction is executed. The minimum monitoring is intended to detect a honring break. If there is little or no contact between the honring and the workpiece, this is detected, and the error reaction is triggered. Only possible for HRIavg, HRIsurface and ForceAvg.

Error reaction Max.

If the entered value in the process is exceeded, the monitoring responds and the defined error reaction is executed. If there are too high forces, vibration or temperatures during the honing process, the error reaction is triggered.

Error reaction Surface

The HRImachine reacts when the area under the HRI® curve is smaller than the entered value.

When machining is slowed down by hand intervention or feed rate limitation, the maximum and minimum values are lower. However, the integral of the HRI® remains relatively stable and in this way changes in the machine can be detected.

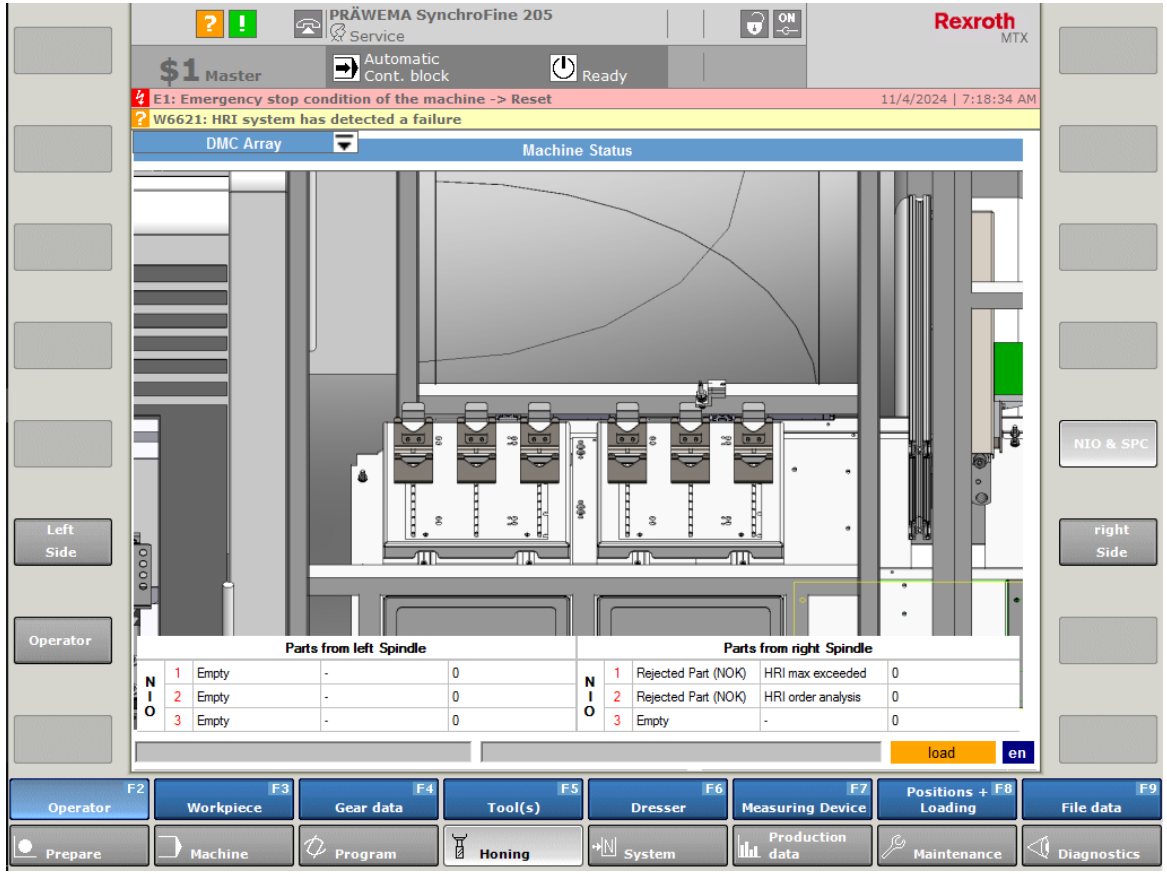
HRI® visualization

Status value

The status value is sent to the HoningHMI and displayed there for the ejected workpieces. This allows the operator at the machine to determine the reason why a workpiece was ejected.

The texts for the status value can be expanded.

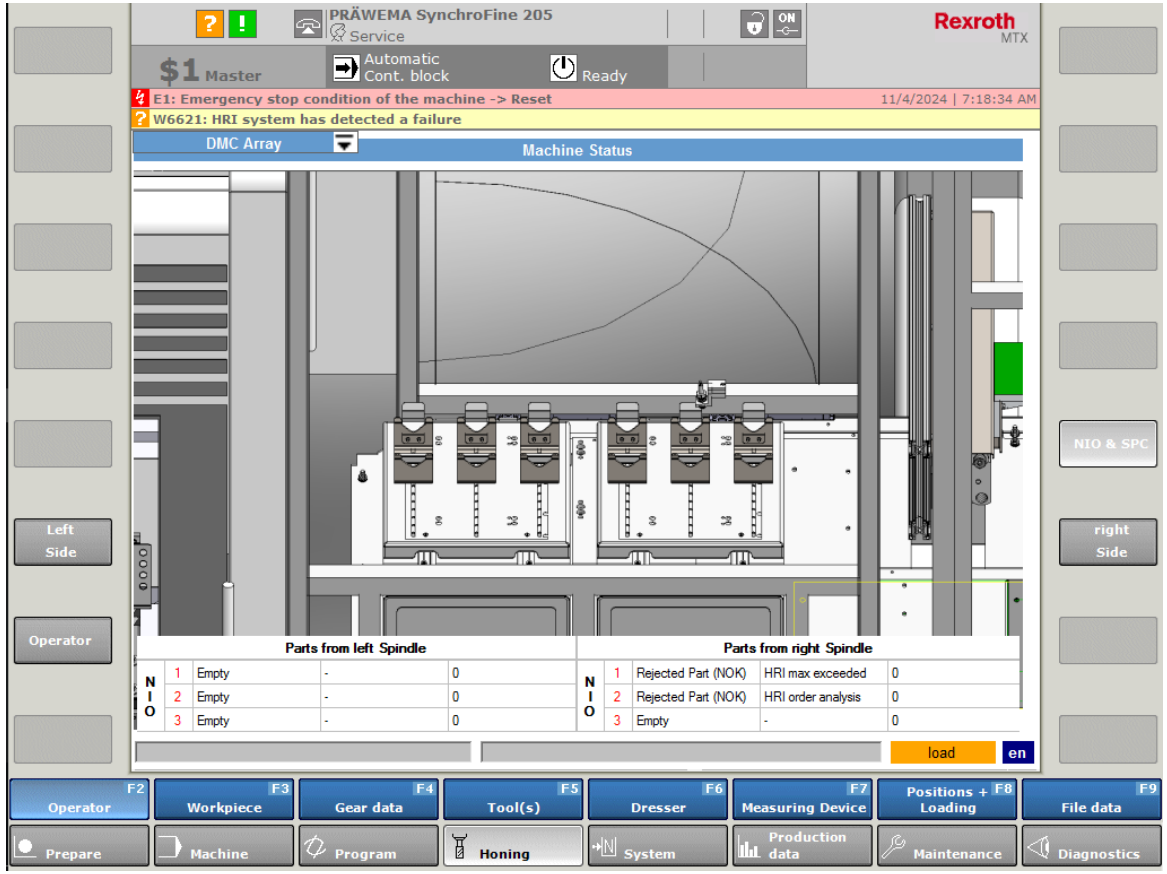
The display depends on the installed version of HoningHMI. The texts are displayed from revision 1839 onwards.



HRI® visualization

Status value

Status Value	Explantation
18	HRI max exceeded
19	HRI min not reached
20	HRI surface exceeded
21	HRI surface not reached
22	HRI order analysis
23	HRI reserve



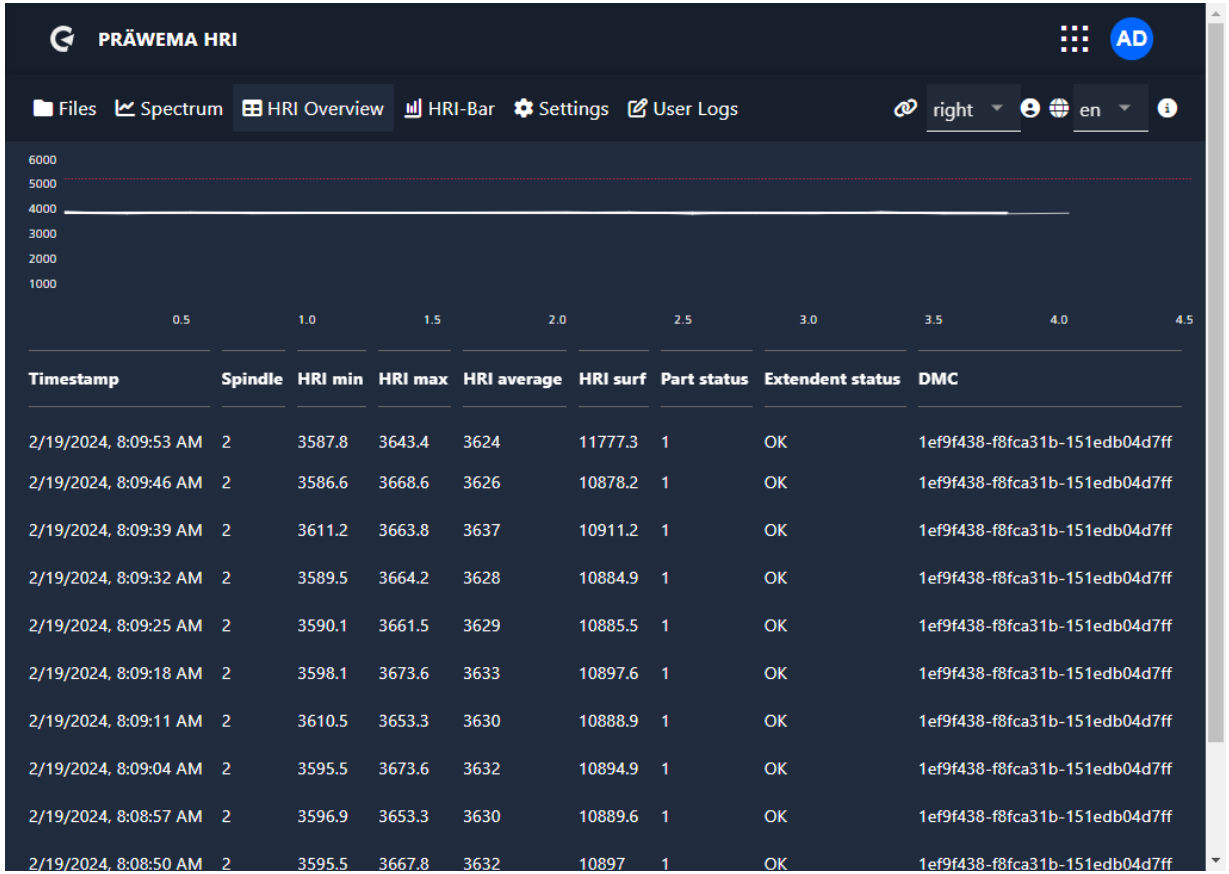
HRI® visualization

HRI® overview

The HRI® diagrams and the HRI® table are summarized in the HRI® overview.

Here is an example of a test machine at Präwema. The HRI limit has been set at 5,000 HRI points. Accordingly, a red line has been drawn in the chart at 5,000. The y-axis of the chart has been scaled 6,000 (+ 20%).

For machines where the process can run in parallel, a distinction is made between the left and right sides of the machine.

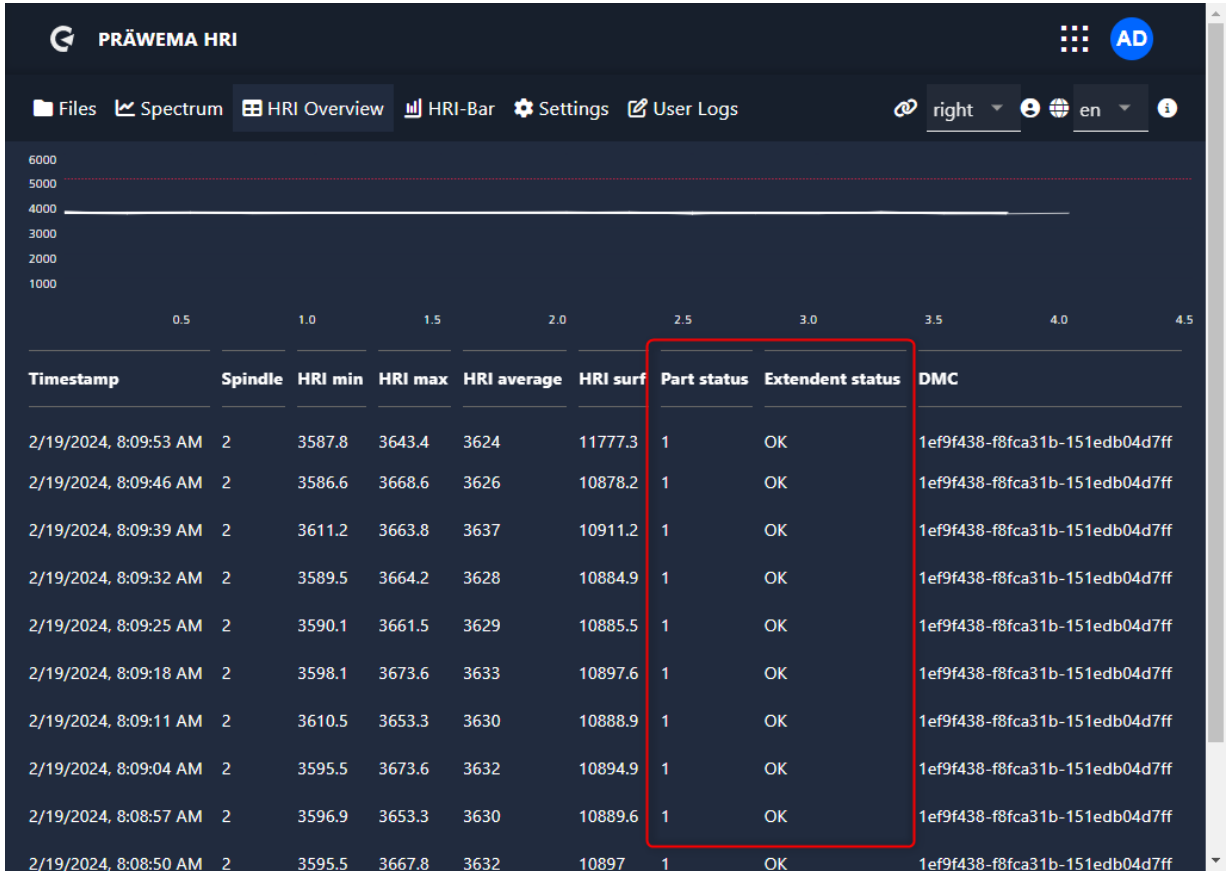


Timestamp	Spindle	HRI min	HRI max	HRI average	HRI surf	Part status	Extendent status	DMC
2/19/2024, 8:09:53 AM	2	3587.8	3643.4	3624	11777.3	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:46 AM	2	3586.6	3668.6	3626	10878.2	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:39 AM	2	3611.2	3663.8	3637	10911.2	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:32 AM	2	3589.5	3664.2	3628	10884.9	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:25 AM	2	3590.1	3661.5	3629	10885.5	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:18 AM	2	3598.1	3673.6	3633	10897.6	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:11 AM	2	3610.5	3653.3	3630	10888.9	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:04 AM	2	3595.5	3673.6	3632	10894.9	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:08:57 AM	2	3596.9	3653.3	3630	10889.6	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:08:50 AM	2	3595.5	3667.8	3632	10897	1	OK	1ef9f438-f8fca31b-151edb04d7ff

HRI® visualization

HRI® overview

Workpiece status	
1	Measurement is OK - limit value was not exceeded
2	The limit was exceeded during processing
4	The average value was not reached during processing
8	The integral was not reached during processing
16	Error message via HRI® (vibration, force or temperature)

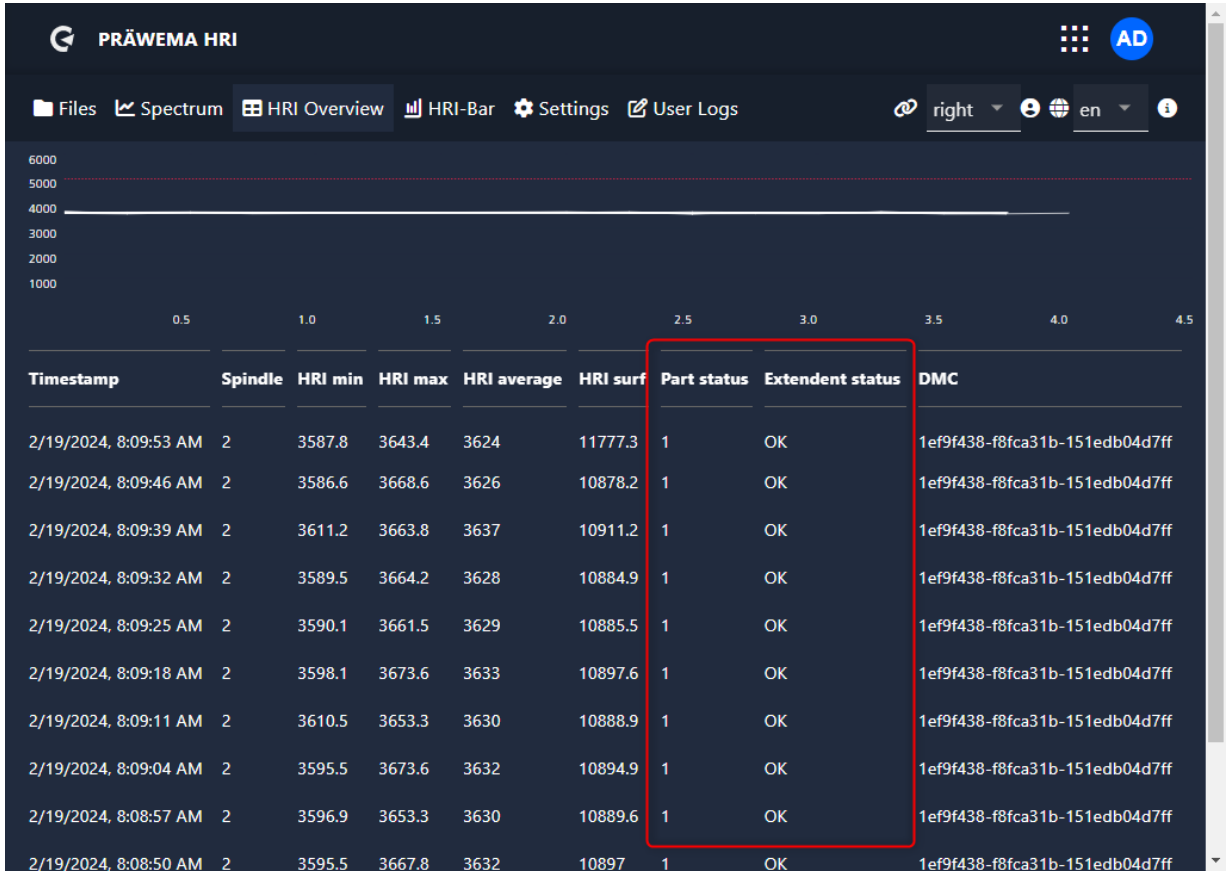


Timestamp	Spindle	HRI min	HRI max	HRI average	HRI surf	Part status	Extendent status	DMC
2/19/2024, 8:09:53 AM	2	3587.8	3643.4	3624	11777.3	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:46 AM	2	3586.6	3668.6	3626	10878.2	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:39 AM	2	3611.2	3663.8	3637	10911.2	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:32 AM	2	3589.5	3664.2	3628	10884.9	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:25 AM	2	3590.1	3661.5	3629	10885.5	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:18 AM	2	3598.1	3673.6	3633	10897.6	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:11 AM	2	3610.5	3653.3	3630	10888.9	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:04 AM	2	3595.5	3673.6	3632	10894.9	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:08:57 AM	2	3596.9	3653.3	3630	10889.6	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:08:50 AM	2	3595.5	3667.8	3632	10897	1	OK	1ef9f438-f8fca31b-151edb04d7ff

HRI® visualization

HRI® overview

Workpiece status	
32	Error message via HRIexpert® (order object or limiting curve)
64	stop after the end of cycle
128	Eject workpiece (SPC)
256	Reset - Emergency retraction to X0 position
512	Eject workpiece (NOK)



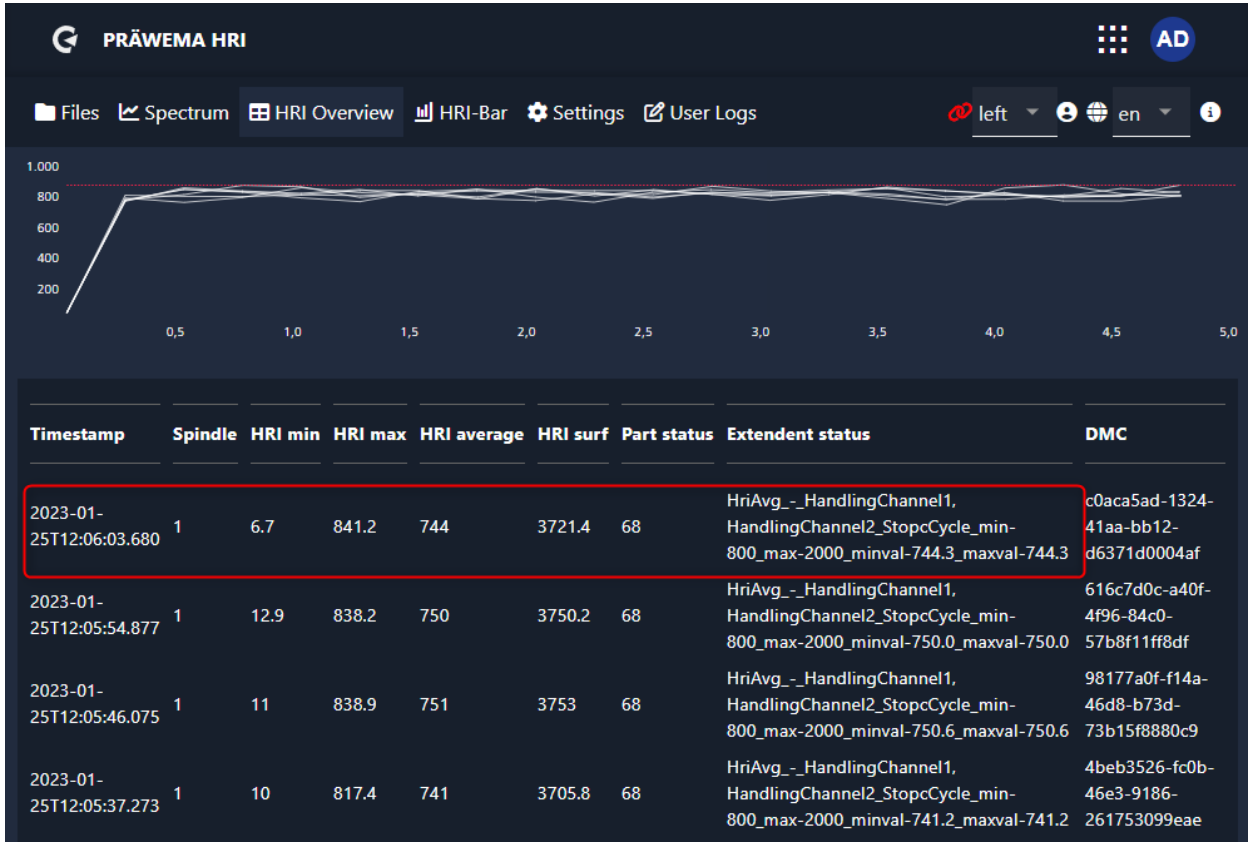
Timestamp	Spindle	HRI min	HRI max	HRI average	HRI surf	Part status	Extendent status	DMC
2/19/2024, 8:09:53 AM	2	3587.8	3643.4	3624	11777.3	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:46 AM	2	3586.6	3668.6	3626	10878.2	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:39 AM	2	3611.2	3663.8	3637	10911.2	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:32 AM	2	3589.5	3664.2	3628	10884.9	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:25 AM	2	3590.1	3661.5	3629	10885.5	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:18 AM	2	3598.1	3673.6	3633	10897.6	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:11 AM	2	3610.5	3653.3	3630	10888.9	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:09:04 AM	2	3595.5	3673.6	3632	10894.9	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:08:57 AM	2	3596.9	3653.3	3630	10889.6	1	OK	1ef9f438-f8fca31b-151edb04d7ff
2/19/2024, 8:08:50 AM	2	3595.5	3667.8	3632	10897	1	OK	1ef9f438-f8fca31b-151edb04d7ff

HRI® visualization

workpiece status

The individual workpiece status signals are bit values and can be combined with one another.

A triggering error message "4 - The average value was not reached during processing" with the error response "64 - Stop after end of cycle" would be output as workpiece status "68".



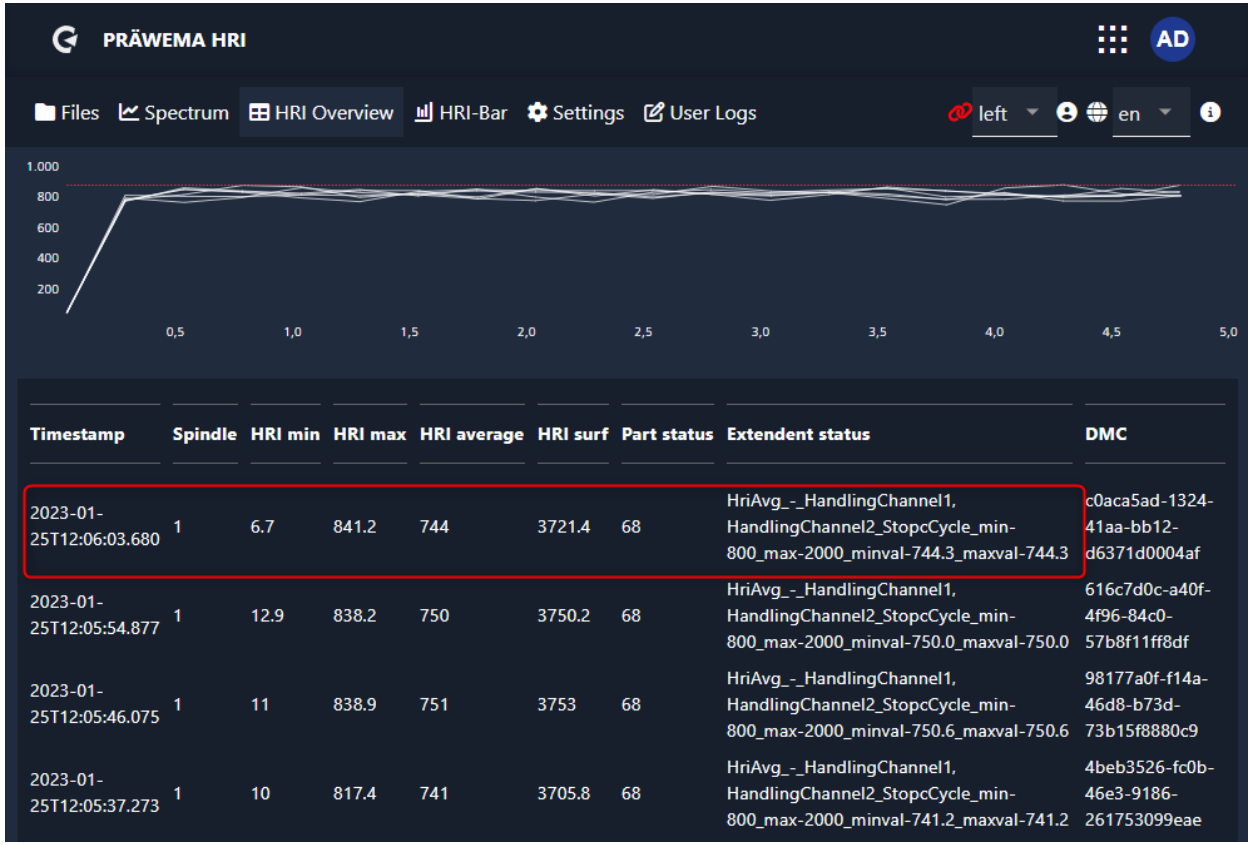
Timestamp	Spindle	HRI min	HRI max	HRI average	HRI surf	Part status	Extendent status	DMC
2023-01-25T12:06:03.680	1	6.7	841.2	744	3721.4	68	HriAvg_-_HandlingChannel1, HandlingChannel2_StopcCycle_min-800_max-2000_minval-744.3_maxval-744.3	c0aca5ad-1324-41aa-bb12-d6371d0004af
2023-01-25T12:05:54.877	1	12.9	838.2	750	3750.2	68	HriAvg_-_HandlingChannel1, HandlingChannel2_StopcCycle_min-800_max-2000_minval-750.0_maxval-750.0	616c7d0c-a40f-4f96-84c0-57b8f11ff8df
2023-01-25T12:05:46.075	1	11	838.9	751	3753	68	HriAvg_-_HandlingChannel1, HandlingChannel2_StopcCycle_min-800_max-2000_minval-750.6_maxval-750.6	98177a0f-f14a-46d8-b73d-73b15f8880c9
2023-01-25T12:05:37.273	1	10	817.4	741	3705.8	68	HriAvg_-_HandlingChannel1, HandlingChannel2_StopcCycle_min-800_max-2000_minval-741.2_maxval-741.2	4beb3526-fc0b-46e3-9186-261753099eae

HRI® visualization

Extended status

In the extended status, the limit violations are displayed as plain text.

With the set limit values and the values of exceeding or falling below the values, as well as the set error reaction.



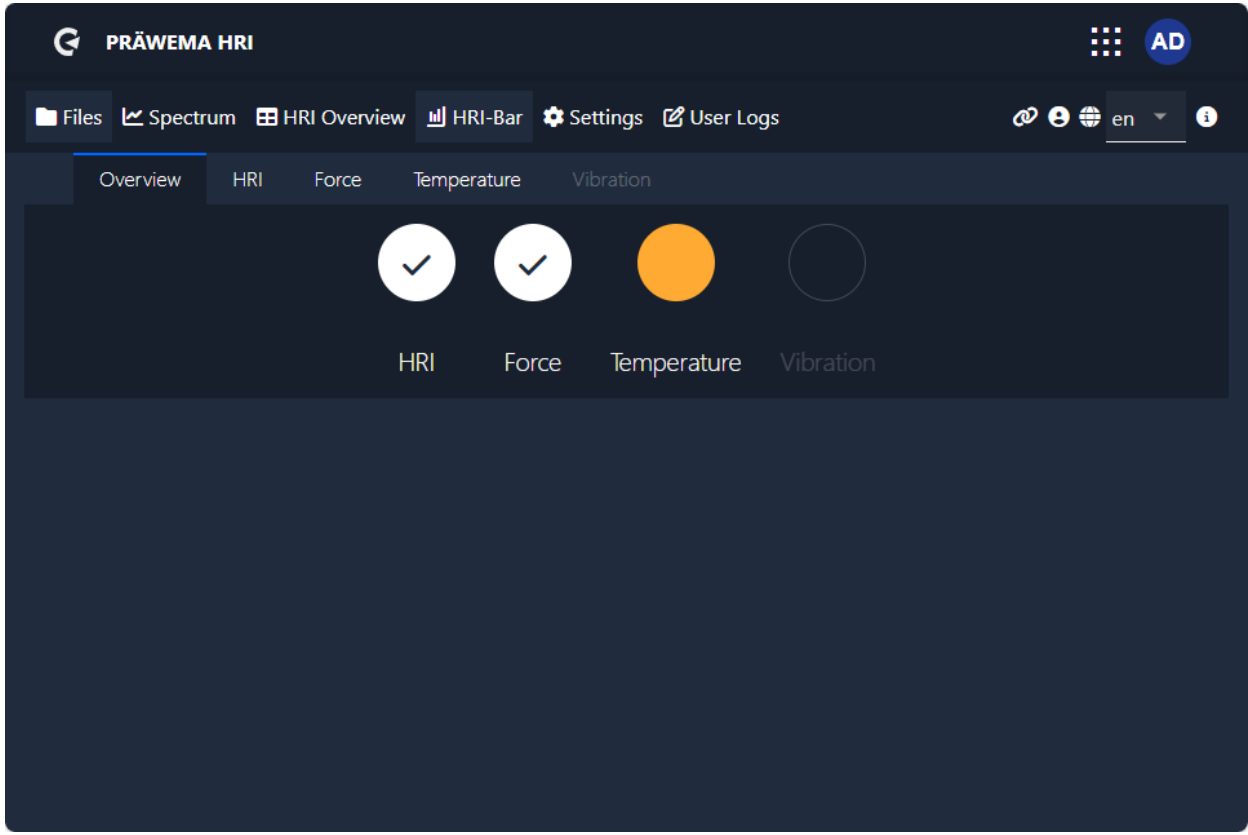
Timestamp	Spindle	HRI min	HRI max	HRI average	HRI surf	Part status	Extendent status	DMC
2023-01-25T12:06:03.680	1	6.7	841.2	744	3721.4	68	HriAvg_-_HandlingChannel1, HandlingChannel2_StopcCycle_min-800_max-2000_minval-744.3_maxval-744.3	c0aca5ad-1324-41aa-bb12-d6371d0004af
2023-01-25T12:05:54.877	1	12.9	838.2	750	3750.2	68	HriAvg_-_HandlingChannel1, HandlingChannel2_StopcCycle_min-800_max-2000_minval-750.0_maxval-750.0	616c7d0c-a40f-4f96-84c0-57b8f11ff8df
2023-01-25T12:05:46.075	1	11	838.9	751	3753	68	HriAvg_-_HandlingChannel1, HandlingChannel2_StopcCycle_min-800_max-2000_minval-750.6_maxval-750.6	98177a0f-f14a-46d8-b73d-73b15f8880c9
2023-01-25T12:05:37.273	1	10	817.4	741	3705.8	68	HriAvg_-_HandlingChannel1, HandlingChannel2_StopcCycle_min-800_max-2000_minval-741.2_maxval-741.2	4beb3526-fc0b-46e3-9186-261753099eae

HRI® visualization

HRI - Bar

As of version 3.1 an overview page has been added. All 4 variables that can be monitored are shown here.

If a monitoring object is created, the corresponding button is activated. If the value is below 80% of the limit value, the button is displayed as a white circle with a check mark. If the value is more than 80% of the set limit value, the button will turn orange and if it is exceeded, it will turn red.



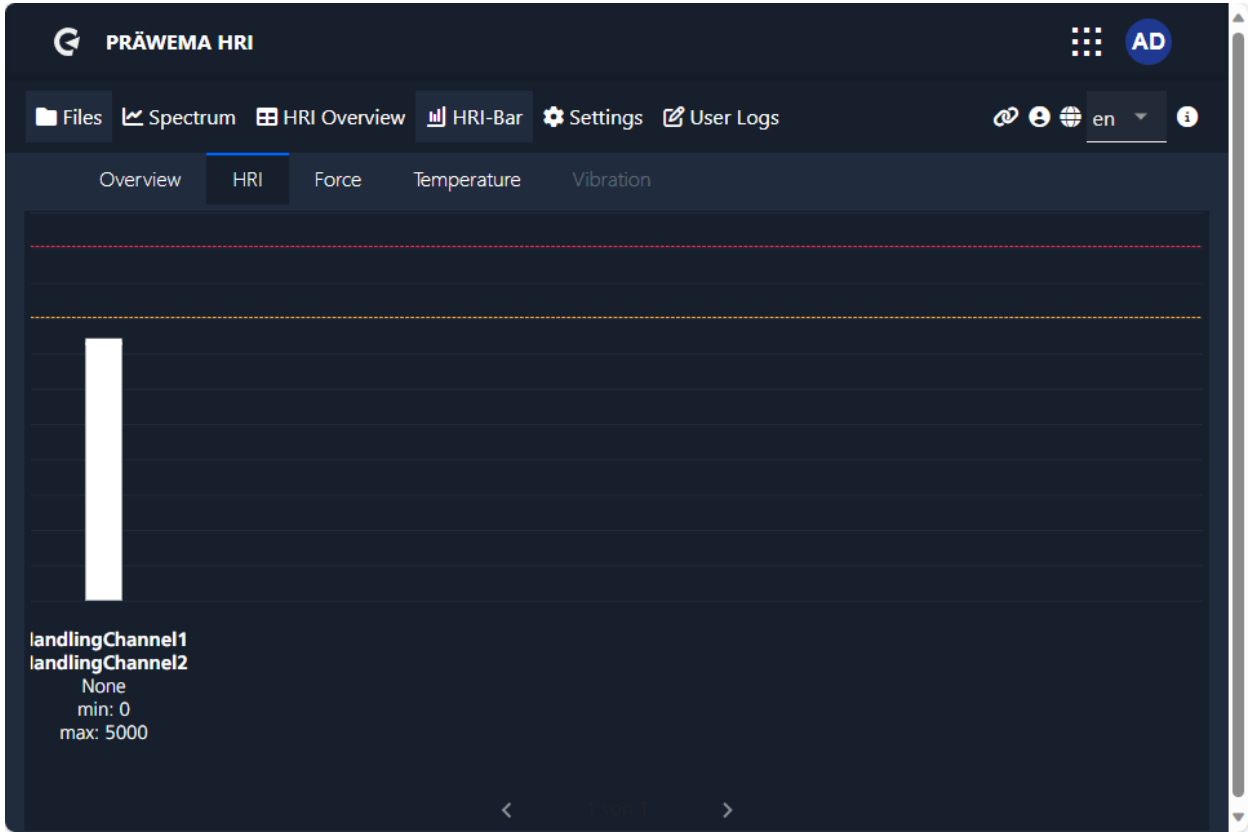
HRI® visualization

HRI - Bar

Click on the button to switch to the single view.

Here the created monitoring objects are displayed.

The monitoring objects of HRIAvg, HRIsurface and ForceAvg are not displayed. The values of these monitoring objects are calculated only at the end of the process.



HRI® visualization

HRI - Bar

In the example, three monitoring objects have been created for the temperature.

At the C1 spindle the limit value is exceeded, at the C2 spindle the measured value is between 80% and 99%. At the B spindle the measured temperature value is below 80% of the limit value.

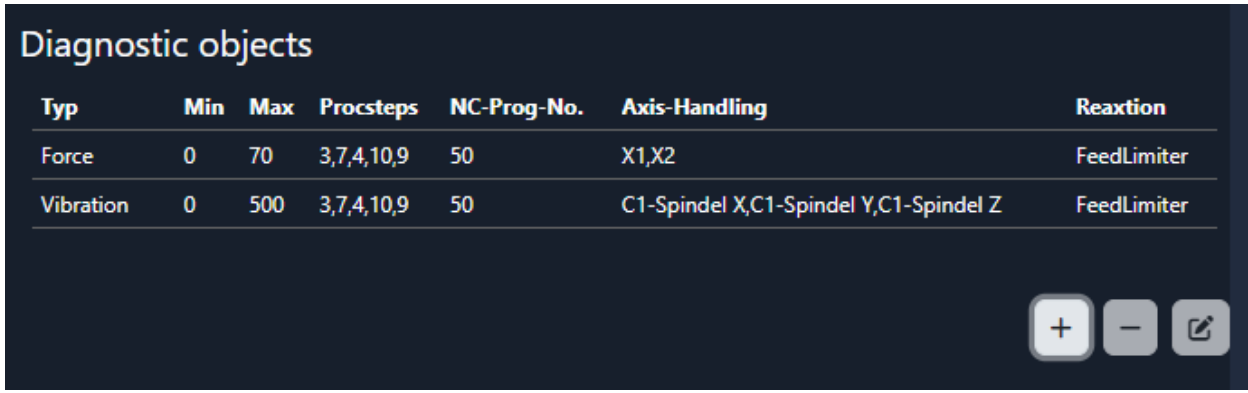
Feed Limiter

Feed Limiter

How does the feed limiter work?

The machine feed rate is reduced by entering limit values for current and vibrations. If 100% of the set limit value is exceeded, the feed limitation becomes active. First, the feed is only reduced. If 120% of the limit exceeded, the feed limiter writes the value to 0%.

The feed rate is increased again only when the value falls below 100% of the limit.



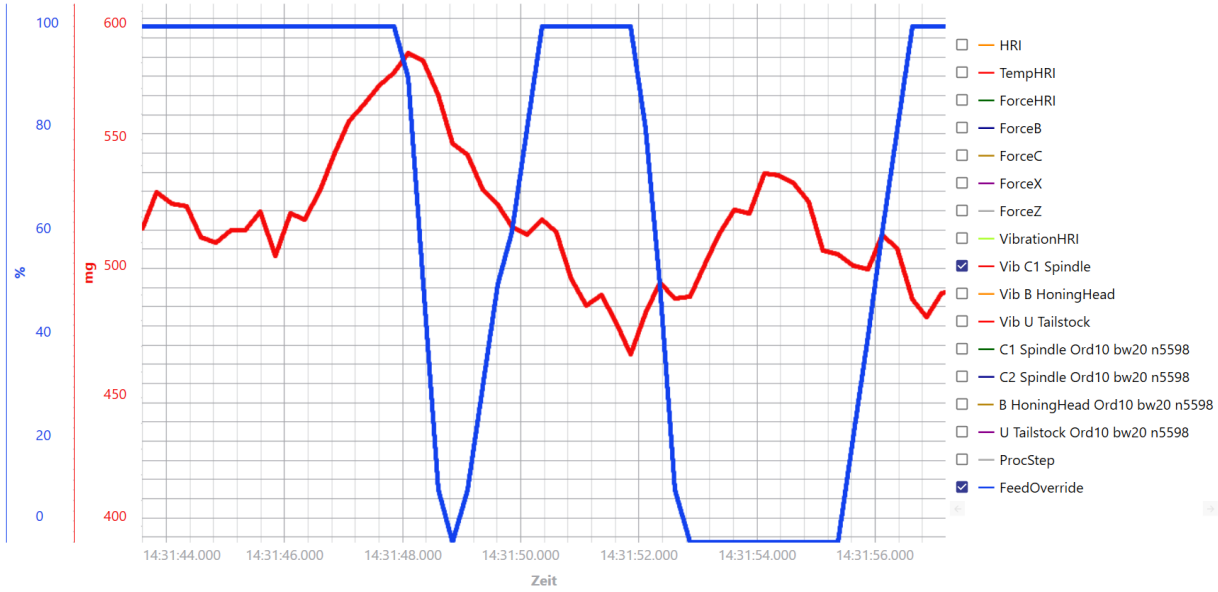
Feed Limiter

Example of a feed limitation

The machine feed is limited by the vibrations of the U-axis.

First the feed is reduced to 90% and after this measure is insufficient it is reduced to 0%.

When the vibrations fall below the limit value again, the feed is increased again.



HRI® settings

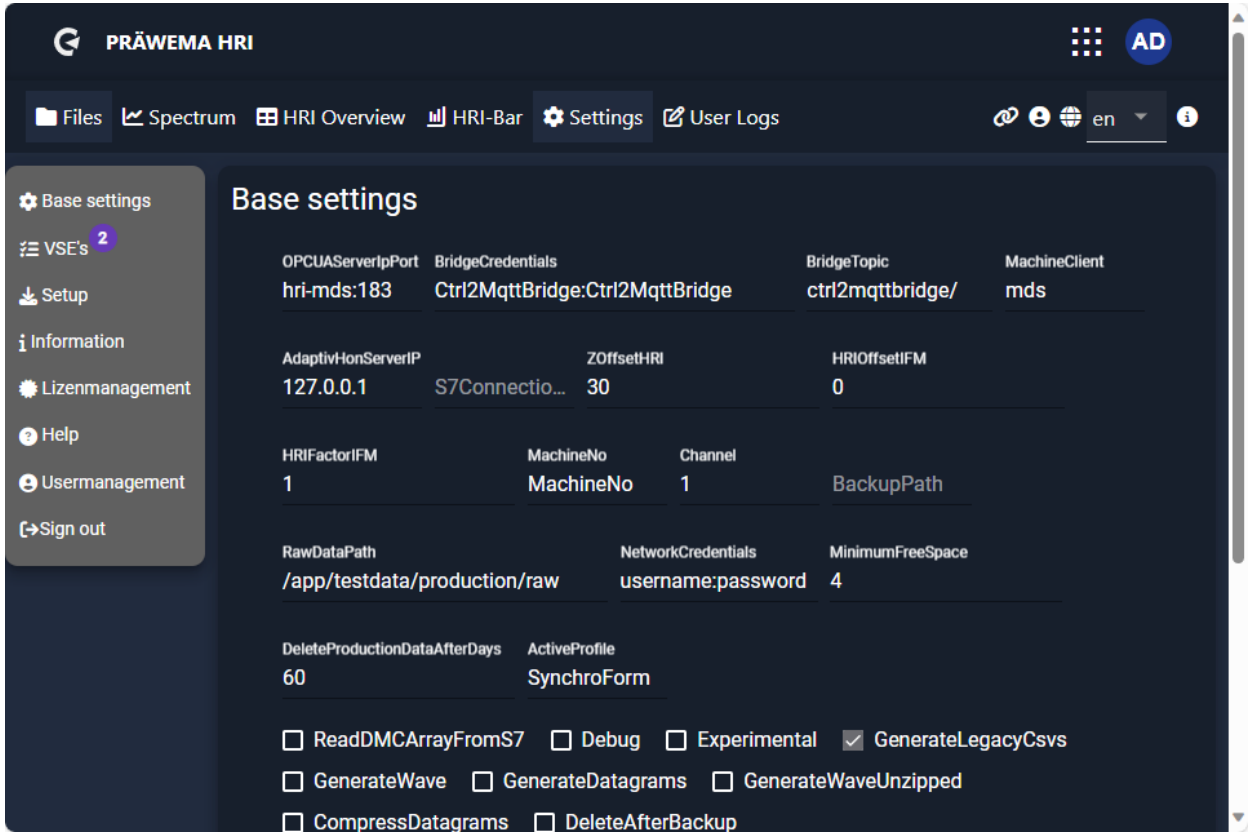
HRI® settings

Base settings

All important settings for communication between the HRImachine and the control can be set under base settings.

Furthermore, some additional options can be set.

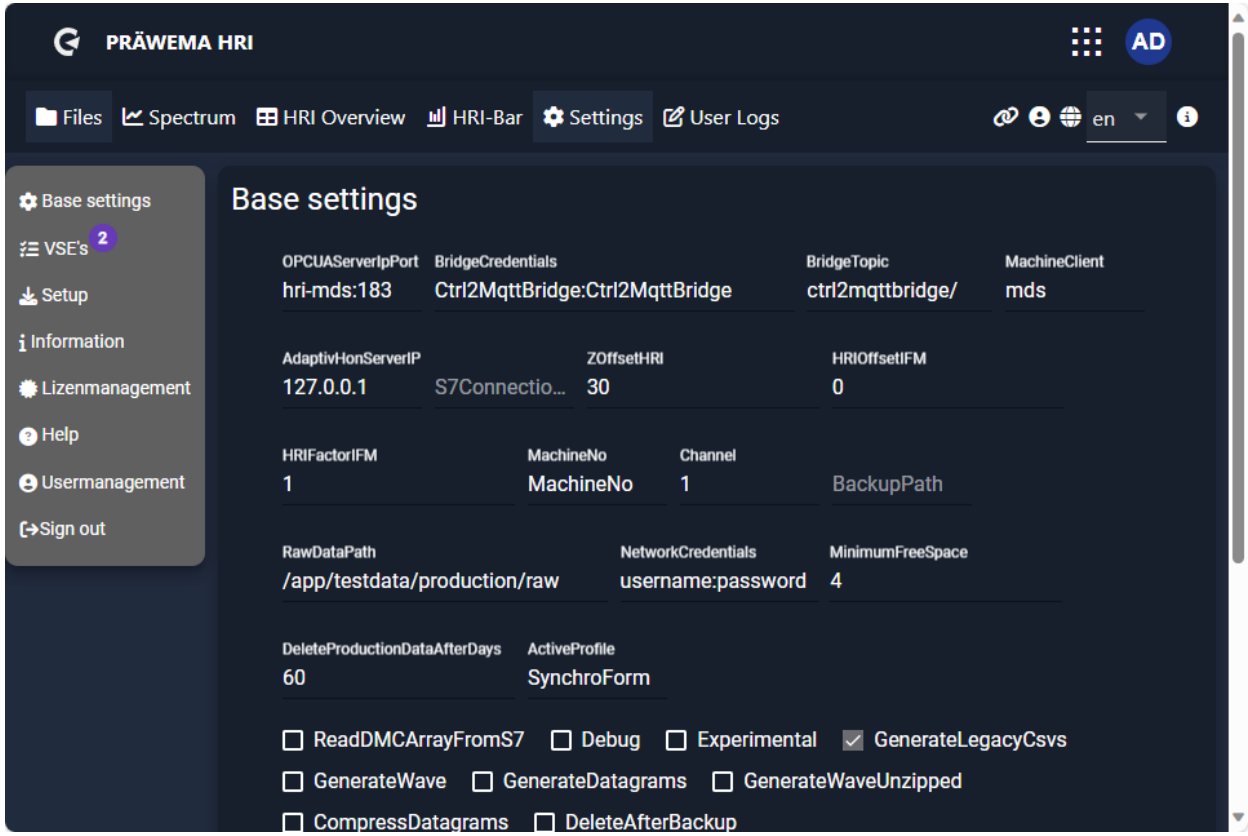
The basic settings are defined once during commissioning. No further adjustments are required. Except in the event of faults or changes to the programming, no changes need to be made here.



HRI® settings

Basic settings for Praewema installation

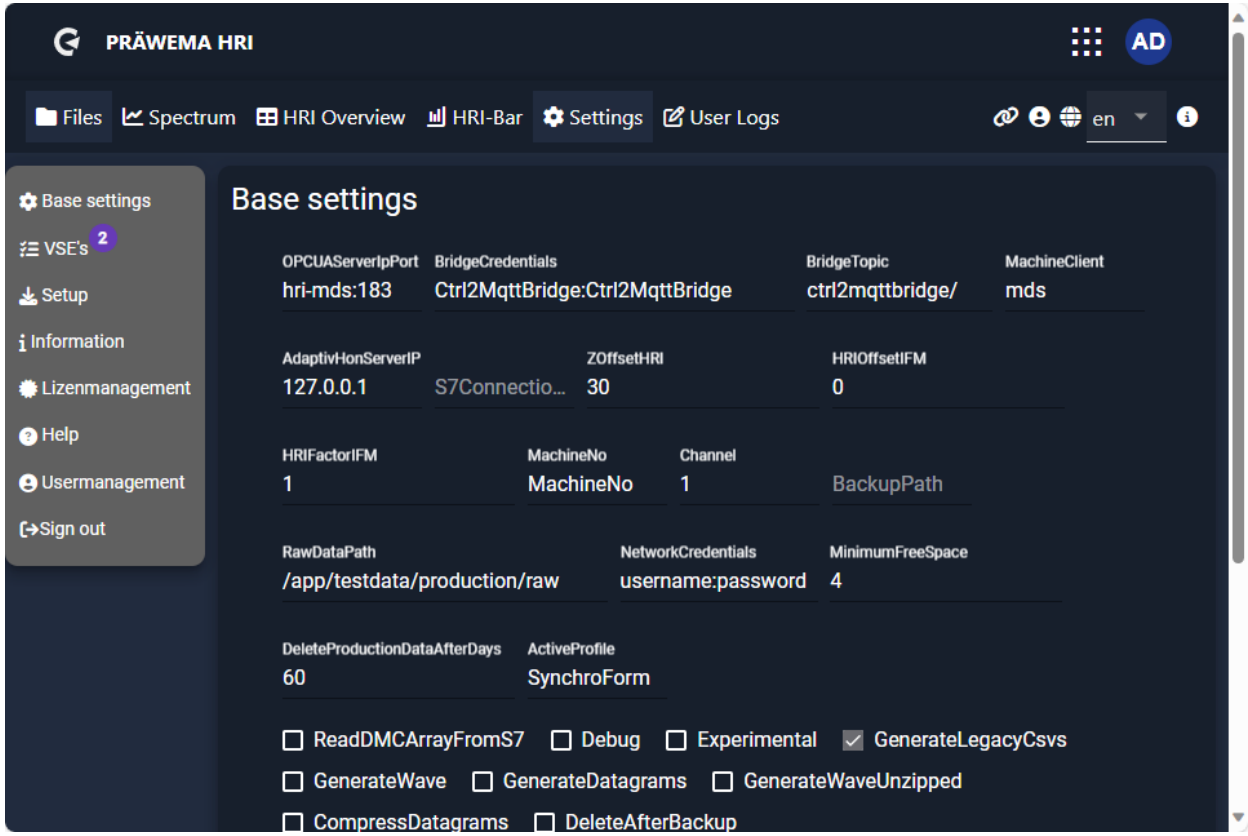
OPCUAServer Port	IP address of the controller with the OPC UA server port
Bridge Credentials	Username and password for the network bridge for DVS Edge
Bridge Topic	For DVS Edge
Machine Client	For DVS Edge
Adaptiv Hon ServerIP	IP address of the controller with the AdaptivHonServer
S7Connection IP	IP address of the S7 CPU in Profinet



HRI® settings

Basic settings for Praewema installation

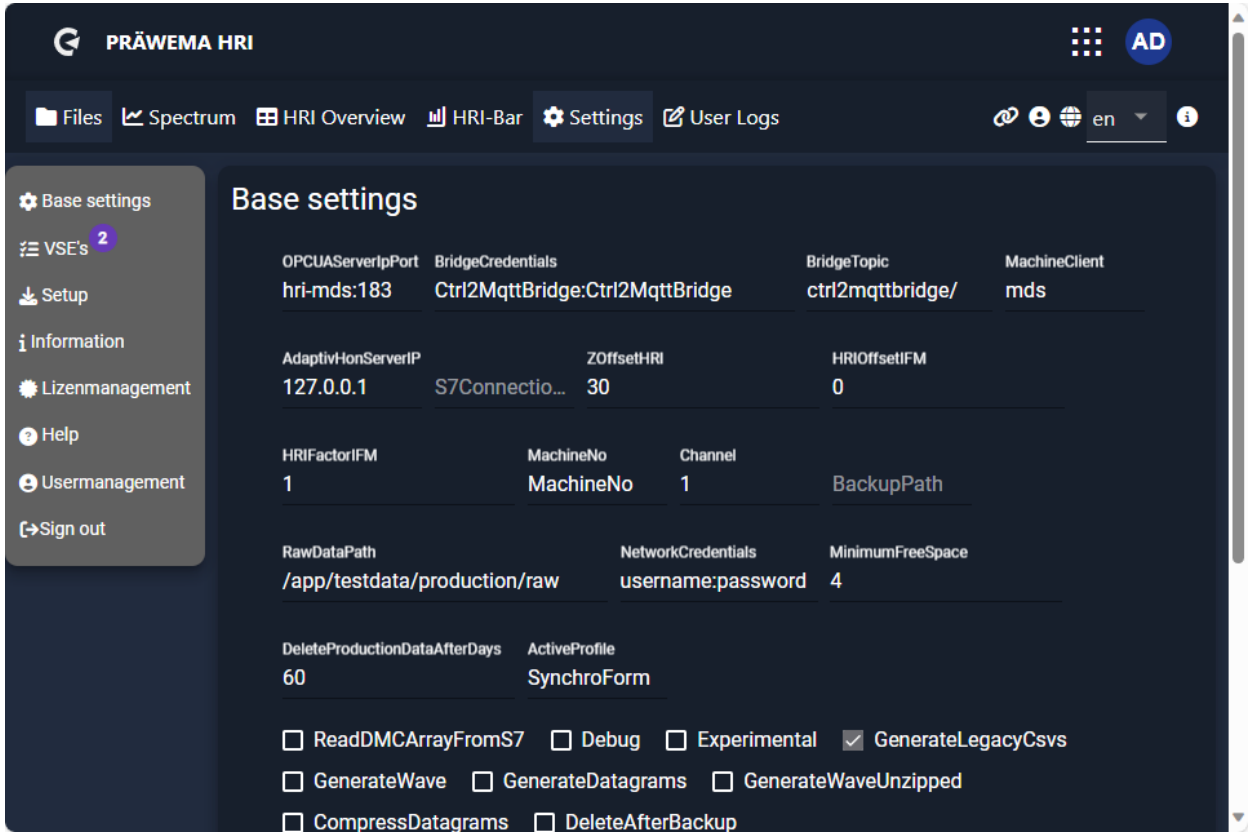
ReadDMC ArrayFromS7	Read data matrix code from Siemens S7
Channel	NC Channel from the Siemens S7 controller
PublishRaw DataViaMqtt	Sends raw data via MQTT
ForceOrder Monitoring	At least one regulatory monitoring system must be in place.
Experimental	Beta functions – **be careful with production machines!**



HRI® settings

Basic settings for Praewema installation

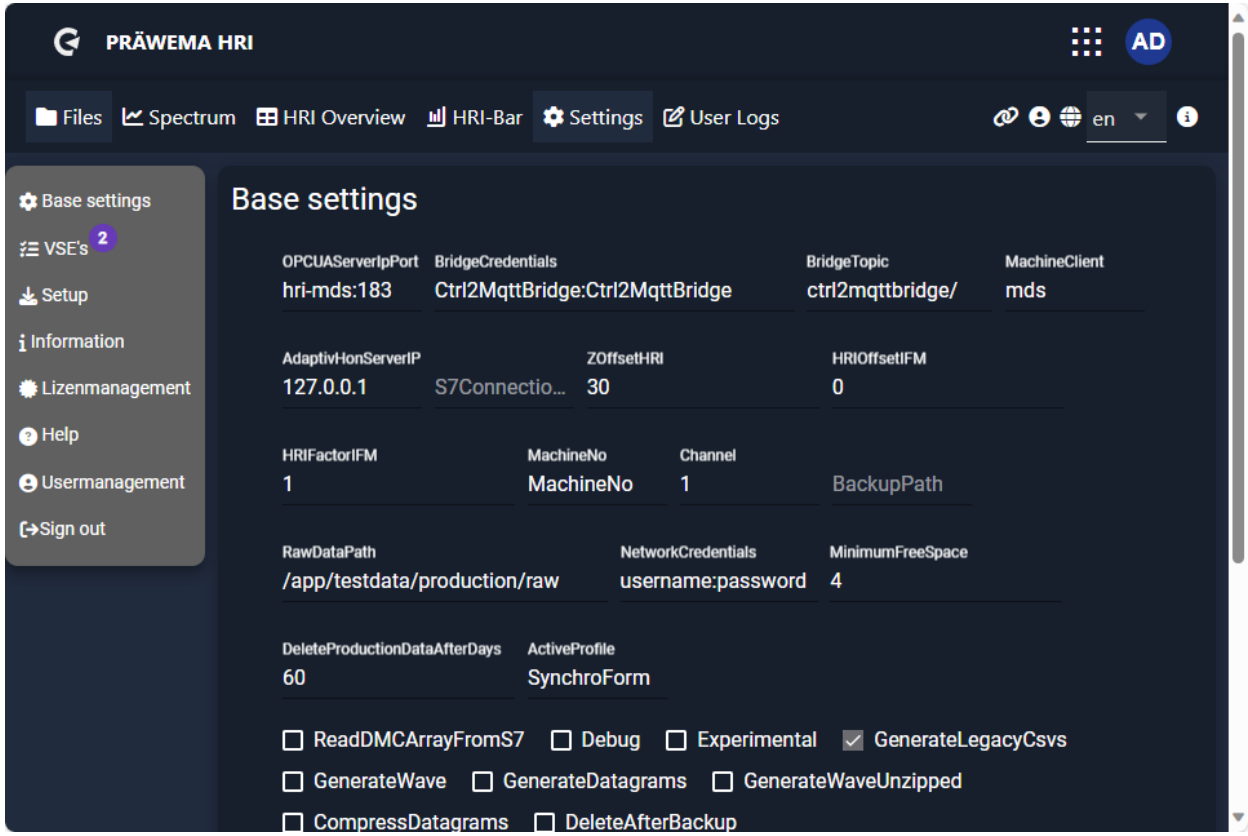
ActiveProfile	Active profile – SynchroForm or SynchroFine
InvertHRI CommMonitor	Invert communication monitoring
FeedOverride InPercent	Feed limiter is written to PLC in percent.



HRI® settings

Basic settings for costumer

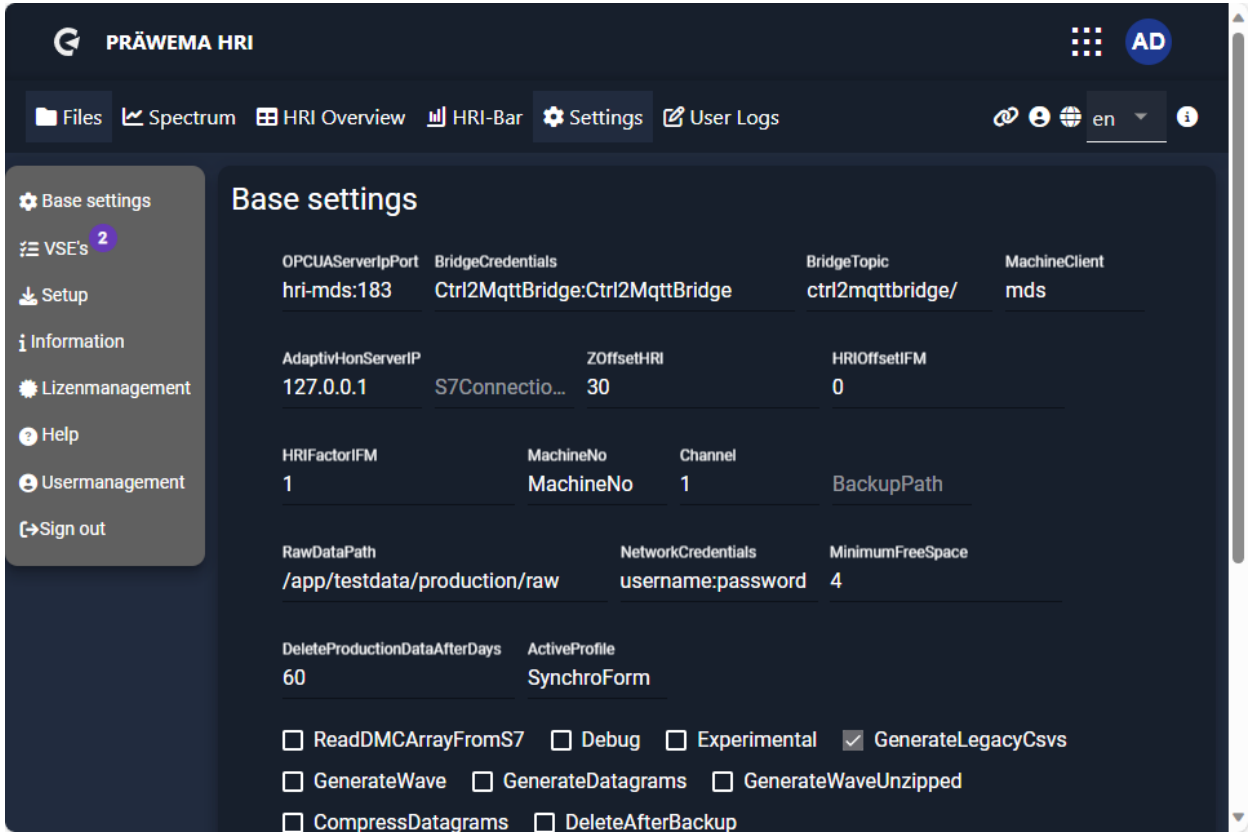
ZOffsetHRI	Only for SynchroFine – offset to the force of the Z axis when the tailstock is activated
HRIOffsetIFM	Offset from the vibration of the HRI calculation
HRIFactorIFM	Factor from the vibration of the HRI calculation
MachineNo	Number of the machine
Debug	Debug function for more recordings



HRI® settings

Base settings for costumer

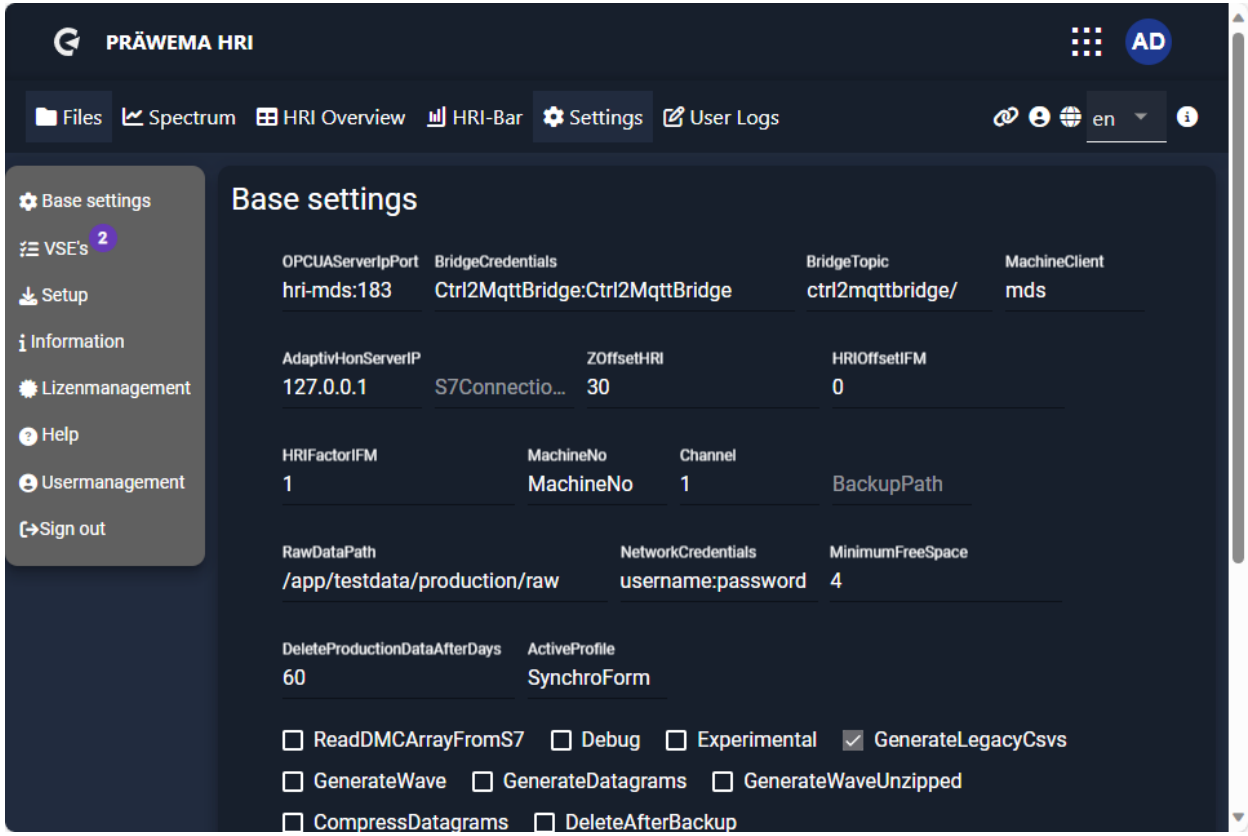
BackupPath	Storage path for the HRI backup on a server
RawDataPath	Storage path for the raw data
Network Credentials	Username and password to log in to a server
Minimum Free Space	Minimum free disk space (in MB)
Delete Production Data After Days	Deletion of logging files after number of days on the machine.



HRI® settings

Base settings for costumer

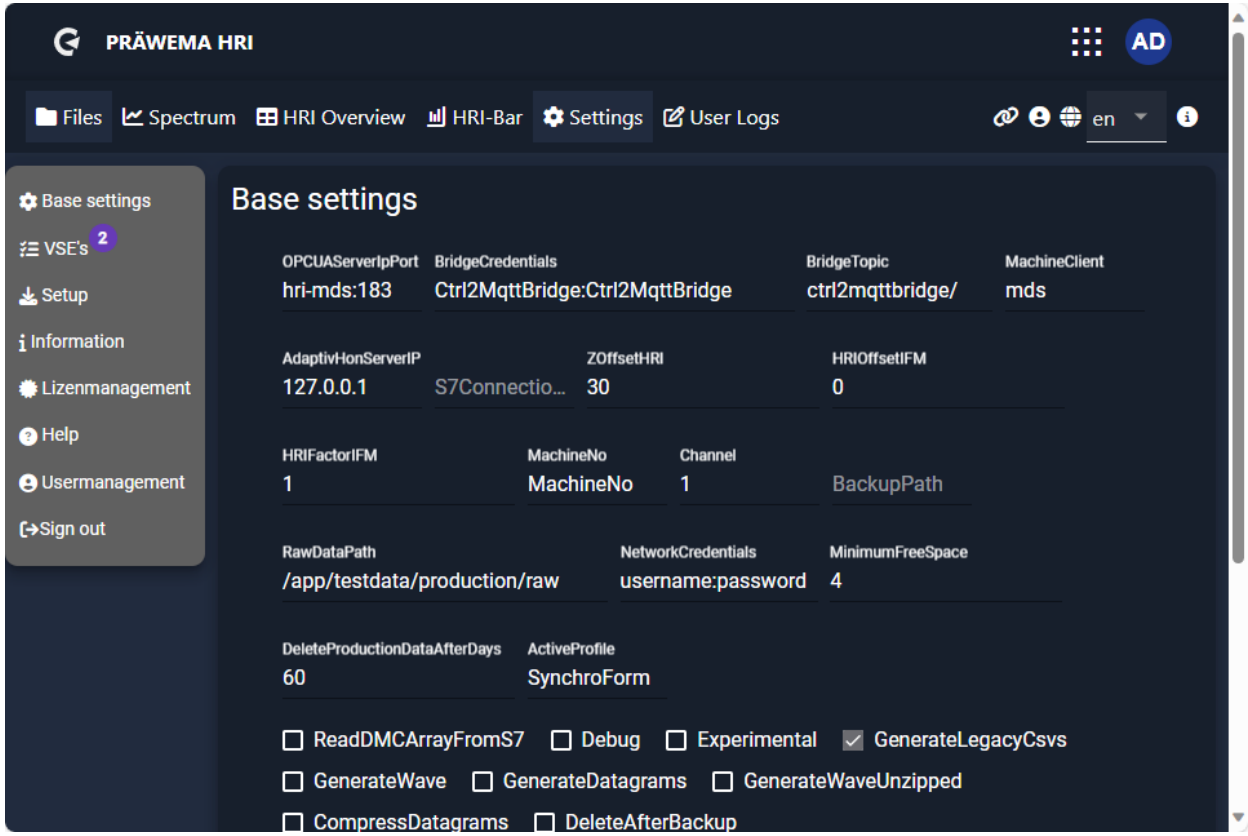
LegacyCsv SaveAvgMax	Stores the average and maximum amplitude of the vibrations for IO components.
DeleteAfter Backup	Deletes the logging files on the machine if an external backup path is set up.



HRI® settings

Base settings for data formats

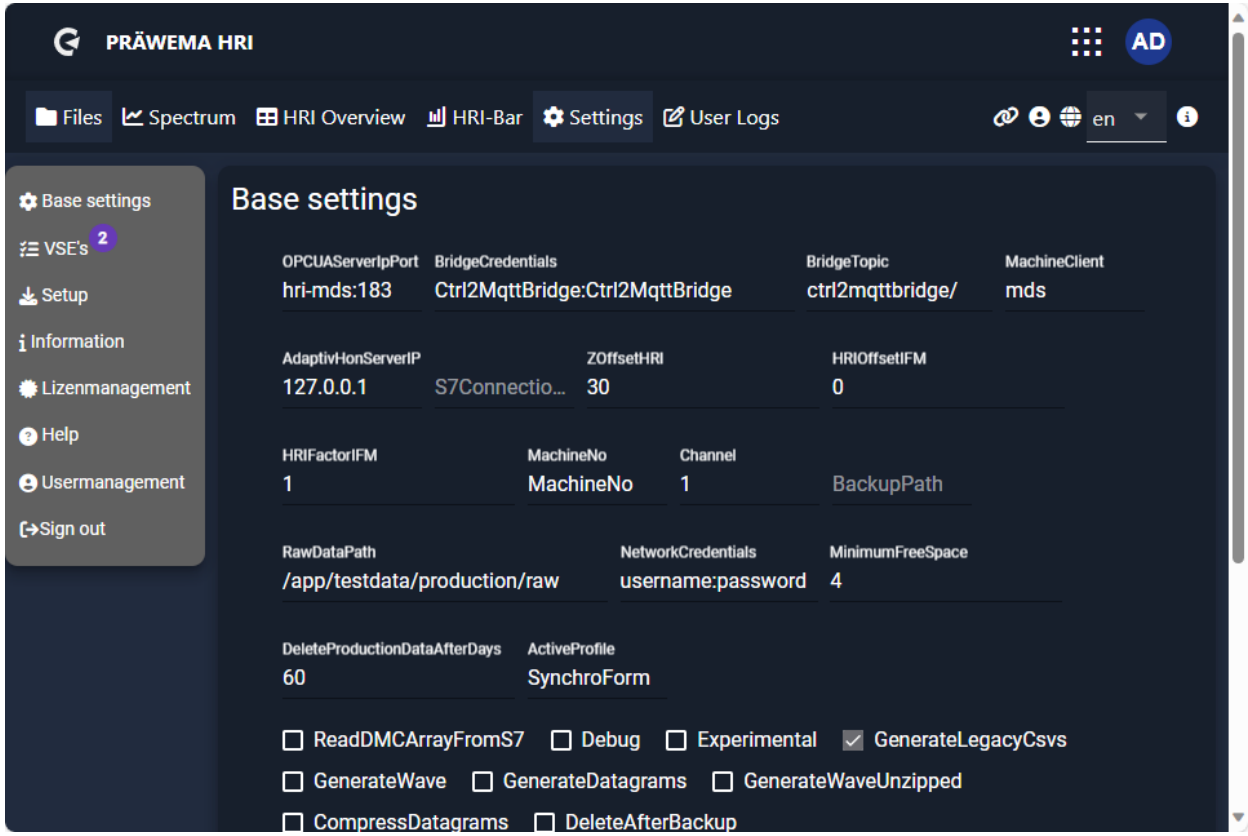
Generate LegacyCsvs	Create standard CSV log files
Generate Wave	Creates a compressed WAVE file from the data from the vibration sensors.
Generate Datagrams	Generates datagrams for analyzing the parts
Generate WaveUnzipped	Creates an uncompressed WAVE file from the data from the vibration sensors.



HRI® settings

Base settings for data formats

CompressDatagrams	Compress datagrams
EnableRawData	Record raw data



HRI® settings

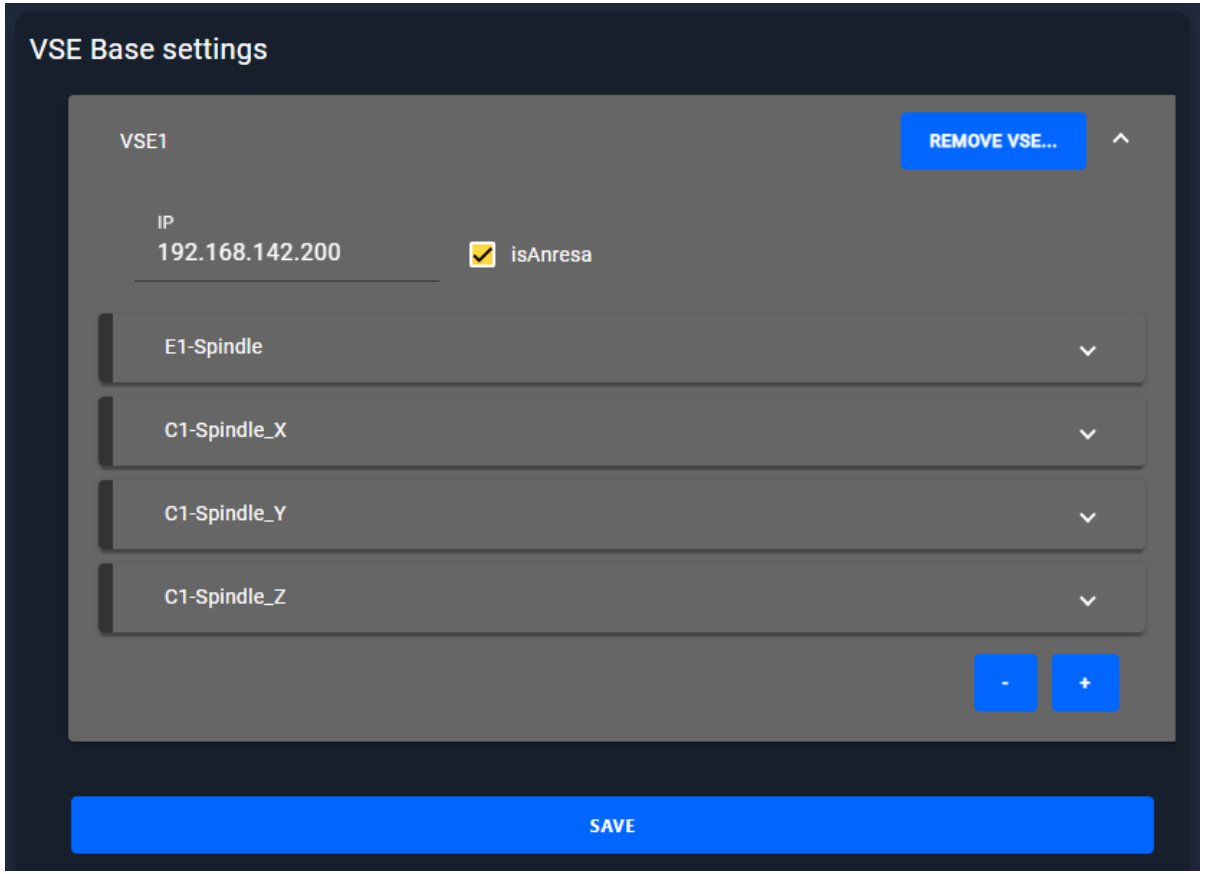
VSE base settings

The individual VSE evaluation units from the manufacturer IFM are displayed in the VSE basic settings.

Usually, one or two VSE with the firmware AnReSa are used. 4 vibration sensor inputs can be connected to each evaluation unit.

On older machines, a VSE unit was installed for each sensor.

In the example, a single-axis VSA001 sensor and a three-axis VSM103 sensor are connected.

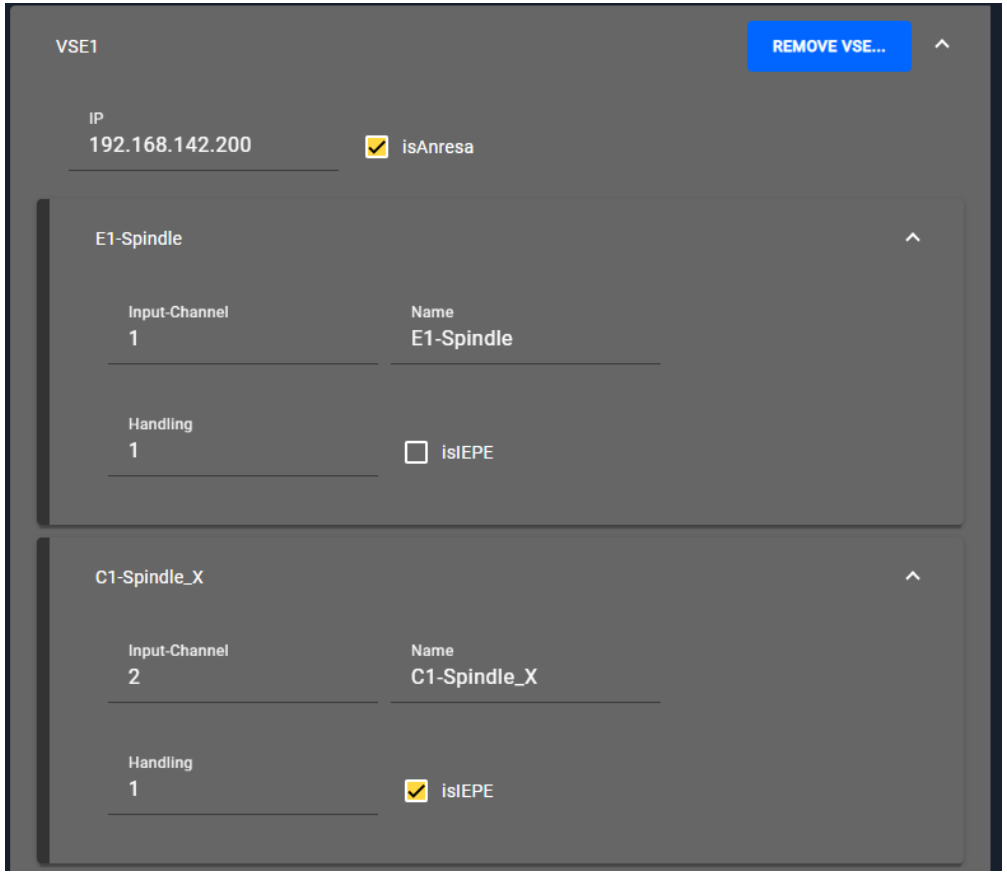


HRI® settings

VSE base settings

The single-axis sensor VSA001 is connected to sensor input 1 and set up as an IFM standard vibration sensor.

The three-axis sensor is connected to inputs 2-4 and set up as an IEPE sensor (current). Each axis of the sensor requires a separate input on the evaluation unit.

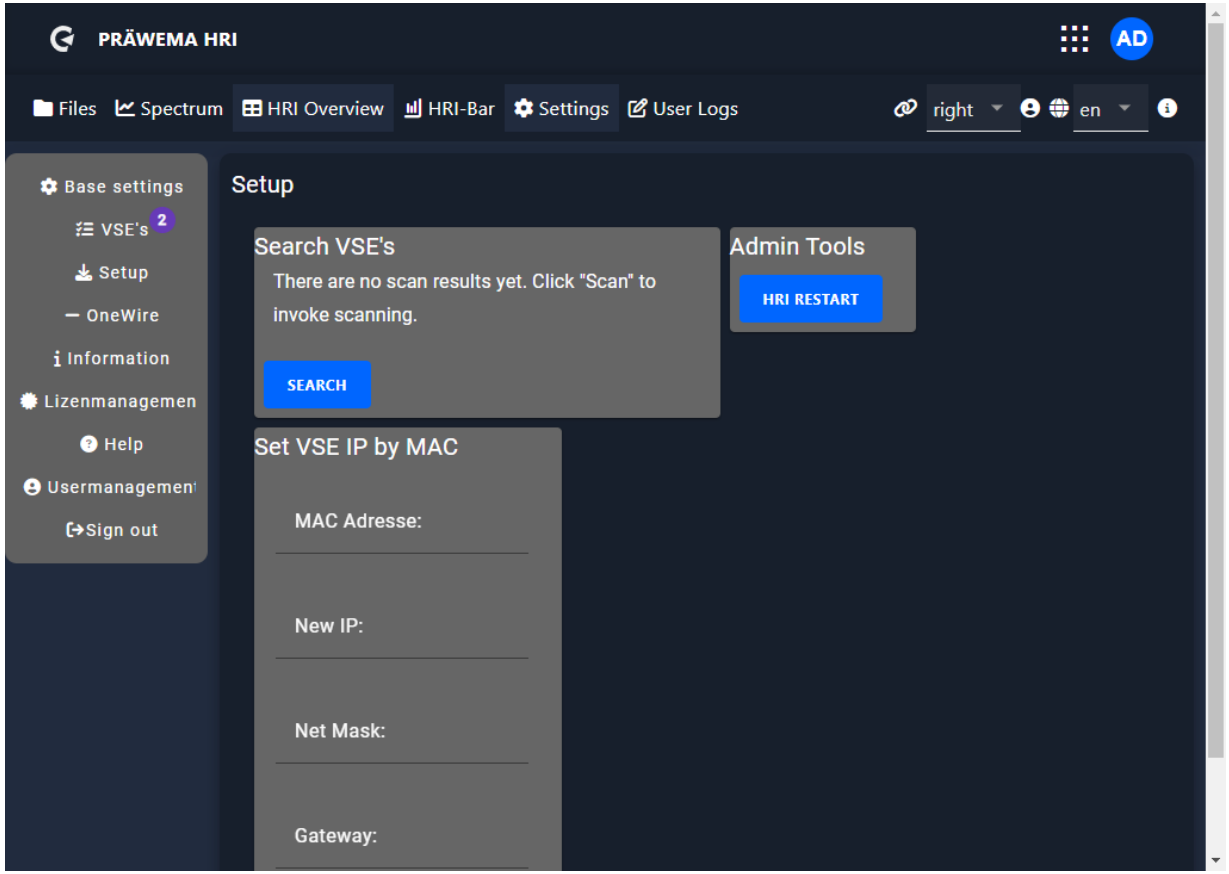


HRI® settings

Setup

In the “Setup" tab, you can search for the evaluation units of the VSE vibration sensors.

The HRI backend can be restarted and if the search for a VSE was unsuccessful, the IP address of the VSE unit can be changed via the MAC address.



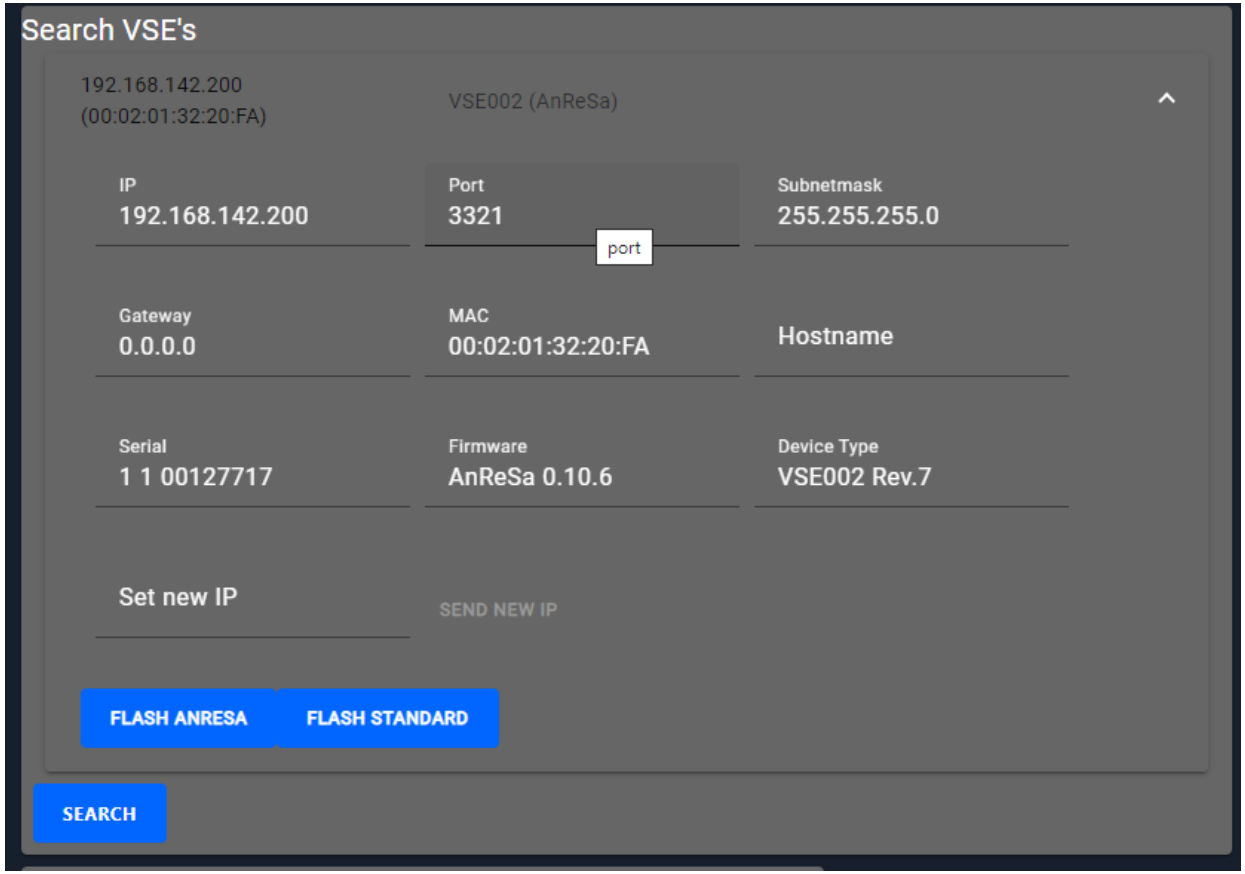
HRI® settings

Setup

After identifying a VSE unit, all relevant settings and information are displayed. In this context, it is possible to change the IP address. It is also possible to switch between the two firmware versions (AnReSa or Standard).

Please note that changes with the IFM Octavis software can only be made with the standard firmware.

Flashing the AnReSa firmware is only possible from hardware version (DeviceType) 6. If the hardware is older, updating the firmware requires the VSE unit to be replaced.



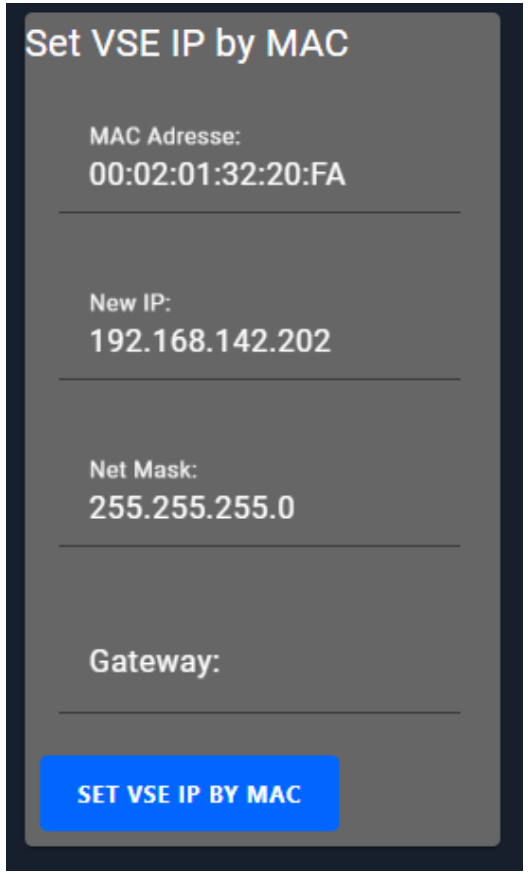
HRI® settings

Setup

If no VSE unit is found or it is not possible to configure the IP address, there is the option of setting the IP address using the MAC address.

The MAC address is located on a sticker on the side of the VSE unit.

To carry out the configuration, the MAC address, the new IP address and the subnet mask must be entered.

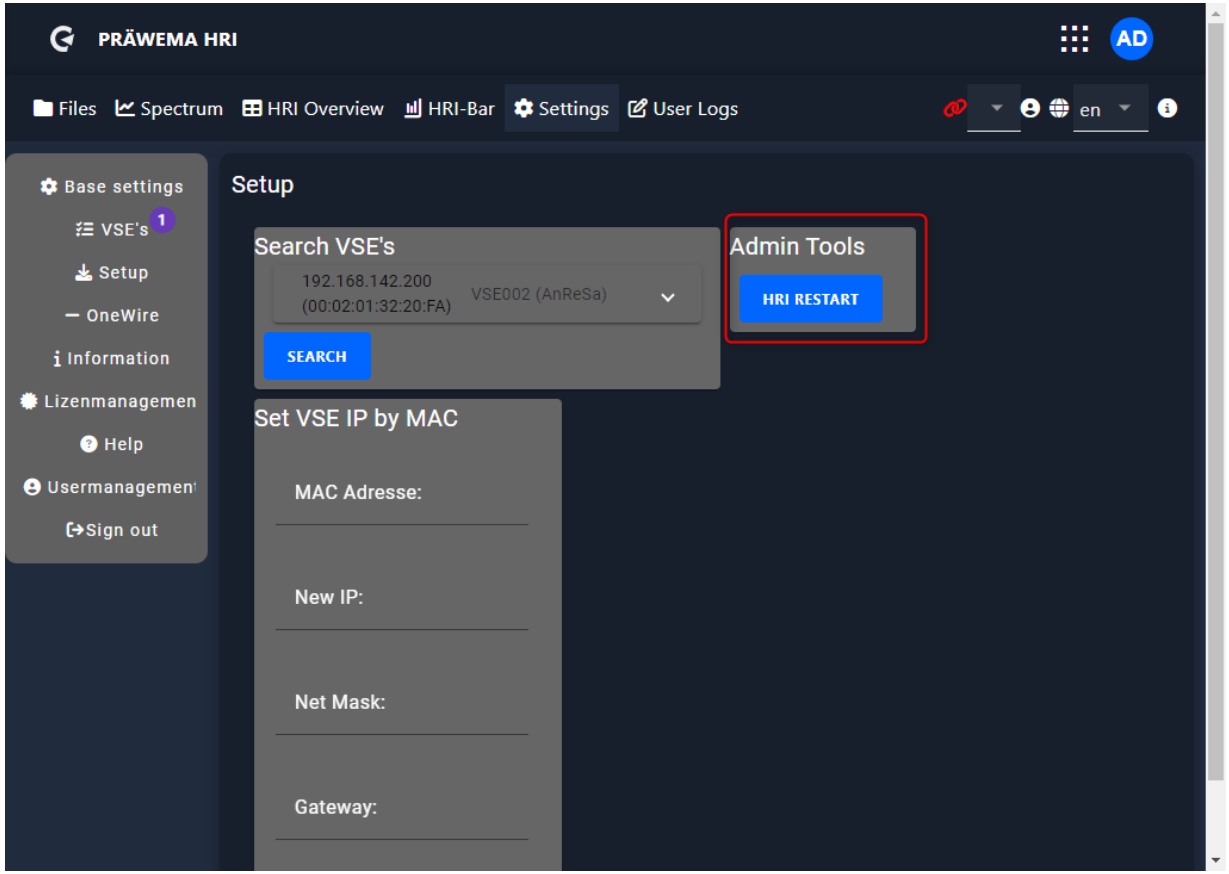


HRI® settings

Setup

To apply changes, it is necessary to restart HRI.

HRI can be restarted in the setup tab.



HRI® settings

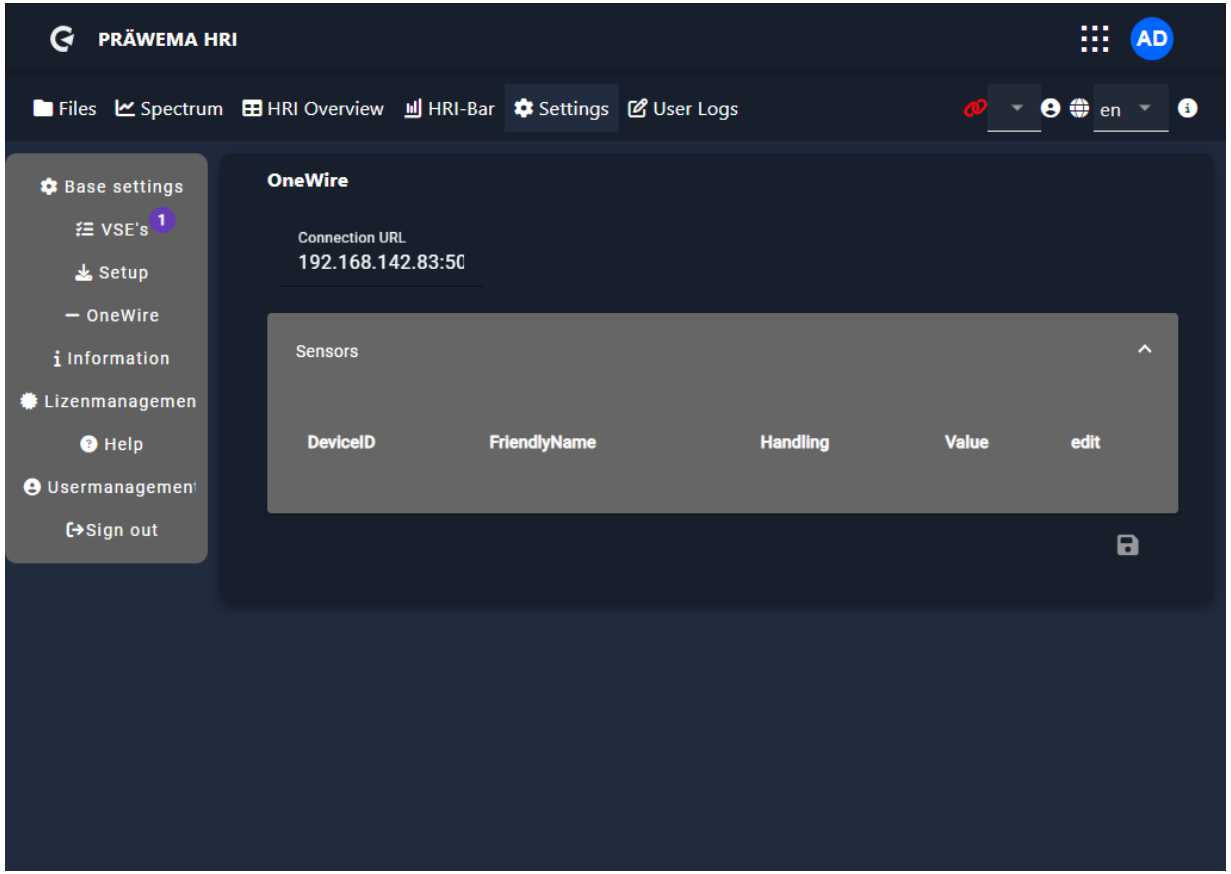
OneWire

The tooling and workpiece spindles have temperature sensors to monitor the bearing temperature.

These sensors use the OneWire bus.

The IP address of the controller must be entered in the HRI. After a successful connection to the controller, all connected sensors are automatically recognized.

The sensors are assigned to the respective mounting locations by using the serial number of the OneWire sensors.

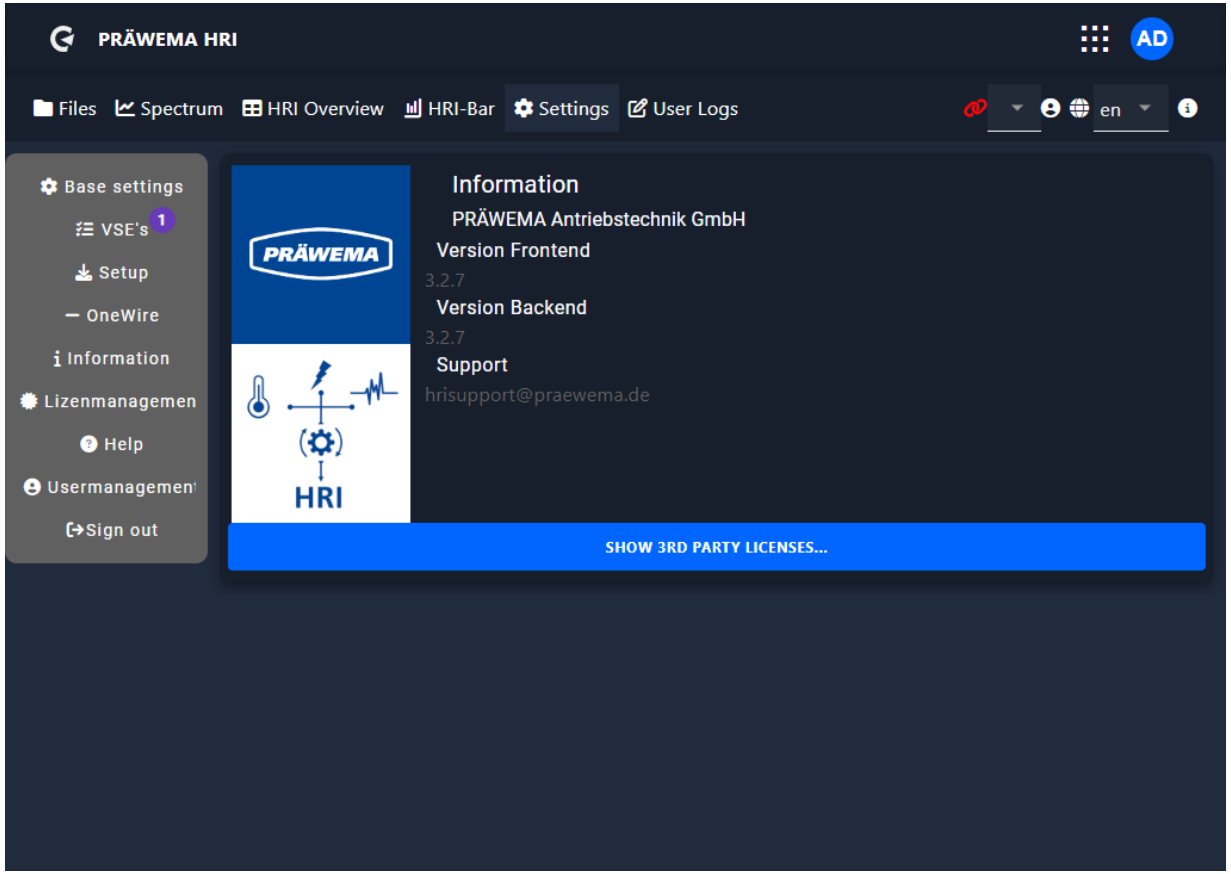


HRI® settings

Information

The backend and frontend versions are displayed under Information.

In case of errors, be sure to indicate the program versions.

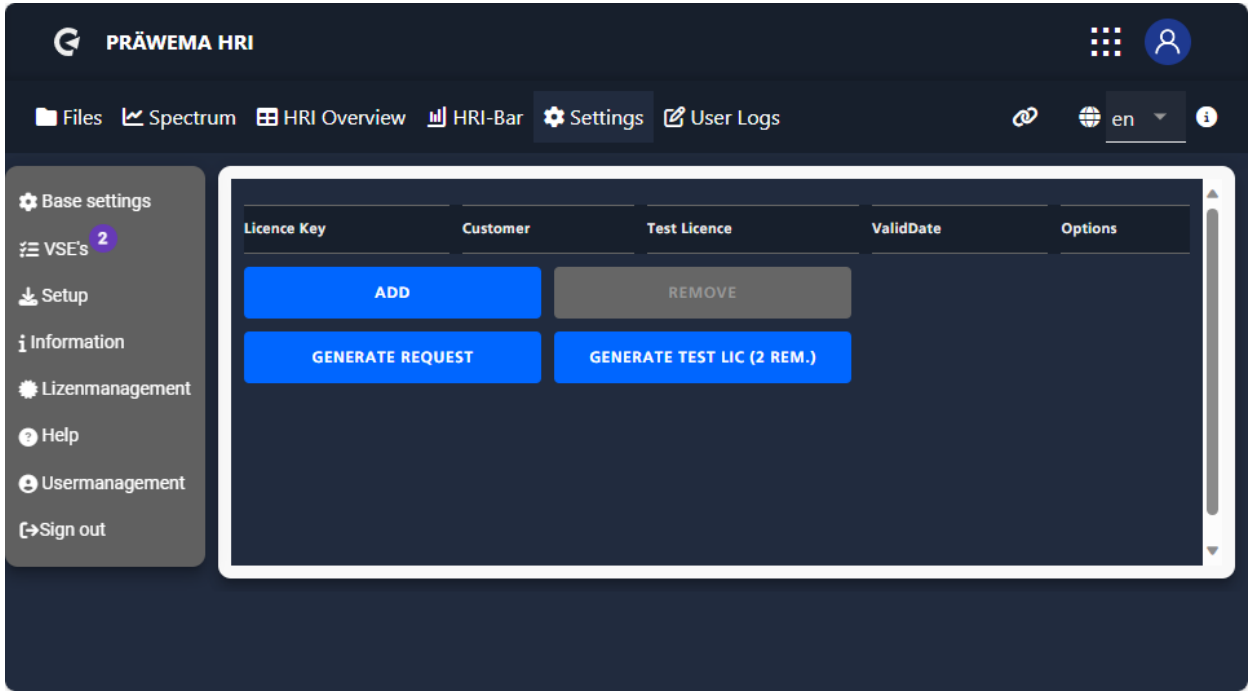


HRI® settings

License management

The installed licenses are displayed under the license management. Under the button "ADD" further licenses can be installed and under "REMOVE" the licenses can be deleted again.

With "GENERATE TEST LIC" a test license can be generated twice. The test license works until the last day of the following month.



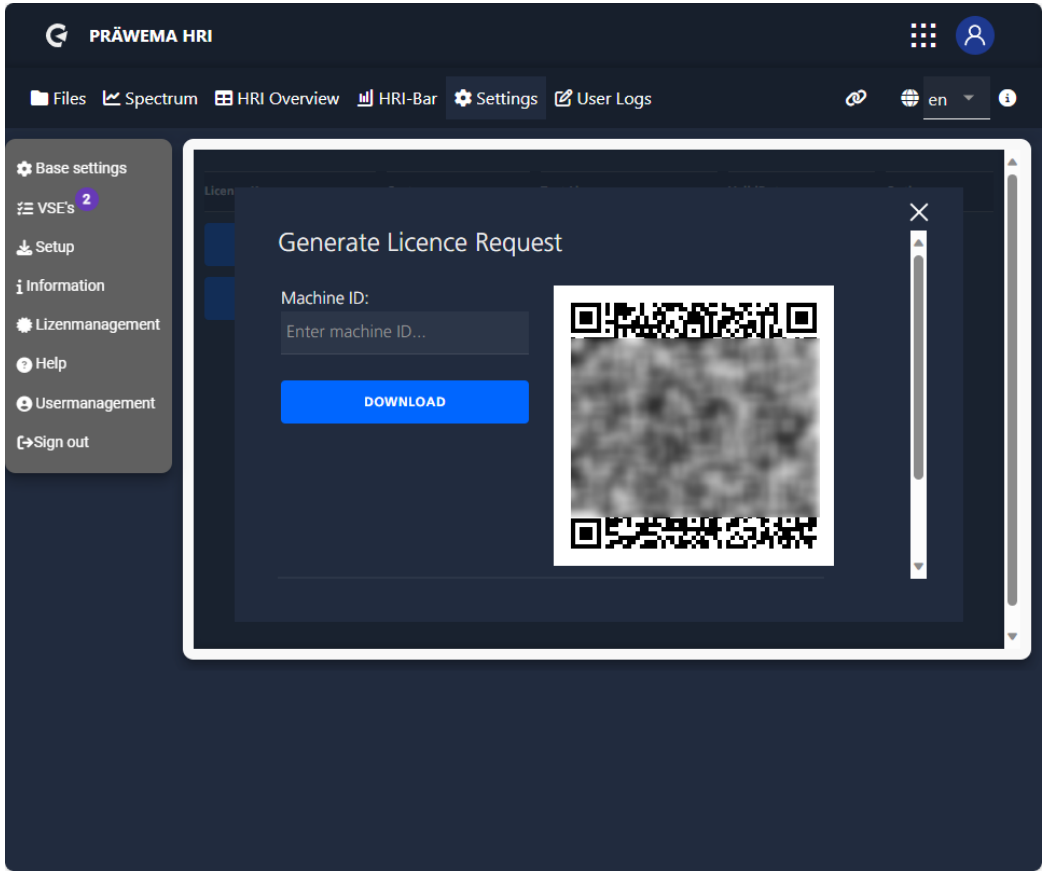
HRI® settings

License management

GENERATE REQUEST" creates an LRQ file. This file can then be used to generate a permanent license. The machine number must be entered to create the LRQ file.

The license key is linked to a MAC address of the controller. When the controller is replaced, a new license must be created. Test licenses can be used for the transition.

The LRQ file is saved in the Downloads folder.

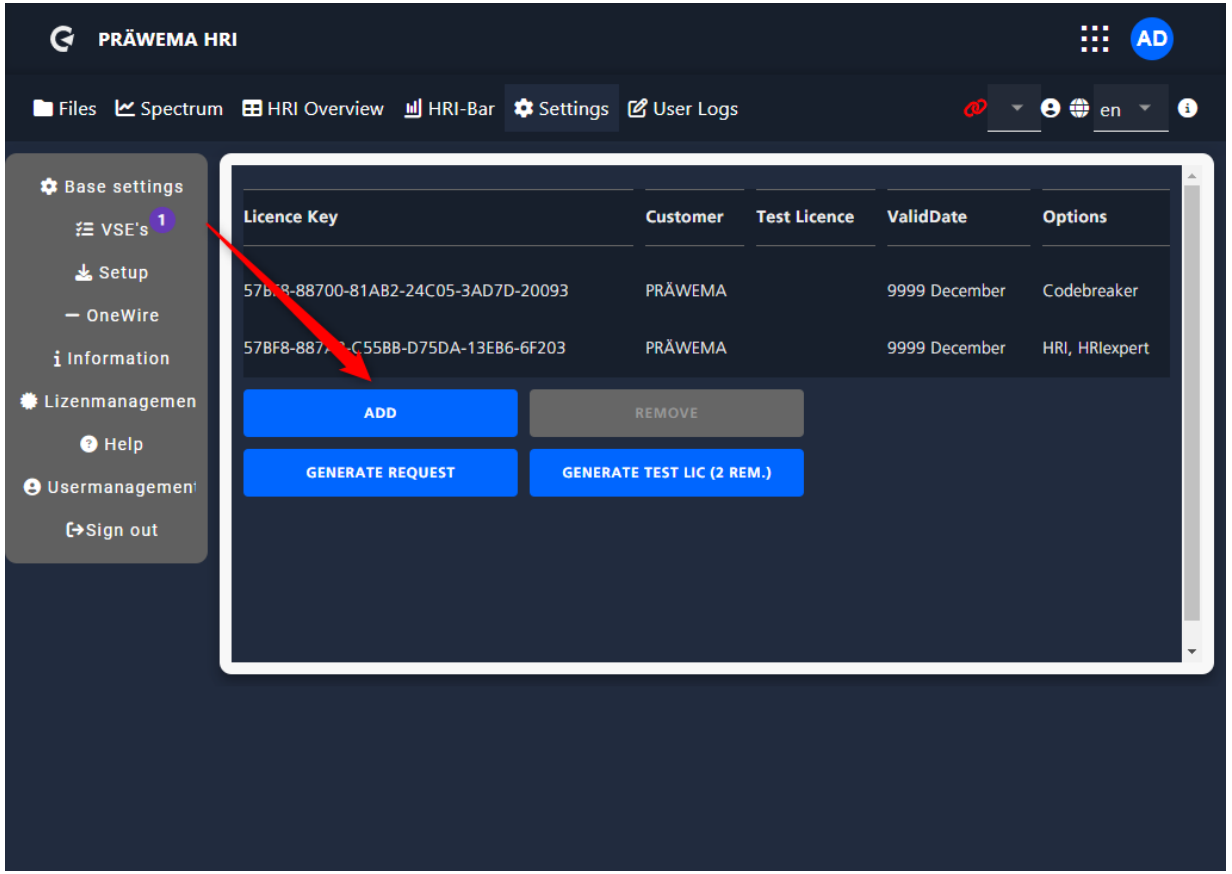


HRI® settings

License management

The information from the License Request File can be used to create a permanent or provisional license and a License File is generated. This license file must be installed in the HRI in order to activate all functions.

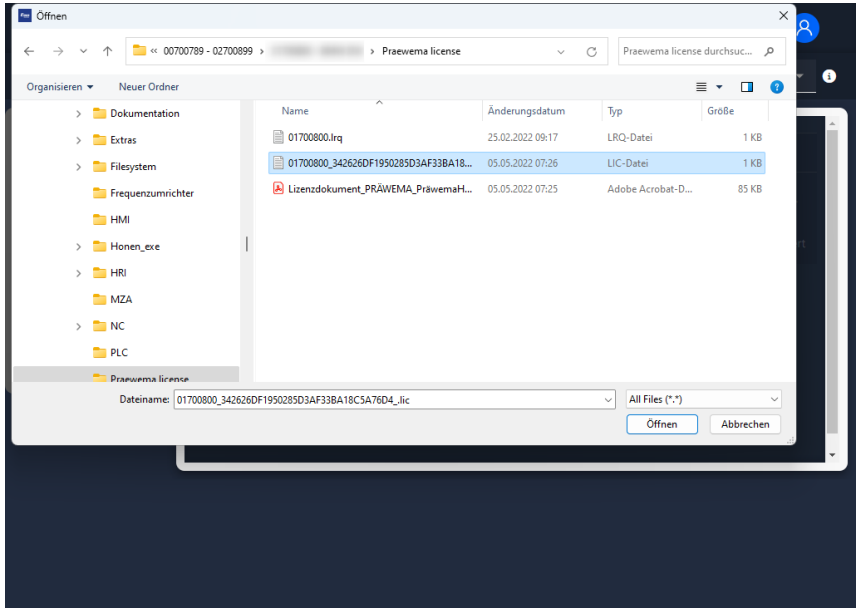
The ADD button opens another window.

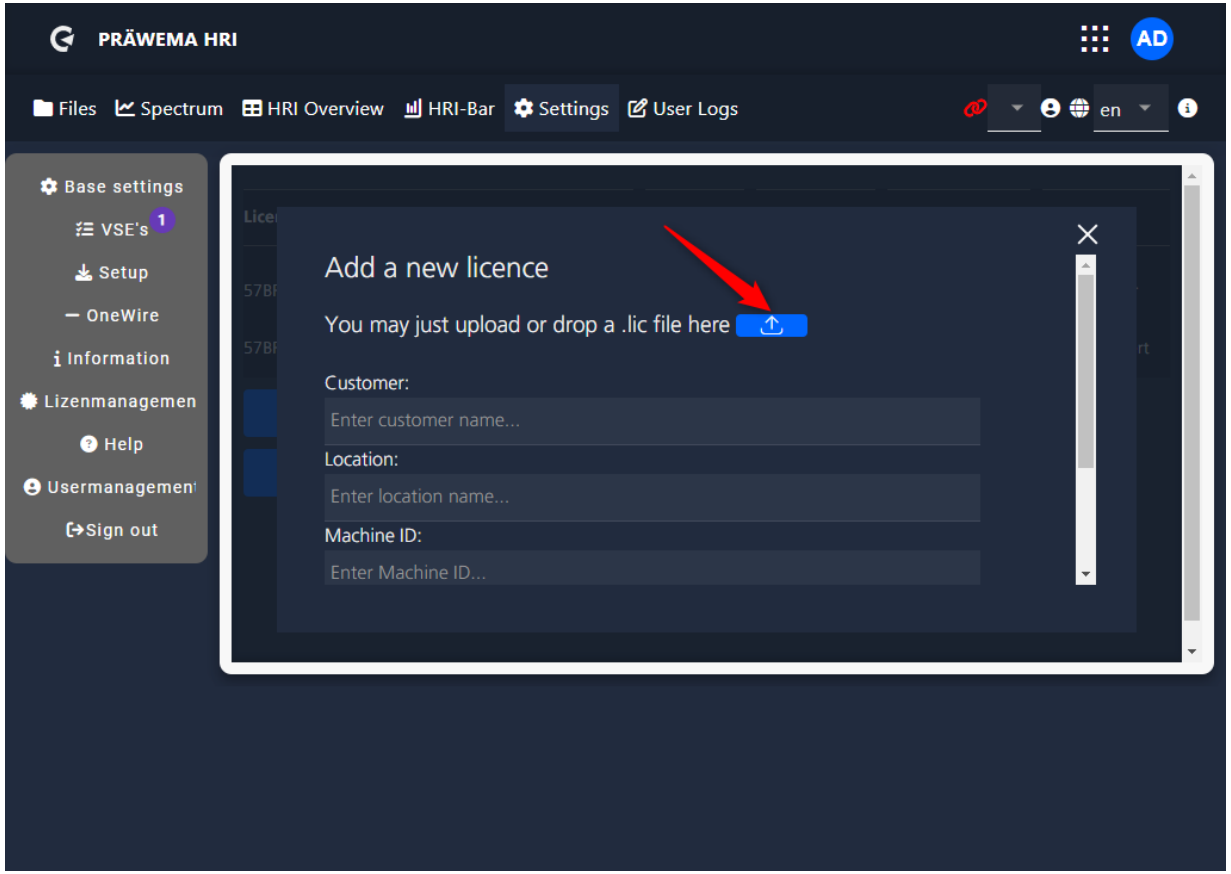


HRI® settings

License management

Here you can import the LIC file by clicking on the blue button.

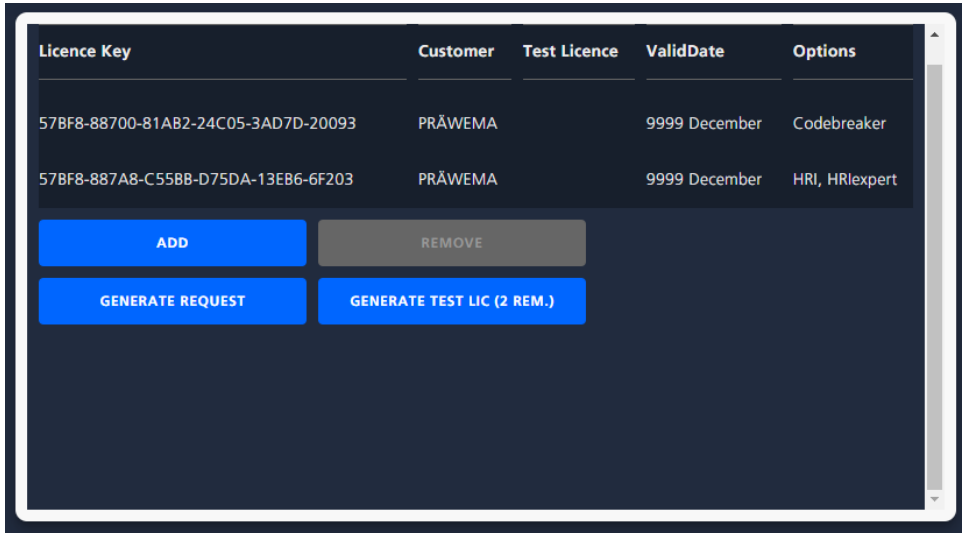




HRI® settings

License management

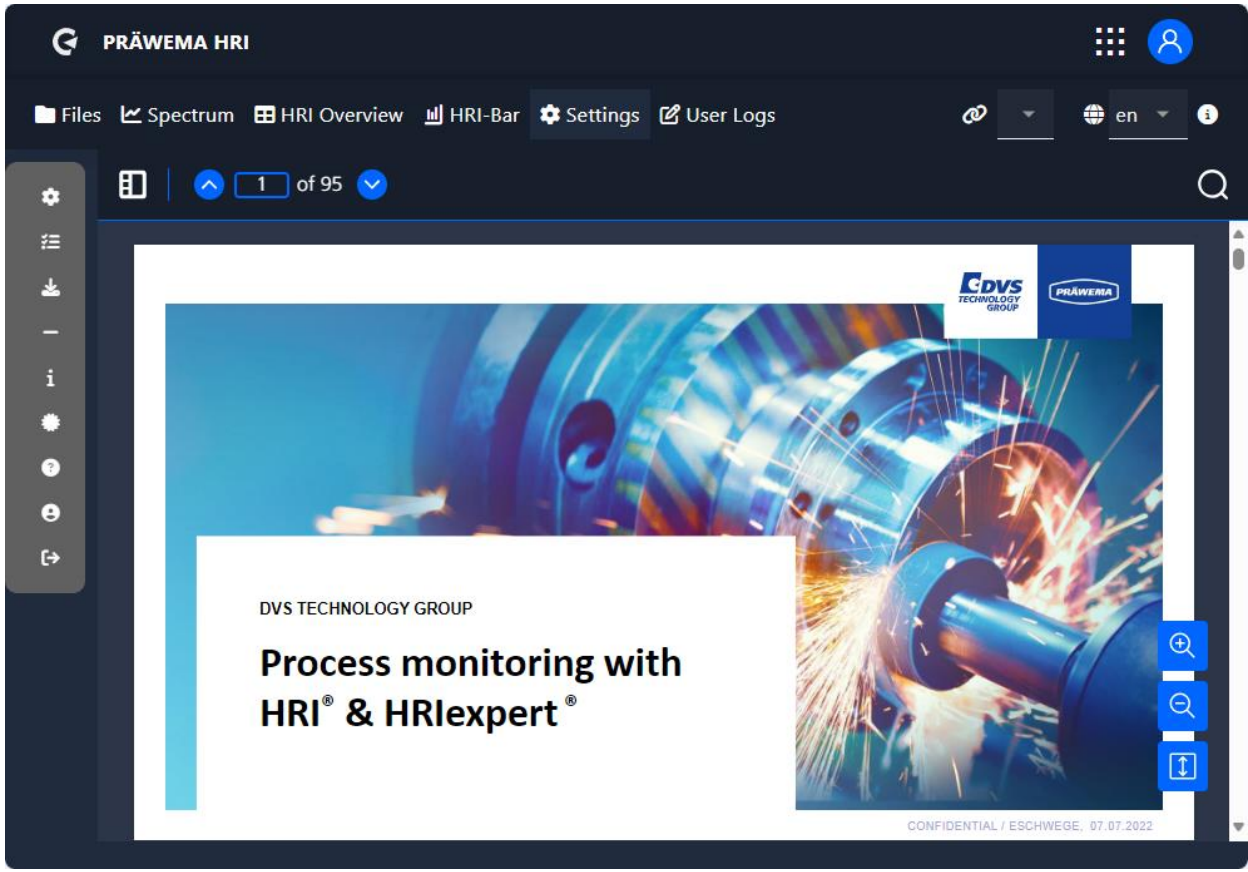
After the import you have to scroll down in the window and save the license key. The new license key is then displayed in the overview.



HRI® settings

Help

The training documentation for HRI® and HRIexpert® can be found under Help.

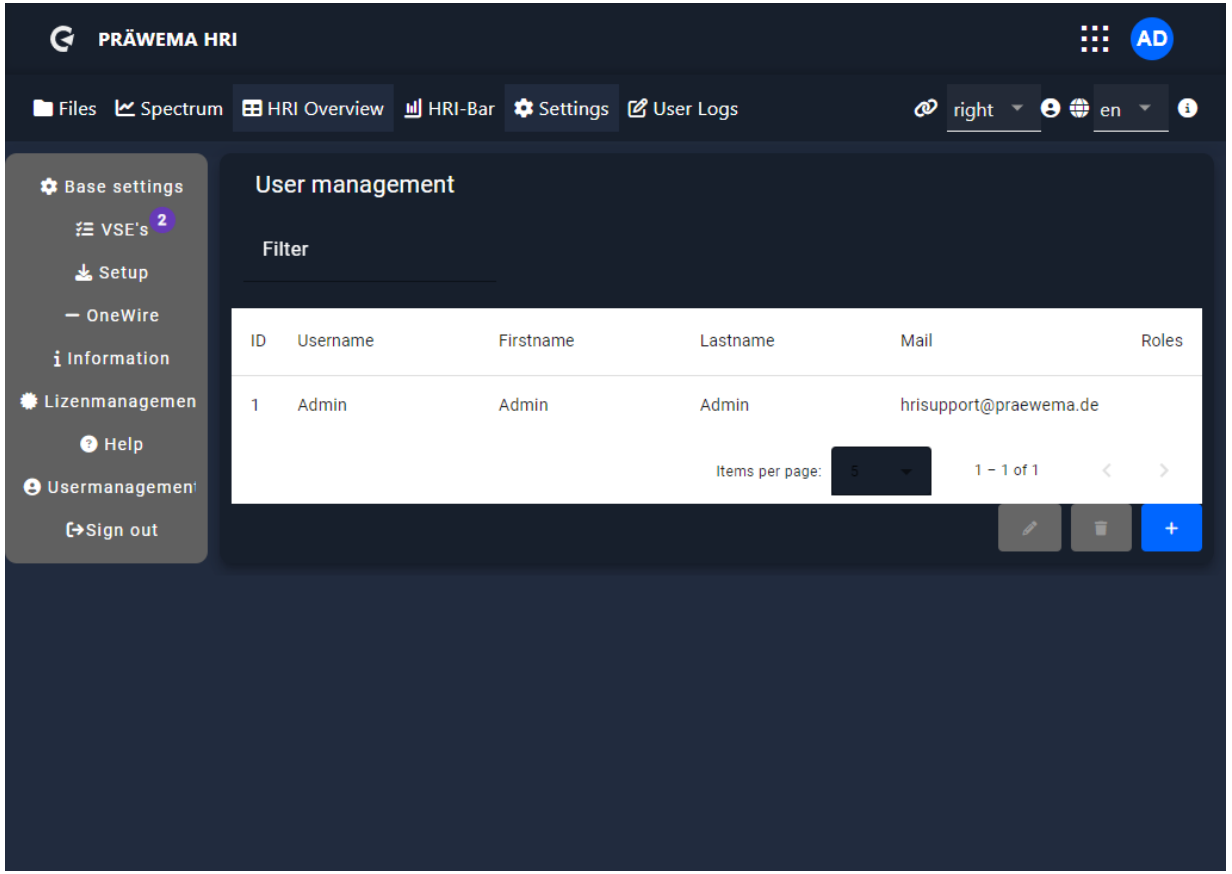


HRI® settings

User management

Different users can be created in user management.
There are 3 permission levels

Permission levels	
Operator	No authorization to change limit values.
Setter	Changes to the limit values by the setter are possible.
Administrator	Changes to limit values and settings are possible.

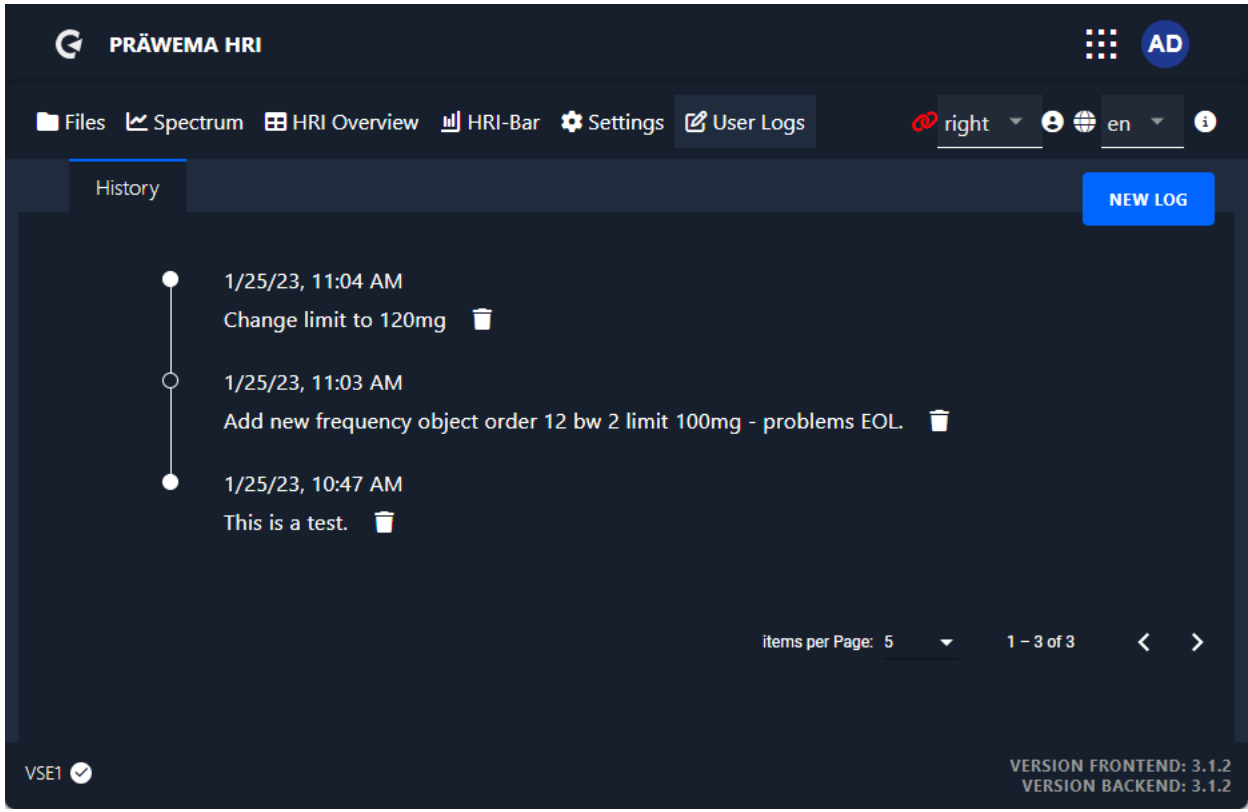


HRI® settings

User logs

A logbook for the machine can be created in the “User Logs” tab.

Here notes about changes and adjustments can be entered. This allows you to document why HRI objects were changed and what effects it has.



Process monitoring
HRIexpert®

Process monitoring HRIexpert®

What is HRIexpert®?

HRIexpert® extends the functional scope of HRI® to include frequency analysis (FFT) of high-frequency data. This function enables the targeted monitoring of specific orders to effectively prevent quality failures of the produced components and to detect them at an early stage, before the next process. The ability to define limit values individually and in detail is extended to orders or even entire limit curves. Saving the frequency curves creates the basis for a workpiece-related detailed analysis.

What added value does HRIexpert® offer?

Order analysis and monitoring are essential functions that require **expert knowledge for parameterization**.

Advanced logging functions enable detailed recording of various machining processes.

The HRIexpert® system generates CSV files that are compatible with third-party systems, ensuring seamless integration into various platforms.

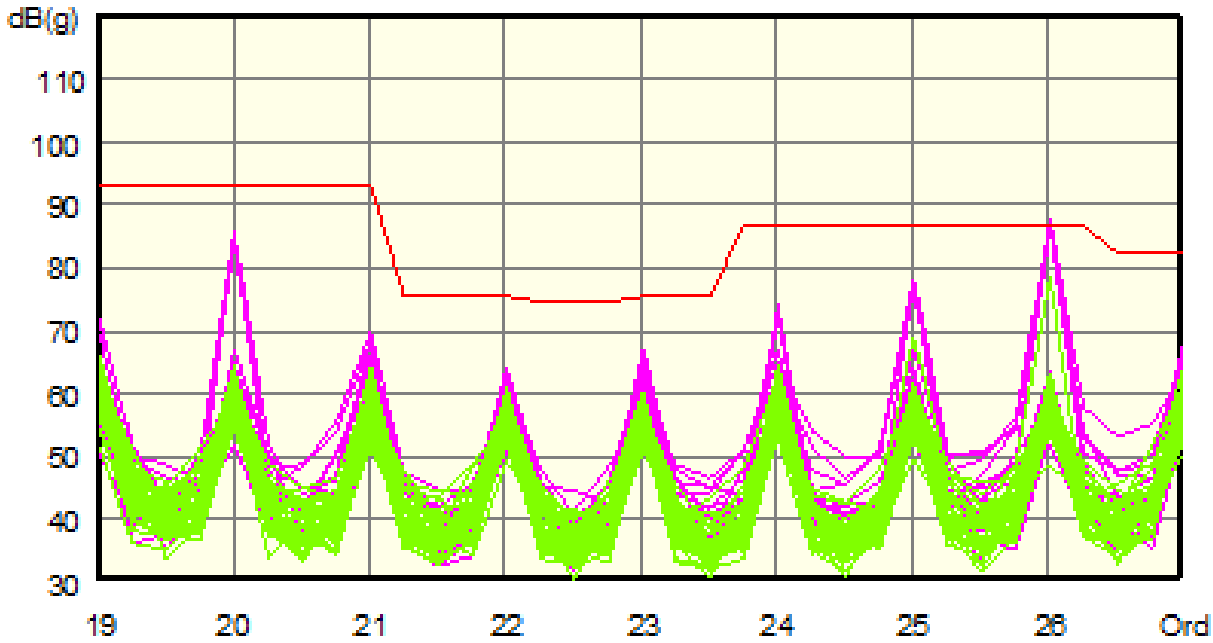
Process monitoring HRIexpert®

Example of an order analysis

In the example, the 26th order causes problems in the transmission.

This order can be specifically monitored with HRIexpert® and the conspicuous workpieces are ejected.

The red line has been defined by the test bench.

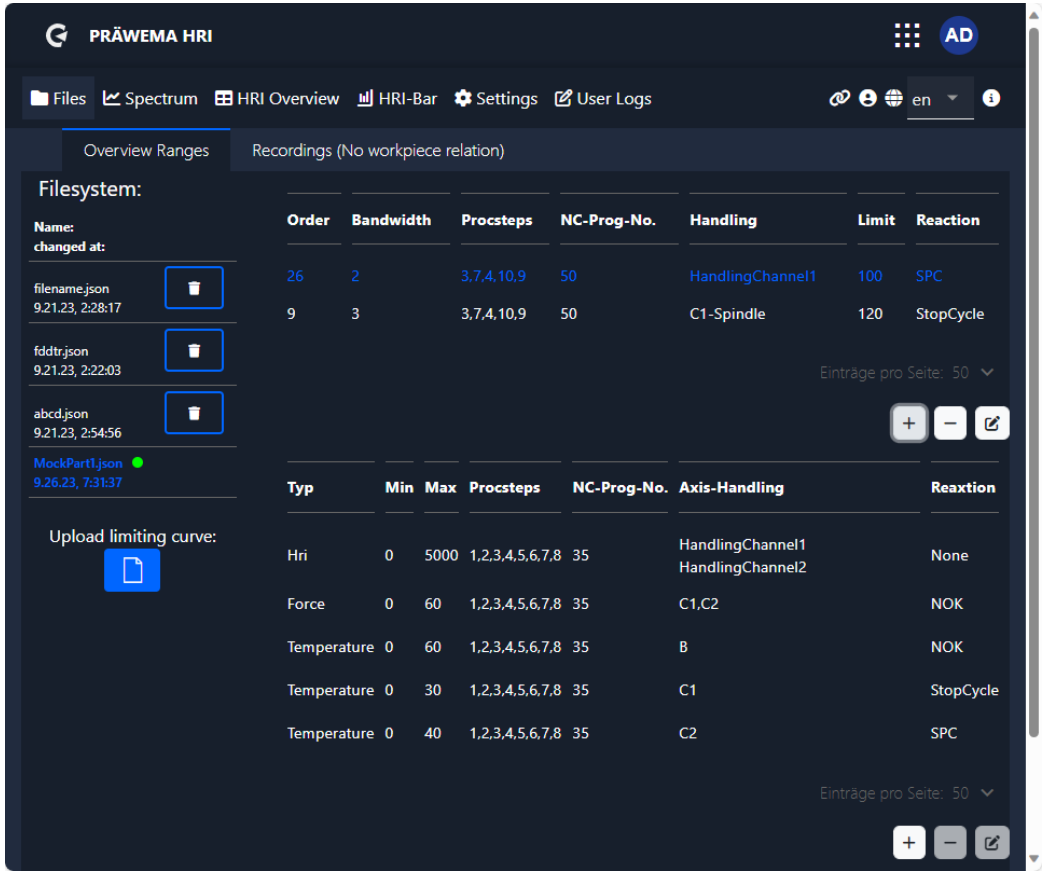


HRIexpert®
settings

HRIexpert® settings

Example of an order analysis

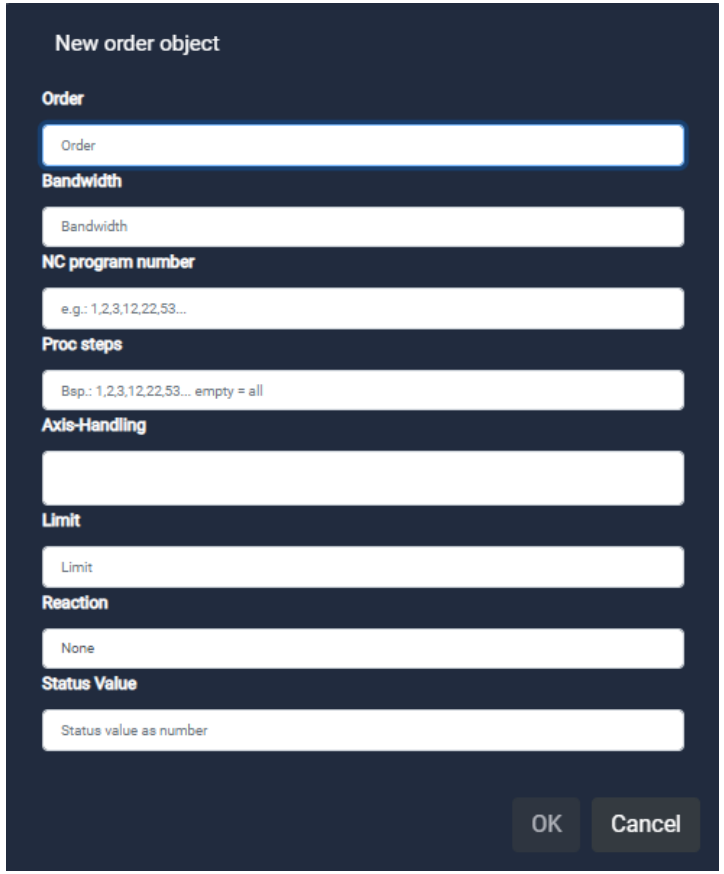
- As in the example, the 26th order is monitored with a bandwidth of two orders.
- All workpieces that exceed the limit of 100 mg are rejected as SPC parts.



HRIexpert® settings

Example of an order analysis

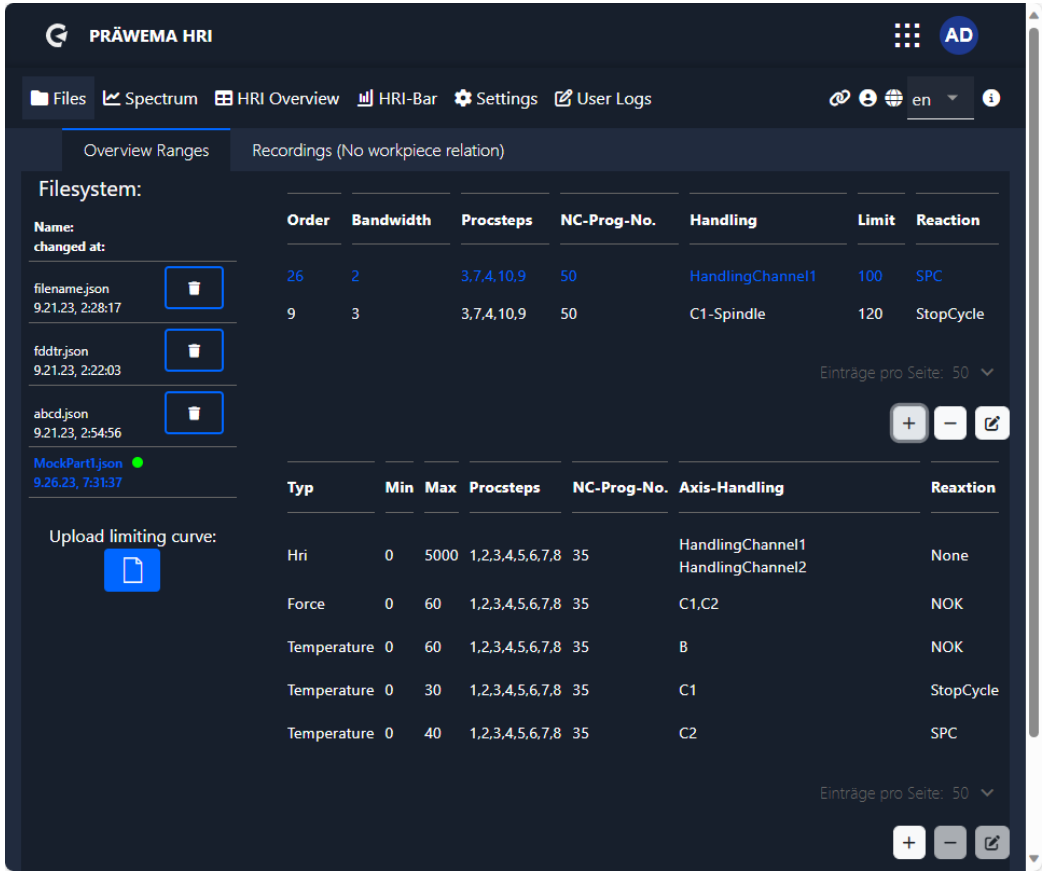
Since version 2.5 an edit screen has been added. The limits are easier to set with the screen and the possibility of incorrect entries has been minimized.



HRIexpert® settings

Example of an order analysis

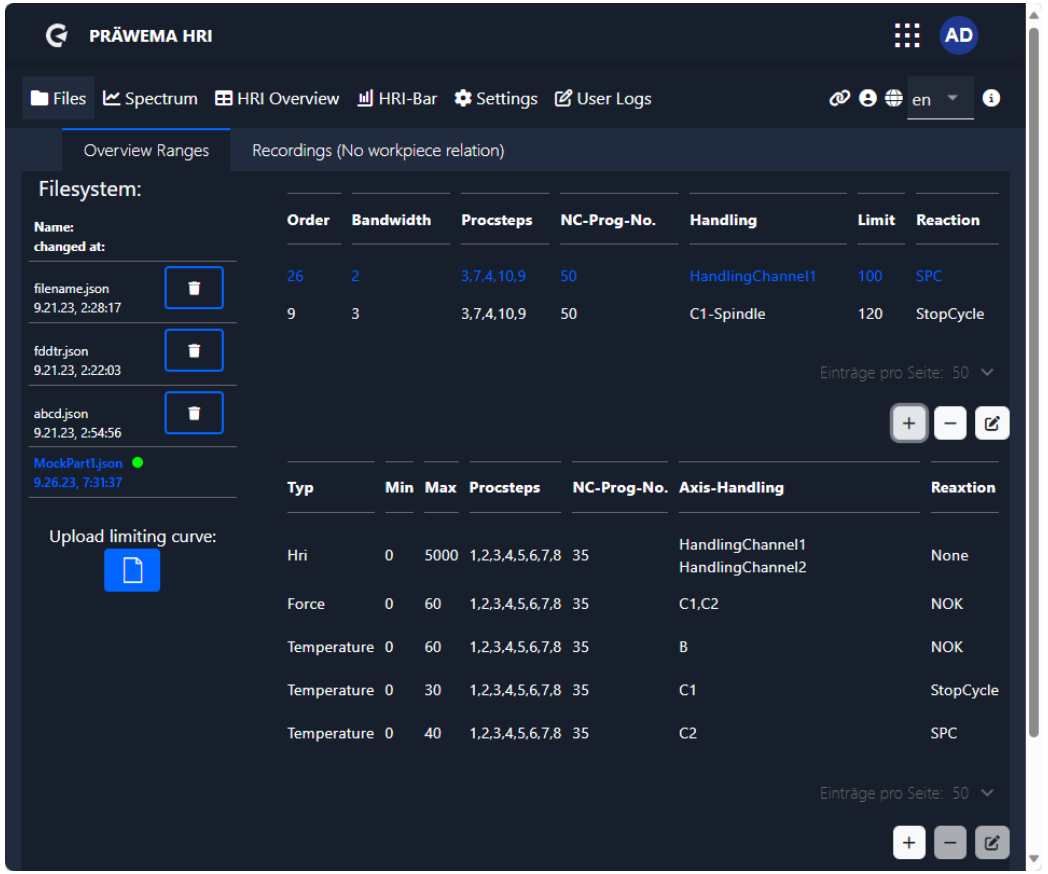
designation	description
Orders	Orders to be monitored => Feedback from the assembly line required.
Bandwidth	Bandwidth of orders.
Proc steps	Process steps of processing that are monitored.
NC prog no	NC program number to be monitored.



HRIexpert® settings

Example of an order analysis

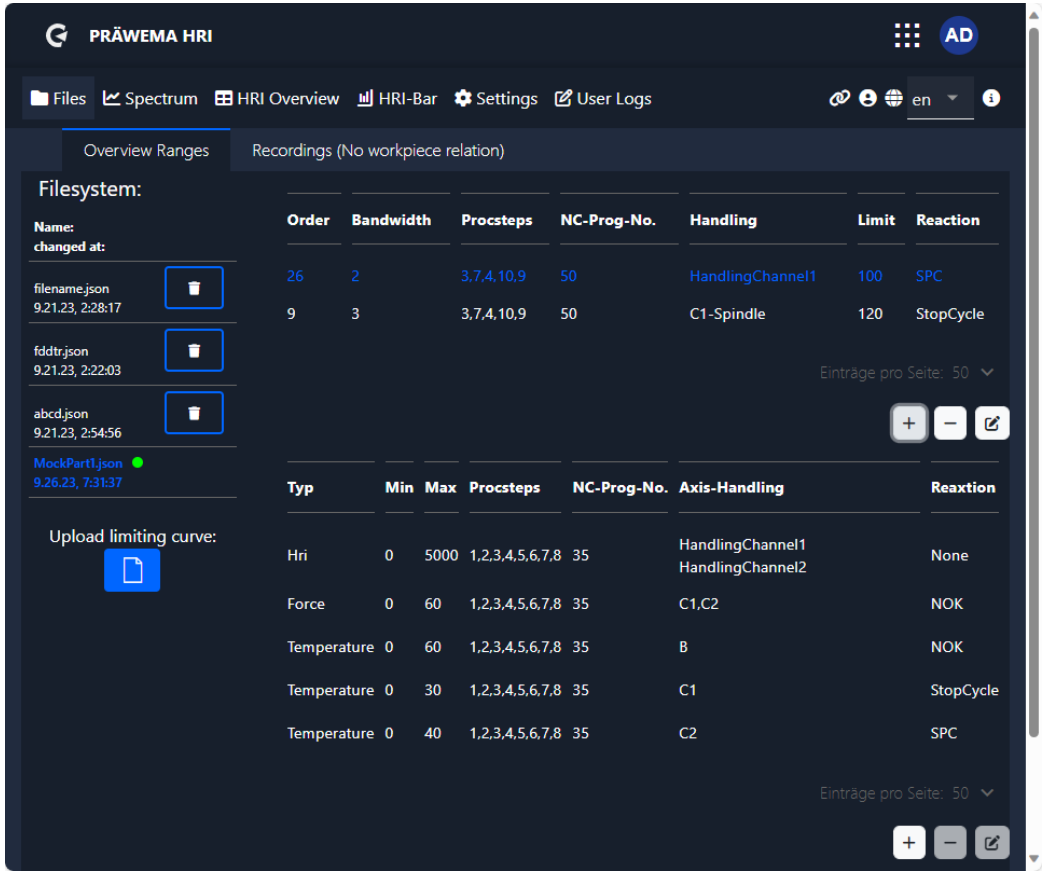
designation	description
Handling	Selection of which spindle or which sensor is to be monitored.
Limit	Limit value which, when exceeded, triggers the error reaction.



HRIexpert® settings

Example of an order analysis

designation	description
Reaction	Error reaction that is triggered when the value is exceeded.
Status value	The status value is sent to the HoningHMI and displayed there for the ejected workpieces.



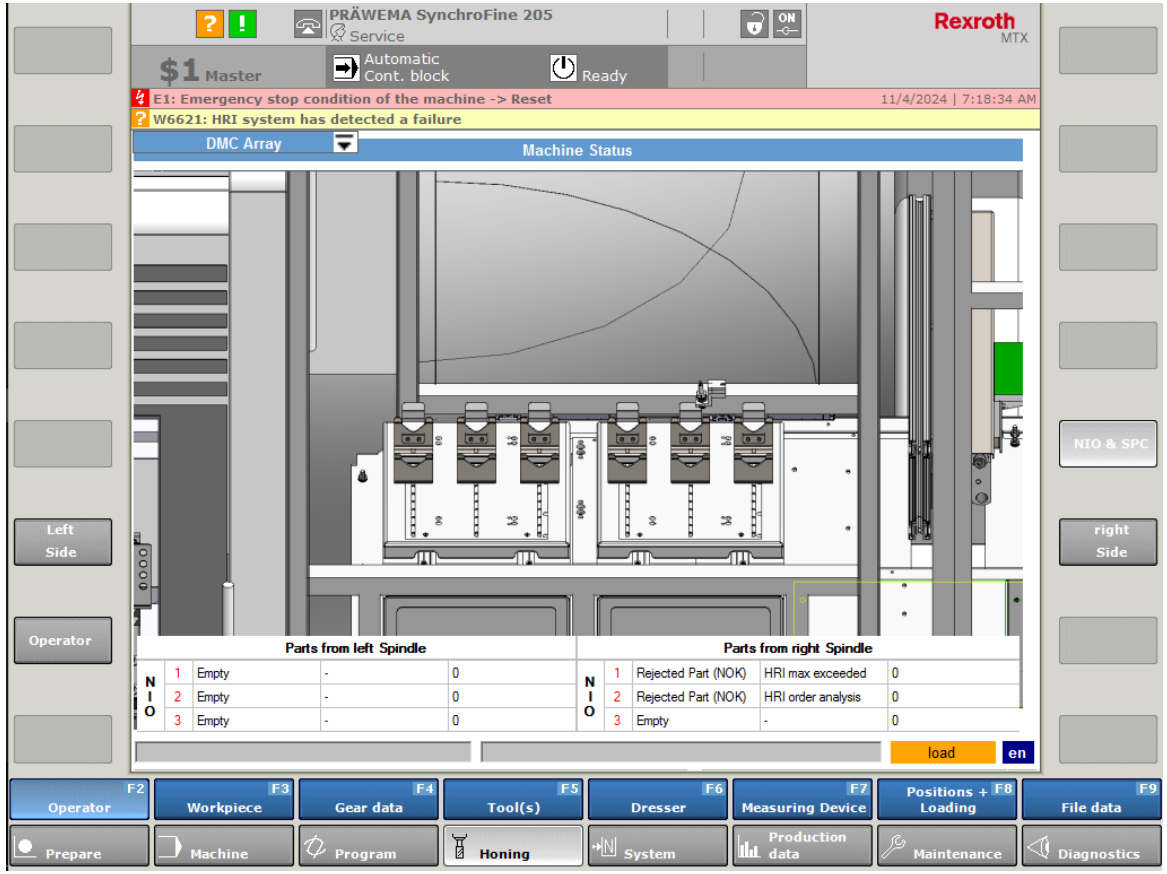
HRI® visualization

Status value

The status value is sent to the HoningHMI and displayed there for the ejected workpieces. This allows the operator at the machine to determine the reason why a workpiece was ejected.

The texts for the status value can be expanded.

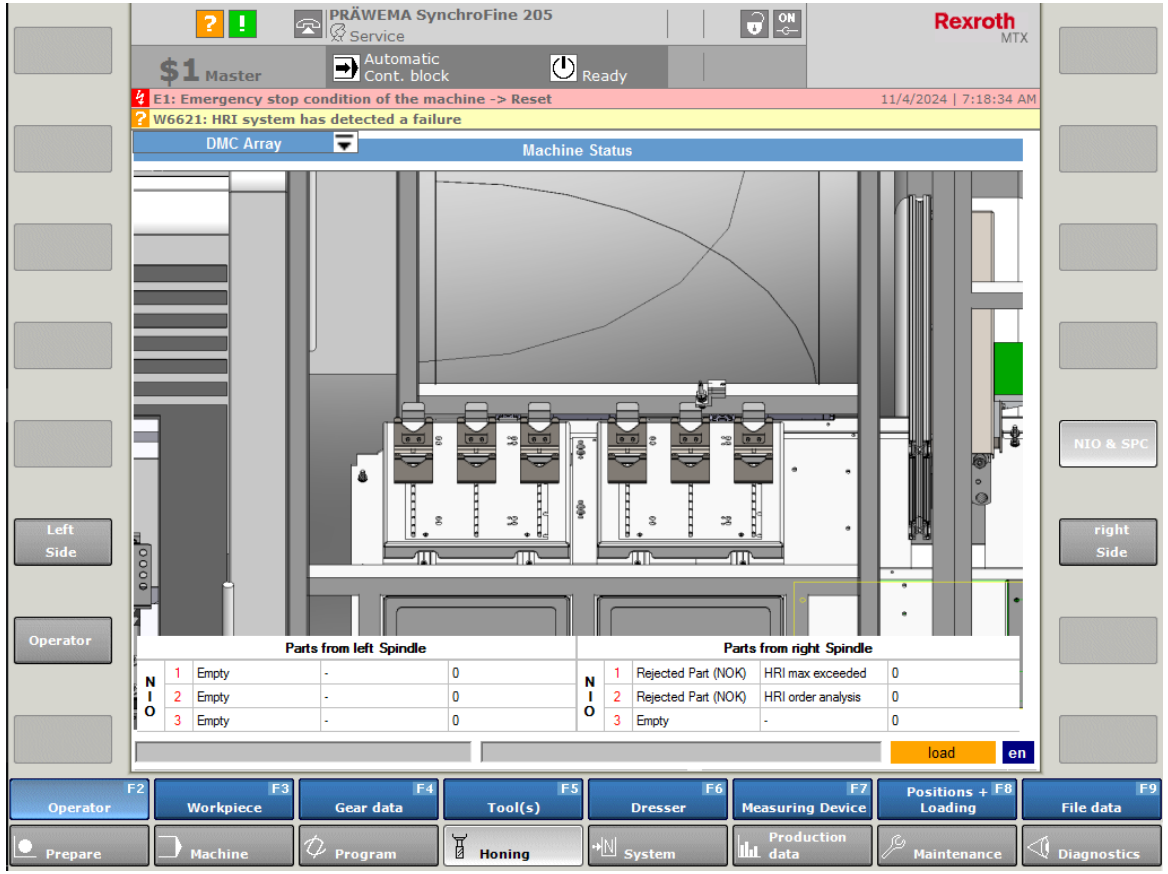
The display depends on the installed version of HoningHMI. The texts are displayed from revision 1839 onwards.



HRI® visualization

Status value

Status Value	Explantation
18	HRI max exceeded
19	HRI min not reached
20	HRI surface exceeded
21	HRI surface not reached
22	HRI order analysis
23	HRI reserve



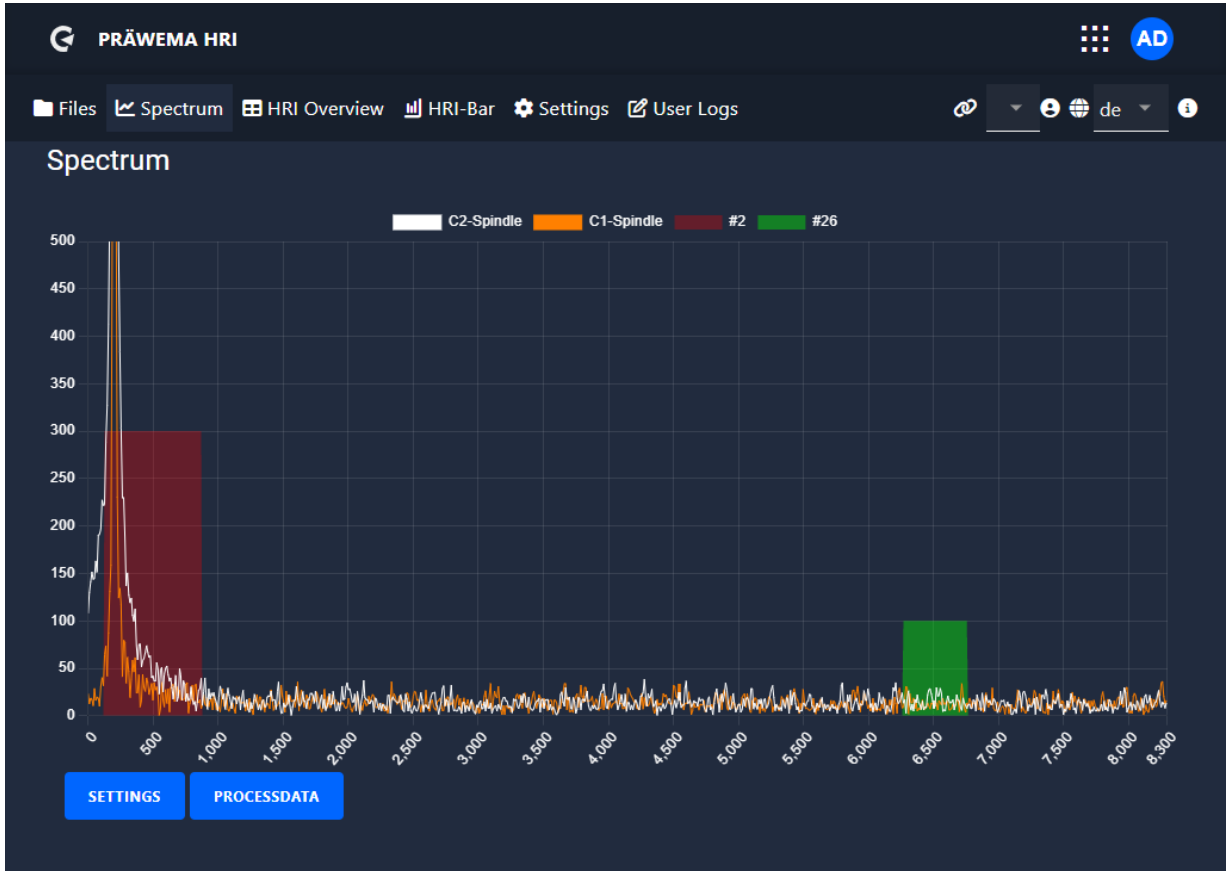
HRIexpert® settings

Example of an order analysis

The frequency objects are displayed in the spectrum screen as a bar graph.

If the process step is not active, the bar is colored light blue.

If the limit value is exceeded, the bar changes its color to red, otherwise the bar is colored green.



HRIexpert® settings

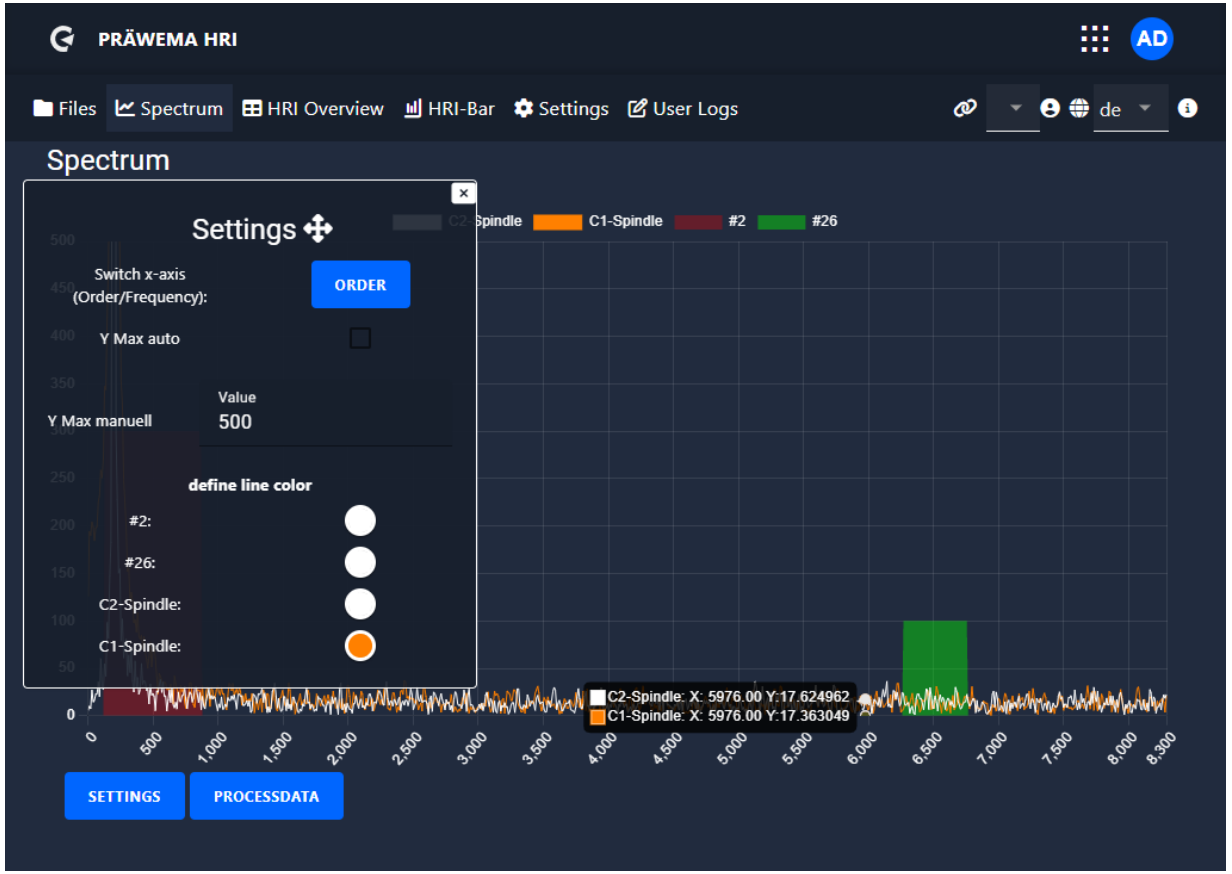
Example of an order analysis

In the “settings" tab, the X-axis can be switched between the frequency and the orders in relation to the speed of the workpiece spindle.

The Y-axis offers the option of either being set to a fixed value or being adjusted automatically.

The colors of the individual lines can also be set individually.

All settings made are saved and are available again the next time the page is called up.



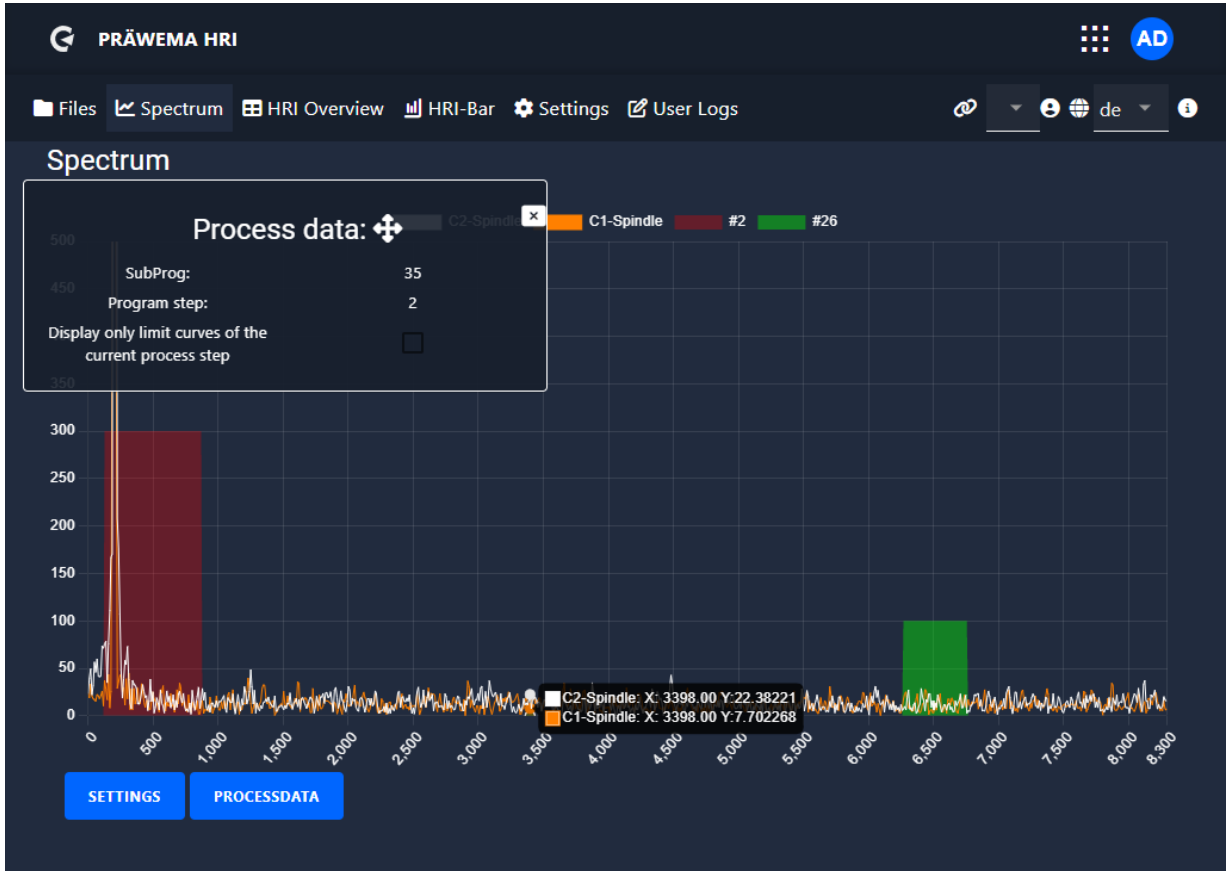
HRIexpert® settings

Example of an order analysis

The current NC program and the current process step are displayed under Process data.

This is used to check in which process step the machine is processing the workpieces.

A button can be used to display the limit curves only in the current process step.



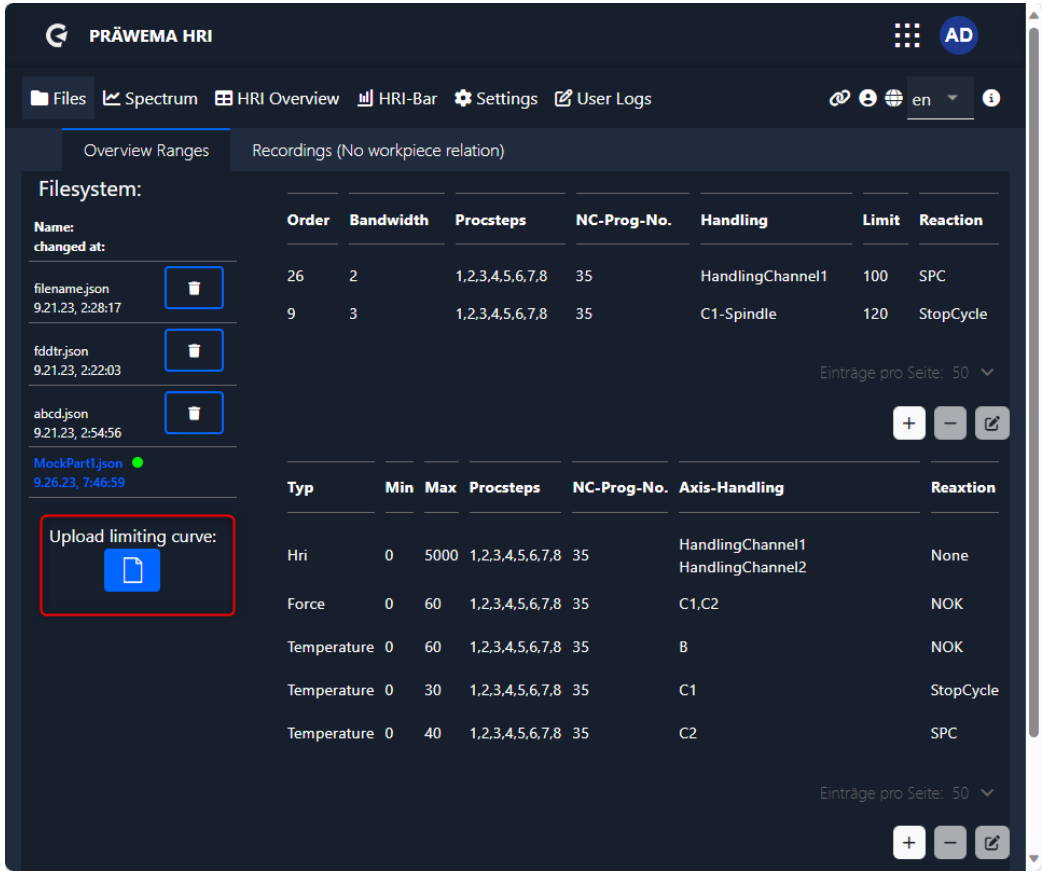
HRIexpert® settings

Limiting curve

With HRI®analyze+ a limit curve can be created and saved as a JSON file.

This limit curve can be read in and visualized with HRImachine.

The name of the JSON file from the limiting curve must be the same name from the part.

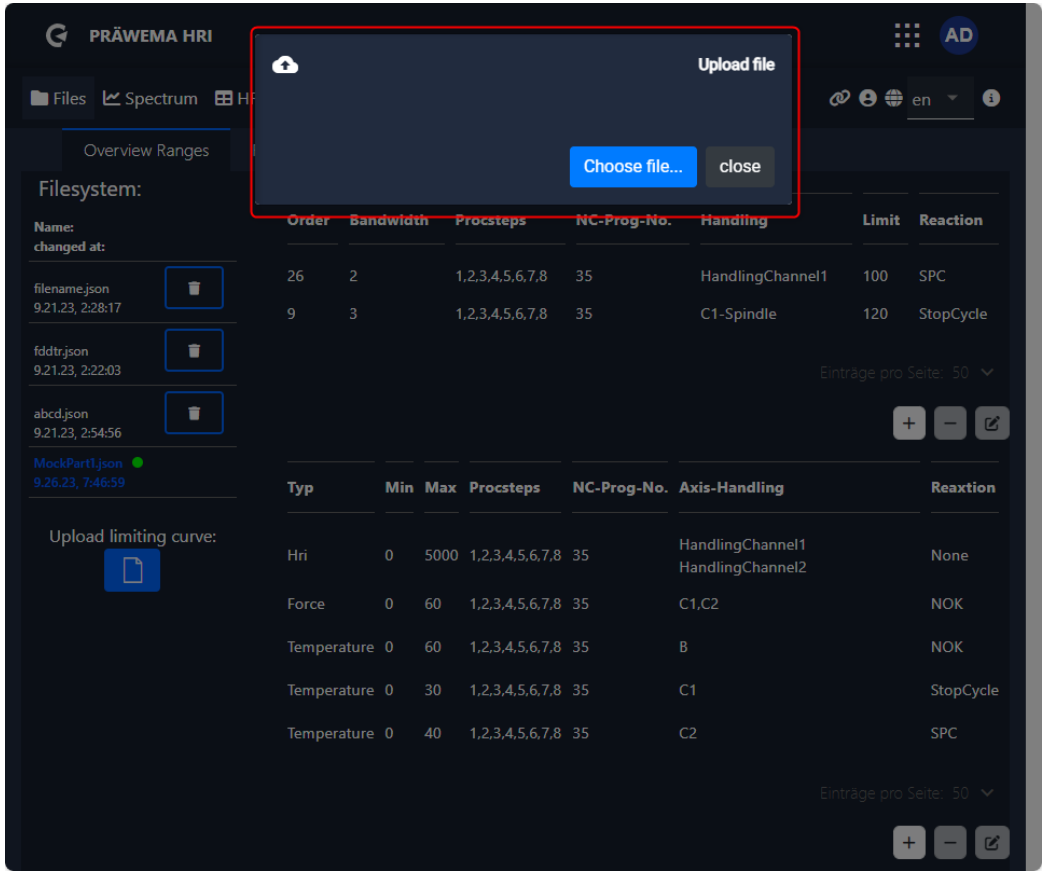


HRIexpert® settings

Limiting curve

Clicking the button opens a second window.

Here you can select the corresponding file to be loaded.

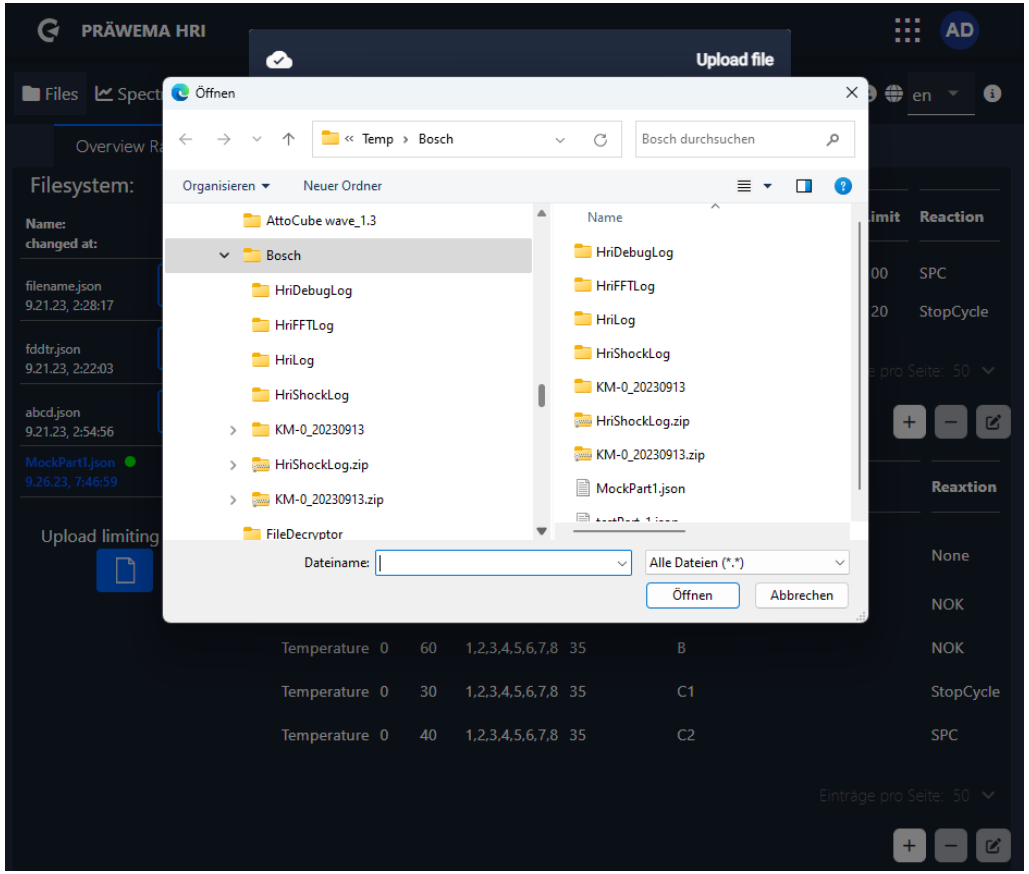


HRIexpert® settings

Limiting curve

A file has been saved in the Downloads folder. The file name of the limiting curve must have the same name as the corresponding component.

Otherwise, the limiting curve cannot be assigned to a component.

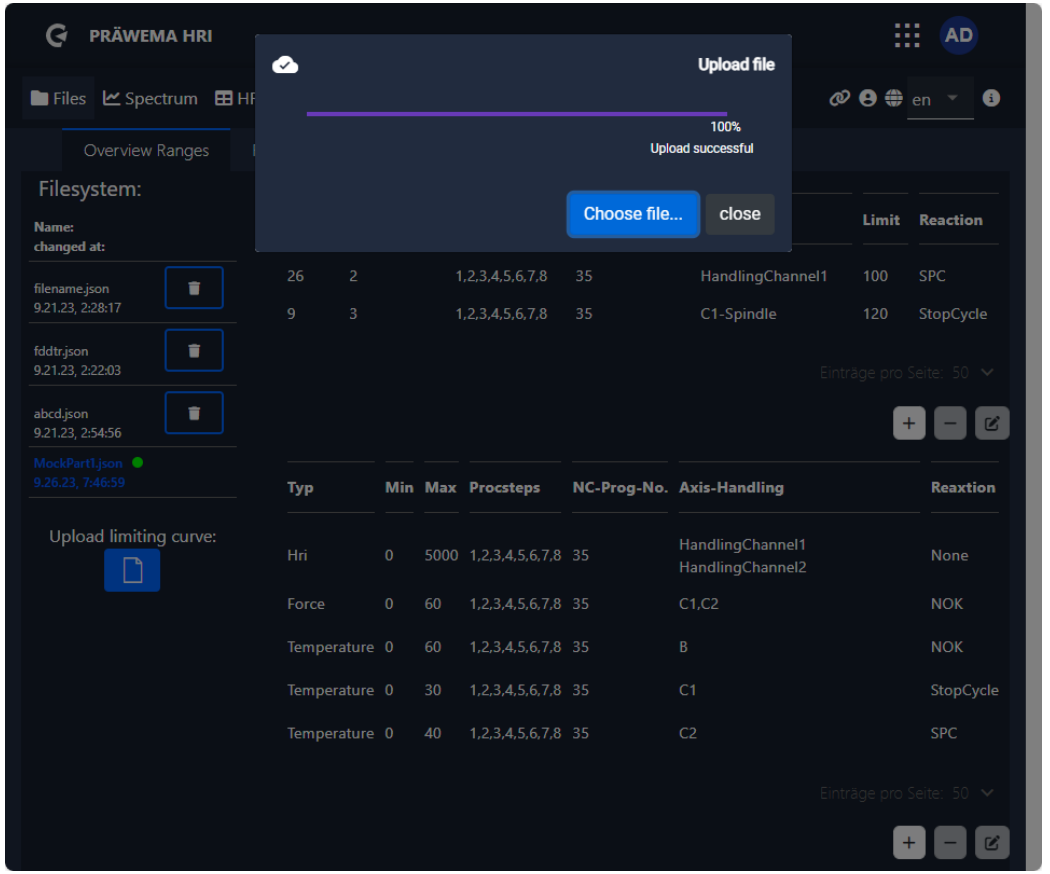


HRIexpert® settings

Limiting curve

After loading the file, the loading bar changes color.
There is no confirmation that the file has been loaded.

After the file has been loaded successfully, you can switch to the spectrum page.

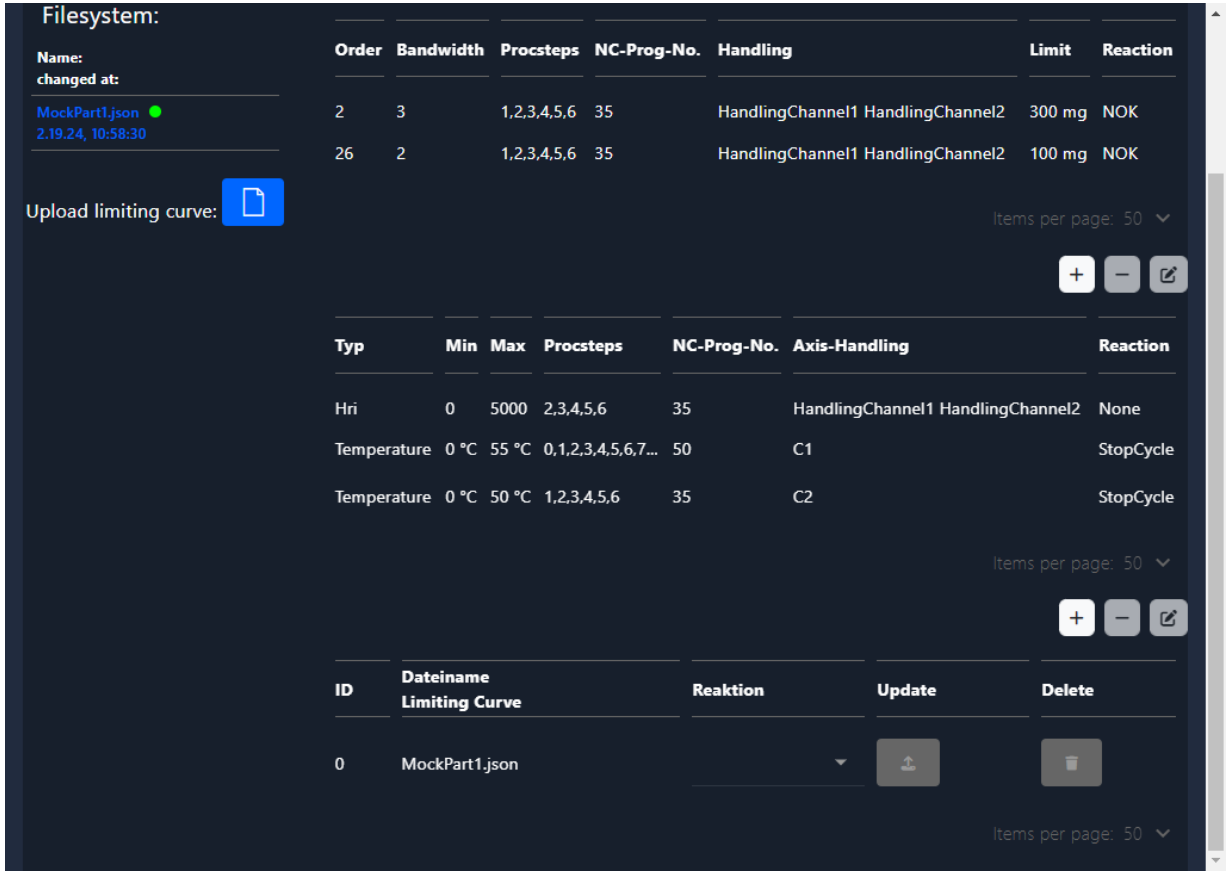


HRIexpert® settings

Limiting curve

The loaded limiting curve is displayed in the visualization.
The error response can be changed.

An update of the limiting curve can be uploaded.

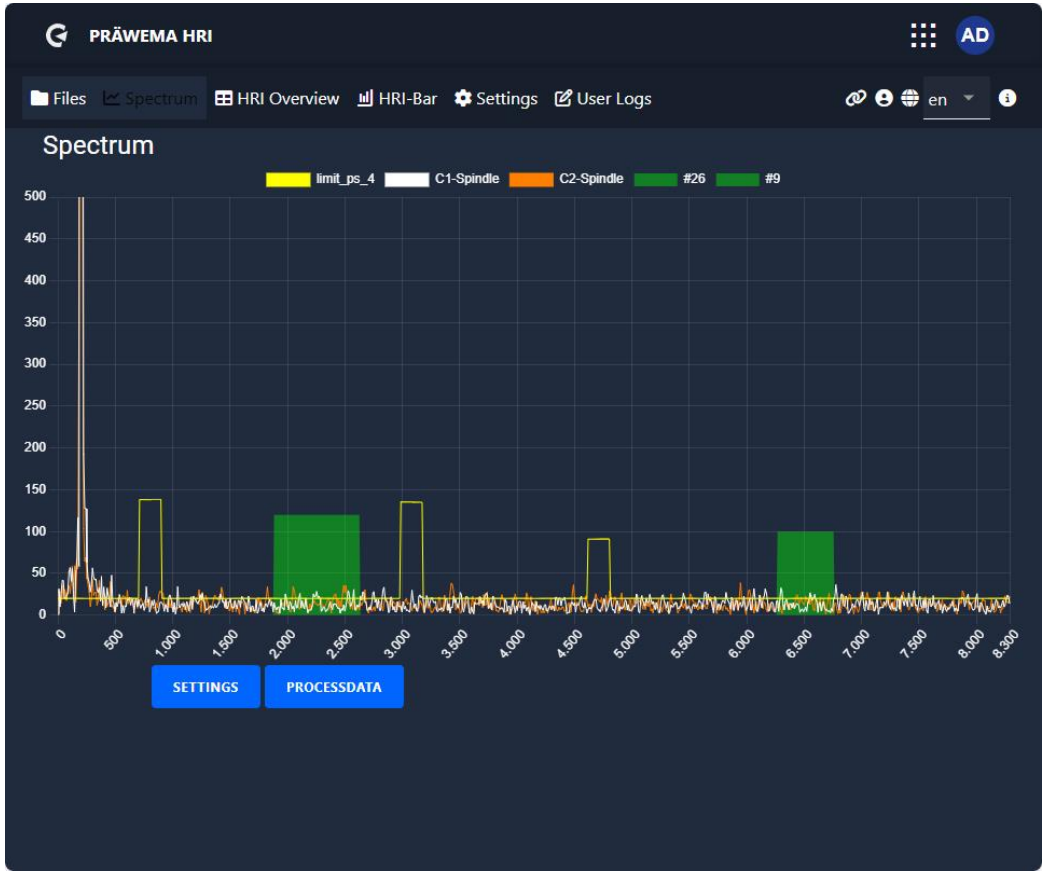


HRIexpert® settings

Limiting curve

The limiting curve is displayed in the spectrum as a yellow border line.

Each active process step has its own limiting curve.



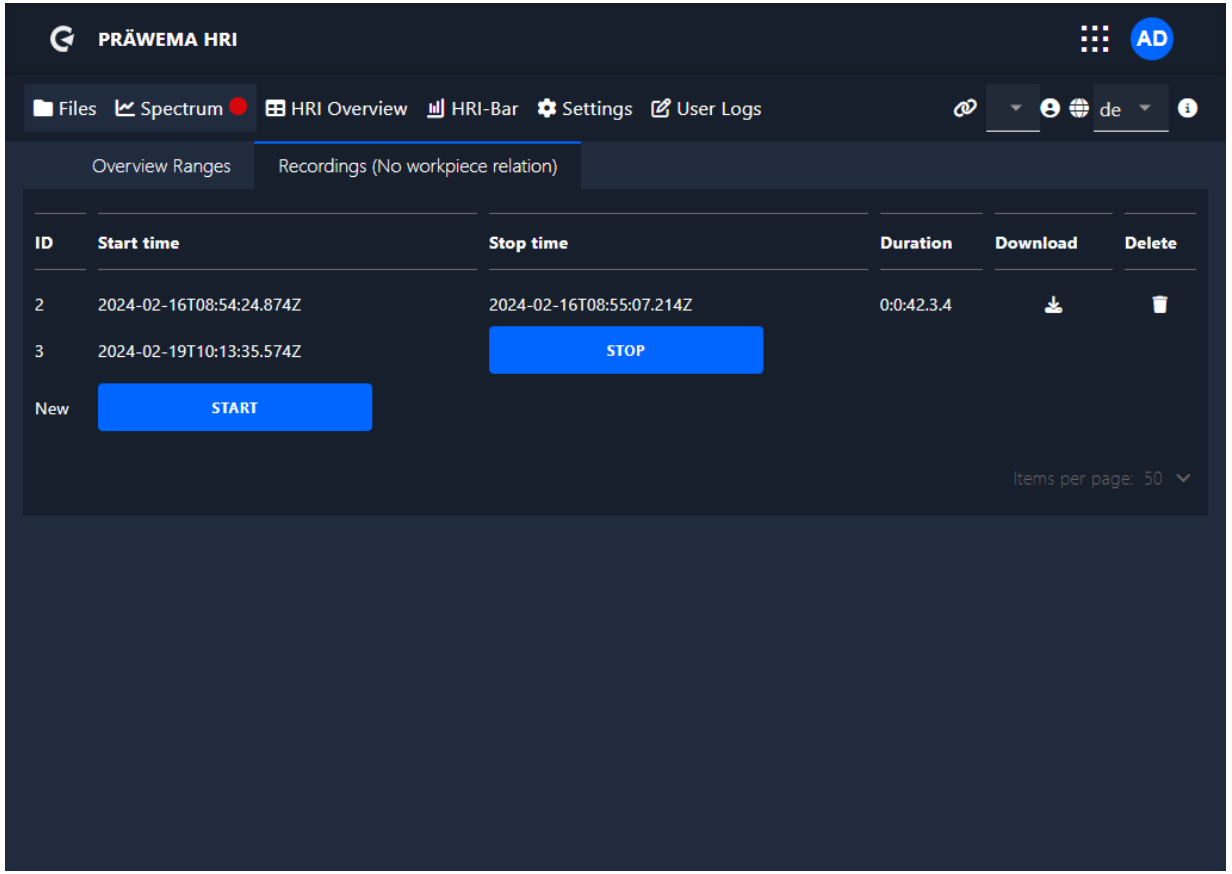
HRIexpert® settings

Recordings spectrum page

A manual recording function of the vibration spectra can be started on the Files page.

The recording can also be stopped and saved here.

The recording is saved as a BIN file. The recording can be opened and analyzed with HRIanalyze+.

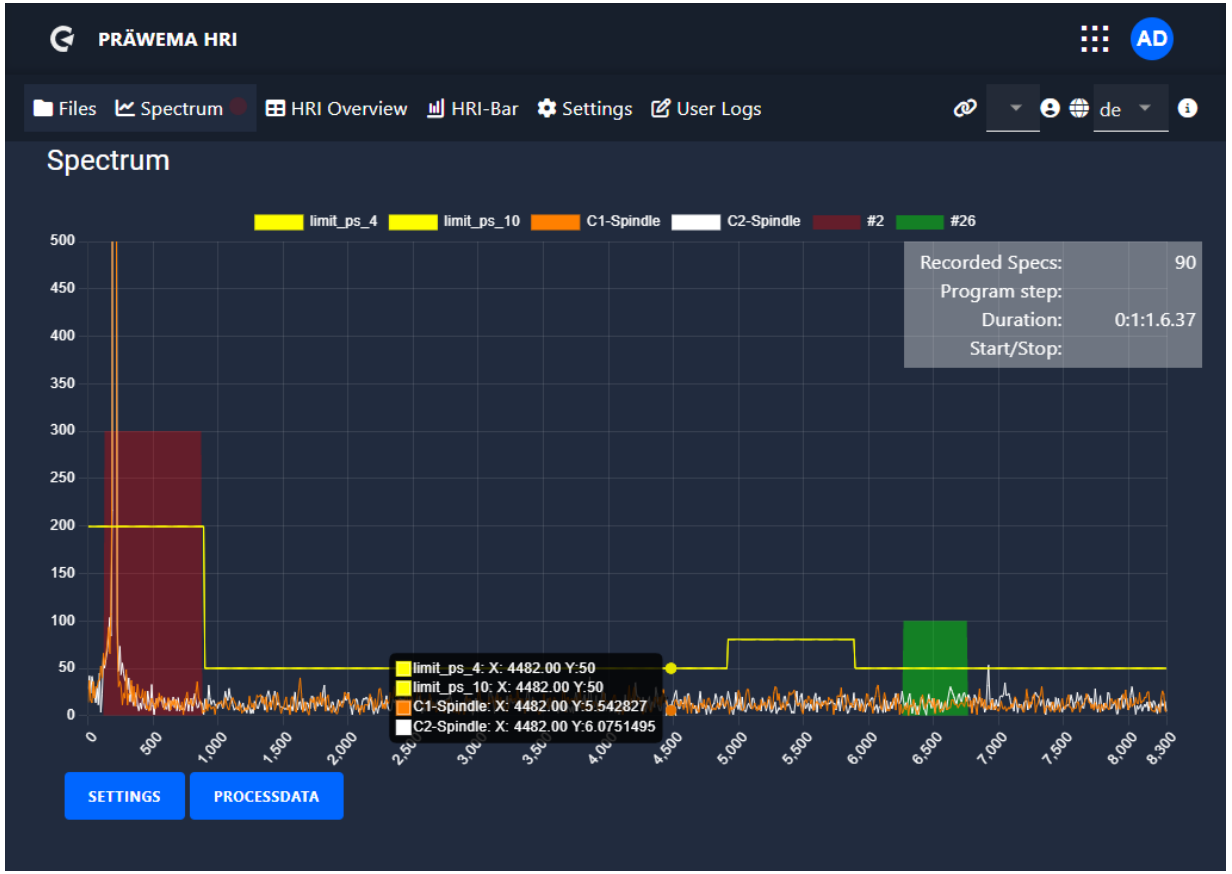


HRIexpert® settings

Recordings spectrum page

When the recording function is activated, an additional field is displayed on the Spectrum page. The recording can be started and stopped there.

To save the recording, switch to the "Files" page.

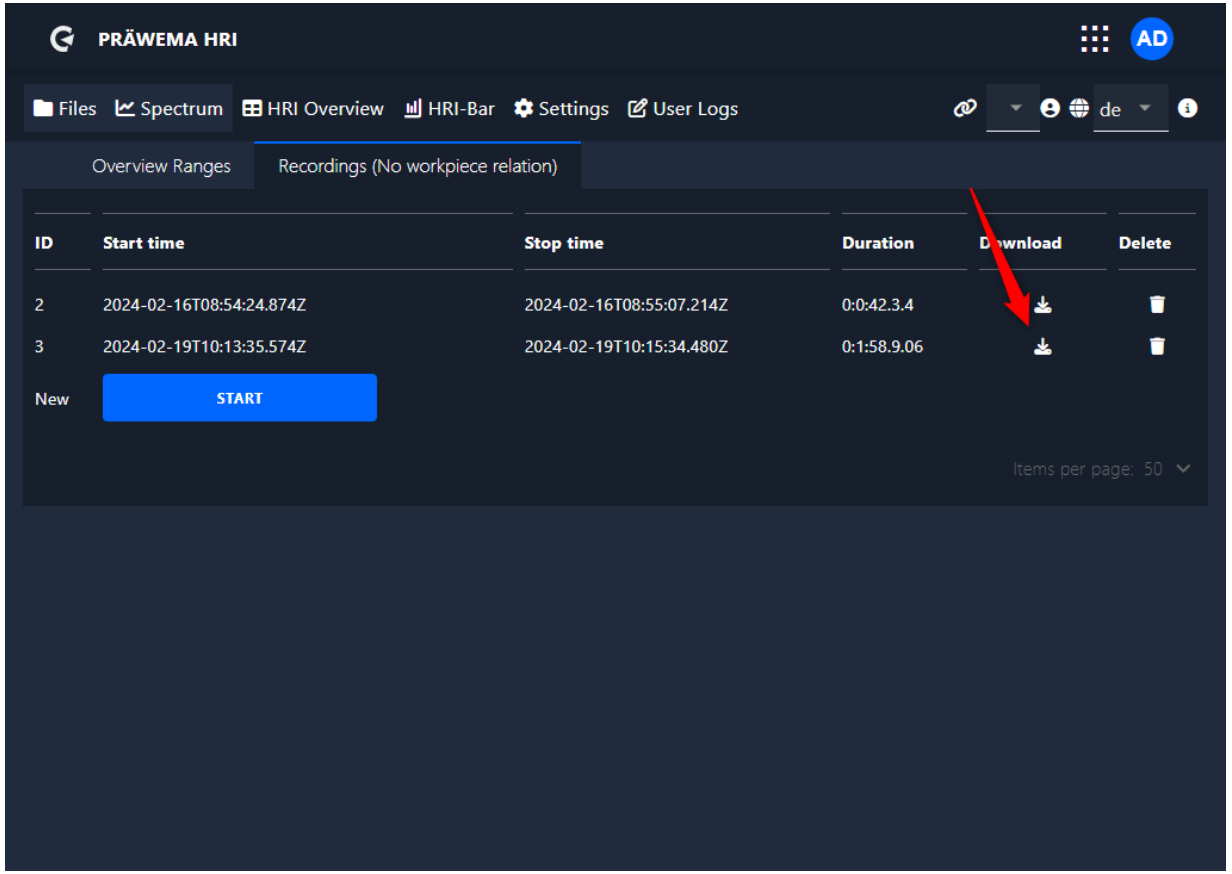


HRIexpert® settings

Recordings spectrum page

After finishing the recording, the BIN file can be downloaded and saved.

The analysis is then carried out with HRI®analyze+.



HRIexpert®
Feed Limiter

HRIexpert® Feed Limiter

Feed Limiter with HRIexpert®

To make the process more stable and to absorb acceleration peaks, a feed rate limit has been programmed.

A limit value for vibration monitoring is programmed under HRIexpert®.

Order	Bandwidth	Procsteps	NC-Prog-No.	Handling	Limit	Reaction
26	2	1,2,3,4,5,6,7,8	35	HandlingChannel1	100	SPC
9	3	1,2,3,4,5,6,7,8	35	C1-Spindle	120	FeedLimiter

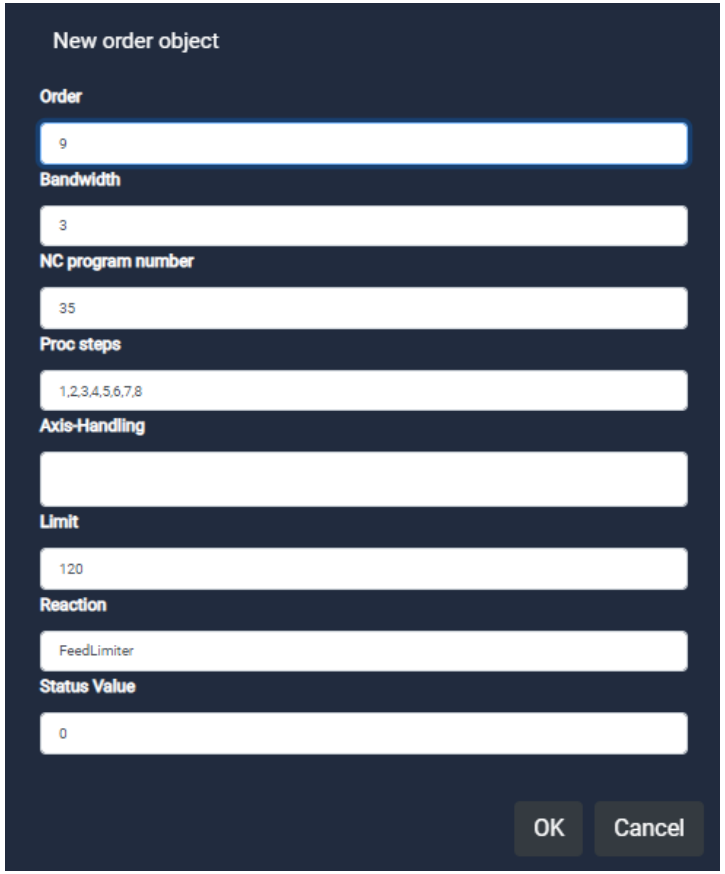
HRIexpert® Feed Limiter

Feed Limiter with HRIexpert®

The feed rate limiter has been added to the selection of the error reaction.

If 100% of the set limit is exceeded, the feed is reduced in 10% steps until the vibrations stabilize. If the vibrations fall below the 100% limit, the feed rate is increased again in steps.

When 120 % of the limit is exceeded, the feed rate is reduced to 0 %. When the vibrations have fallen below 100 % of the limit, the feed rate is increased again to 100 % in 10 % steps.

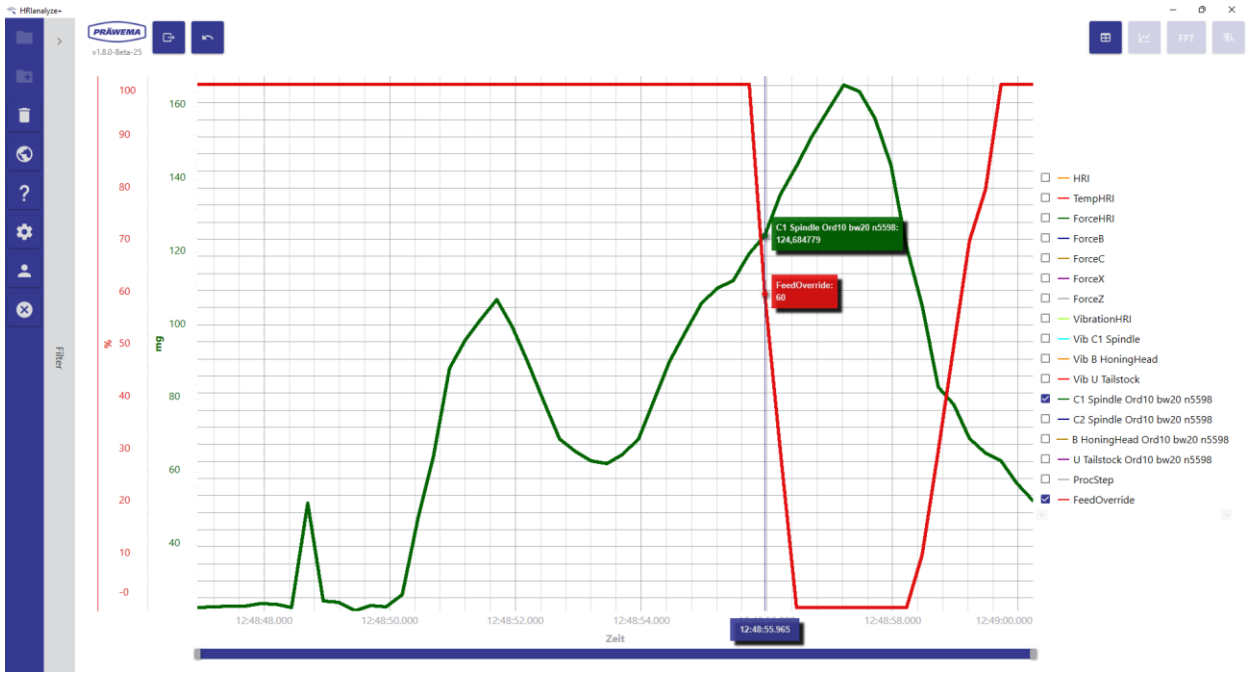


HRIexpert® Feed Limiter

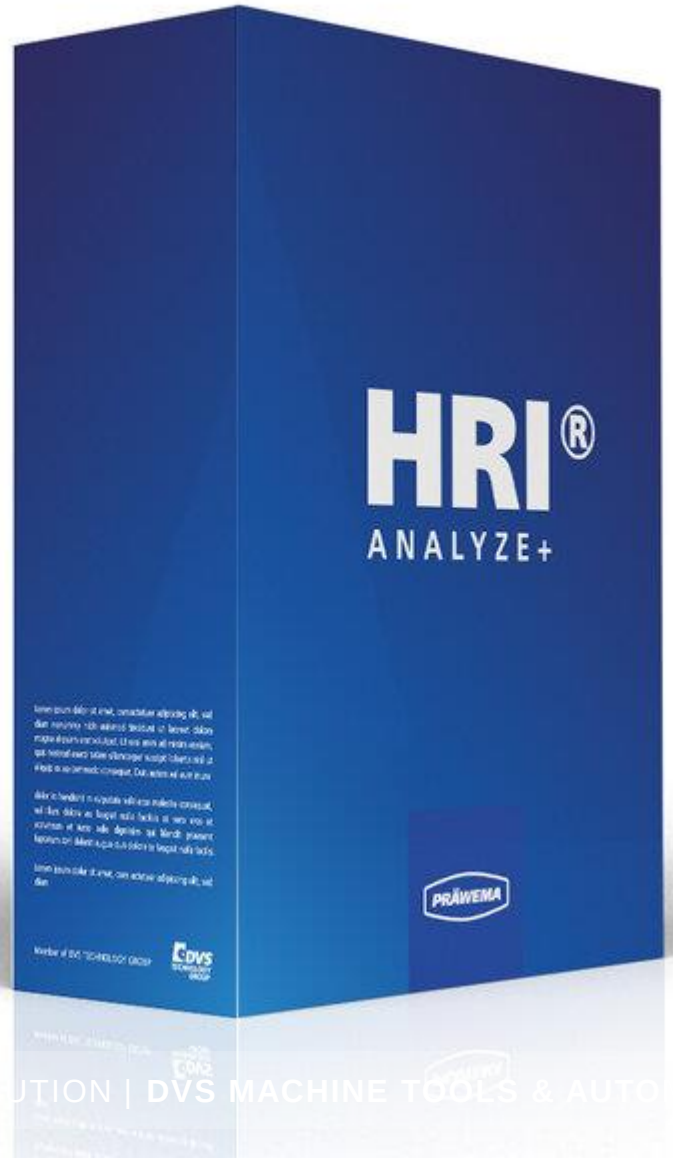
Feed Limiter with HRIexpert®

The signals "Vibration C1 spindle" [for the first 20 orders, value in mg] and FeedOverride [feed limitation] are shown.

When the limit of 120 mg is exceeded, the feed limitation becomes active and reduces the feed of the X axis.



Software tool HRI®analyze+



Software tool HRI®analyze+

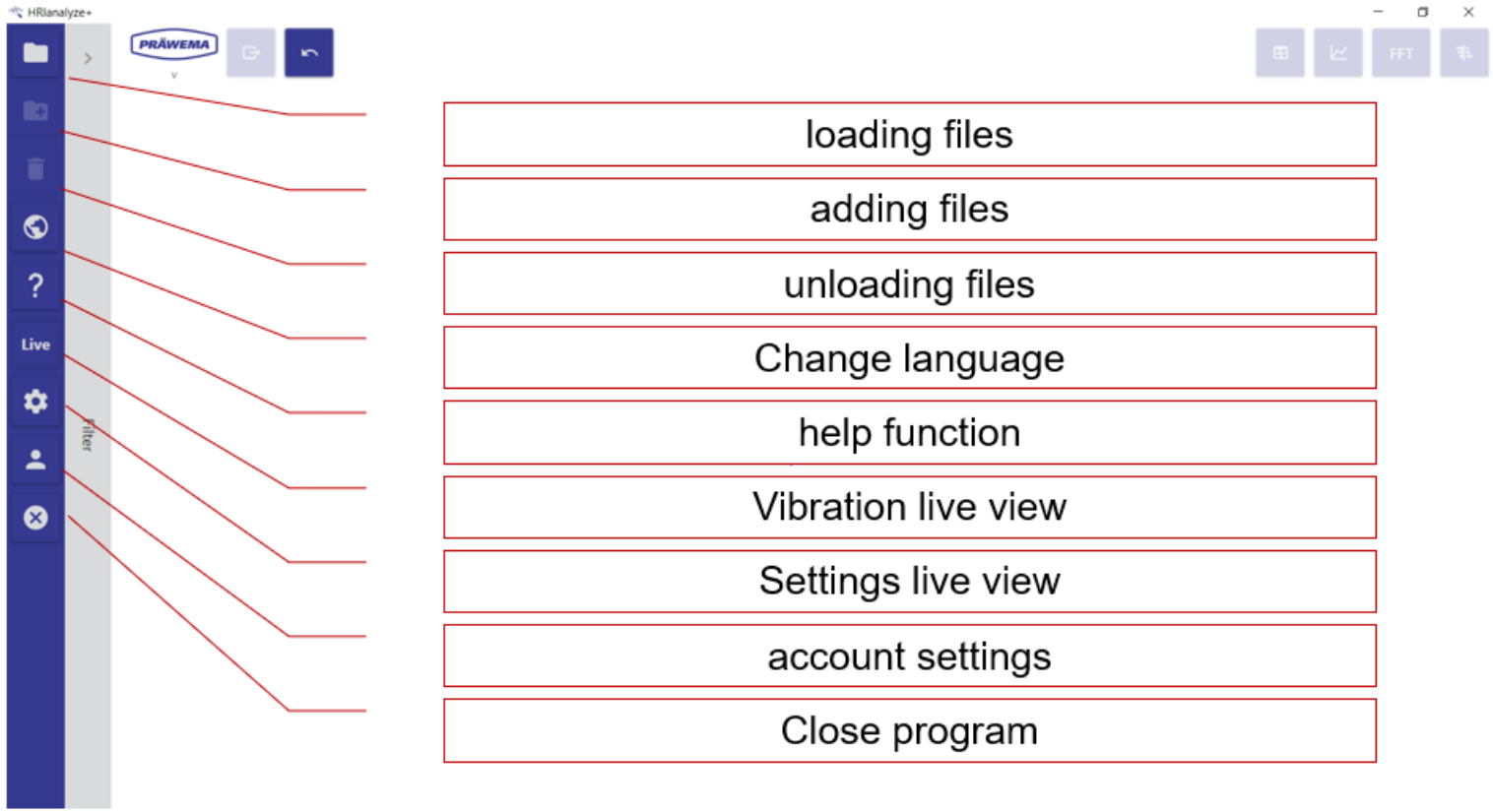
The HRI®analyze + program was developed to analyze the recorded HRI data. The program recognizes independently whether it concerns HriLog-, HriDebugLog- , HriFFTLog- or HriShockLogfiles.

The values can be displayed in diagrams to get an overview of the production and part quality as quickly as possible.

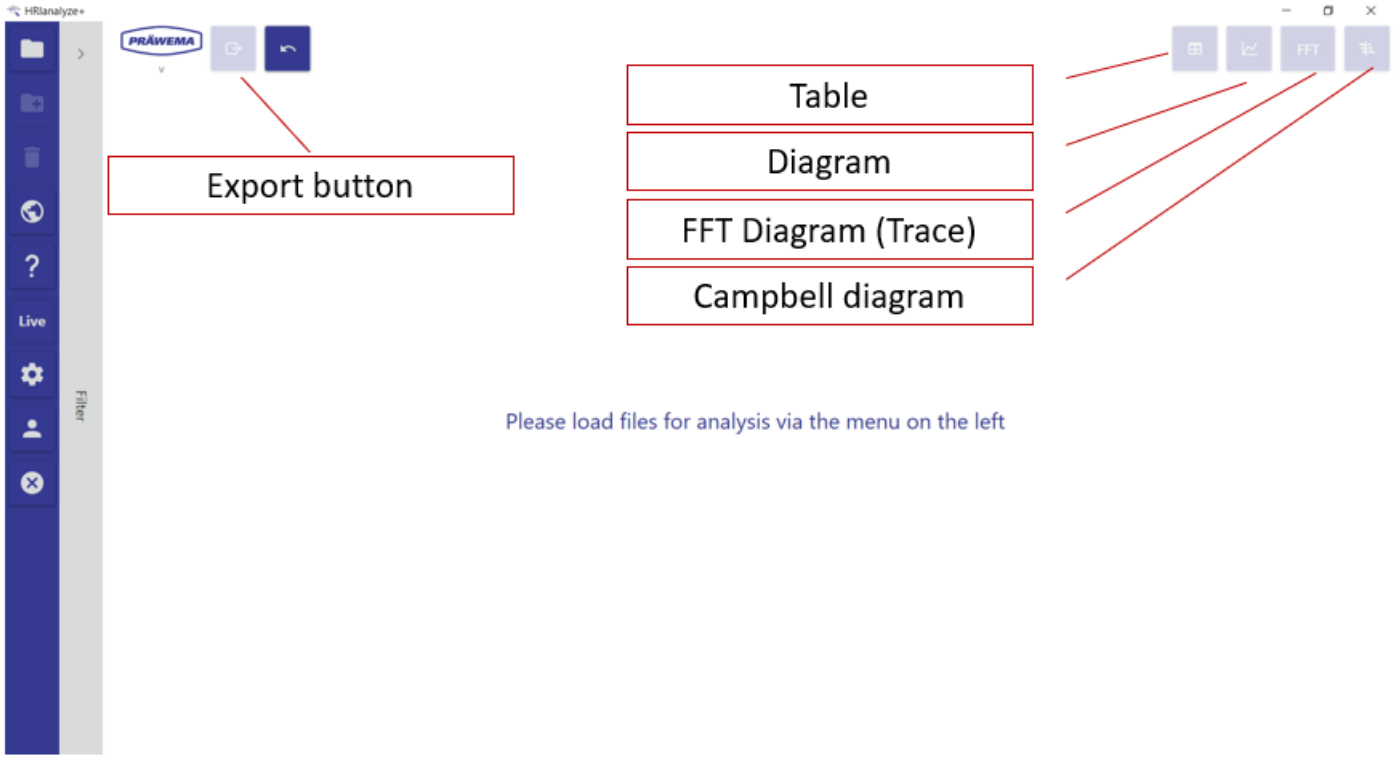
For a better overview, certain parameters are always preselected.

It is possible to read the XML files from the Siemens Servo Trace and CSV files from the drive oscilloscope from Bosch Rexroth and have an FFT calculated from the imported data.

Software tool HRI®analyze+



Software tool HRI®analyze+



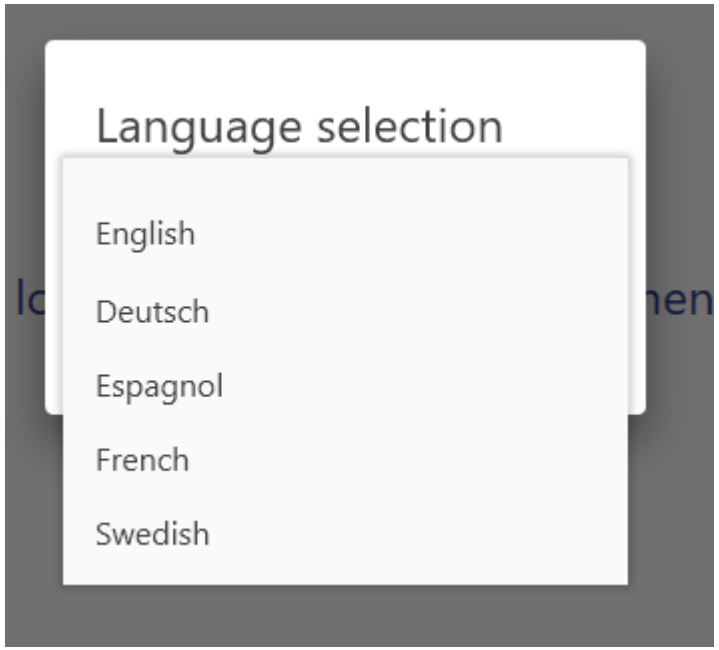
Software tool HRI®analyze+

Language selection

Now it is possible to chose five languages.

- English
- German
- Spain
- French
- Swedish

Other language packages are in progress.



Software tool HRI®analyze+

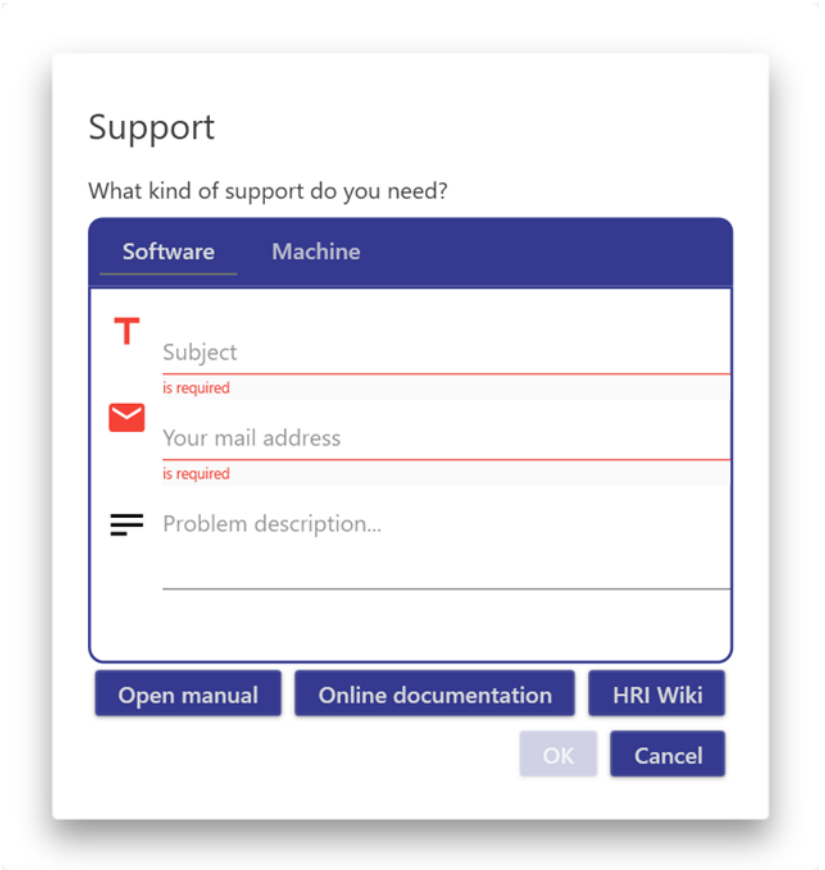
Help function

Via HRI®analyze + you can contact a Präwema team of experts in the "Software" tab.

You send an email to:

hrisupport@praewema.de

You can also open a training documentation and online documentation.



Software tool HRI®analyze+

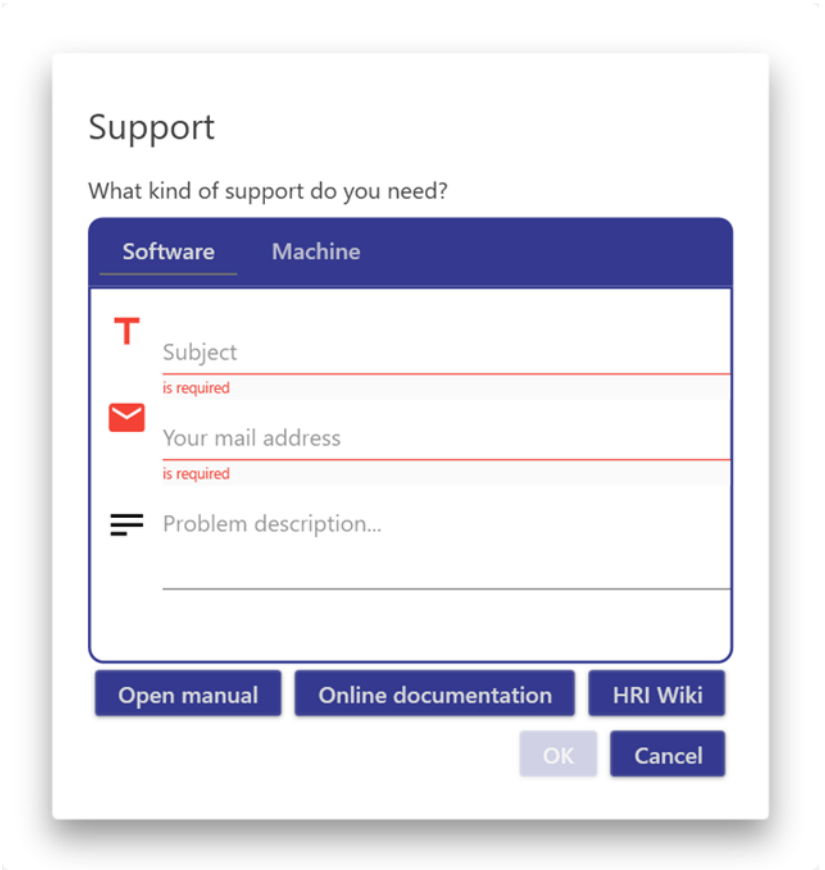
Help function

An email is sent to

service@praewema.de

under the Machine tab.

Inquiries about problems with the machines are processed there.



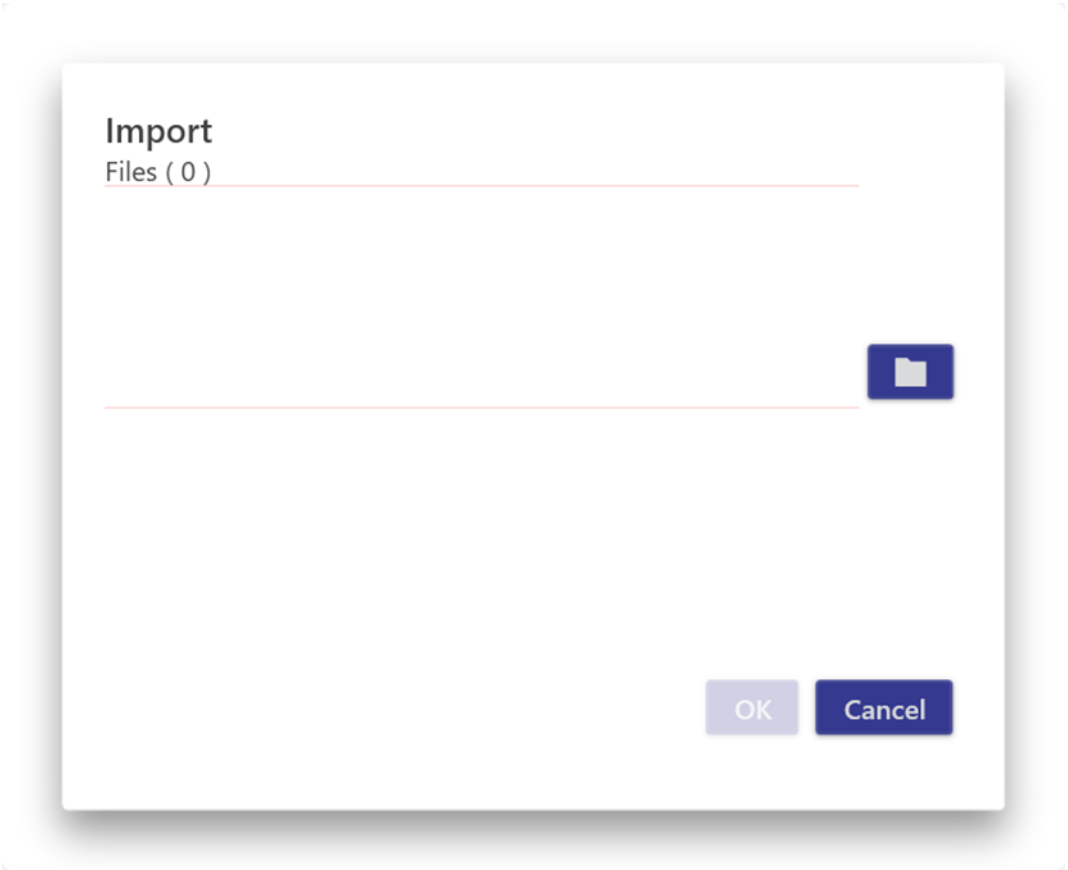
Software tool HRI®analyze+

Loading Files

All 4 file types of HRI® and HRIexpert® can be loaded.
The program automatically recognizes what type it is.

- HriLog
- HriDebugLog
- HriFFTLog
- HriShockLog

It is although possible to open the files from the HRI®machine spectrum analyzer.



Software tool HRI®analyze+

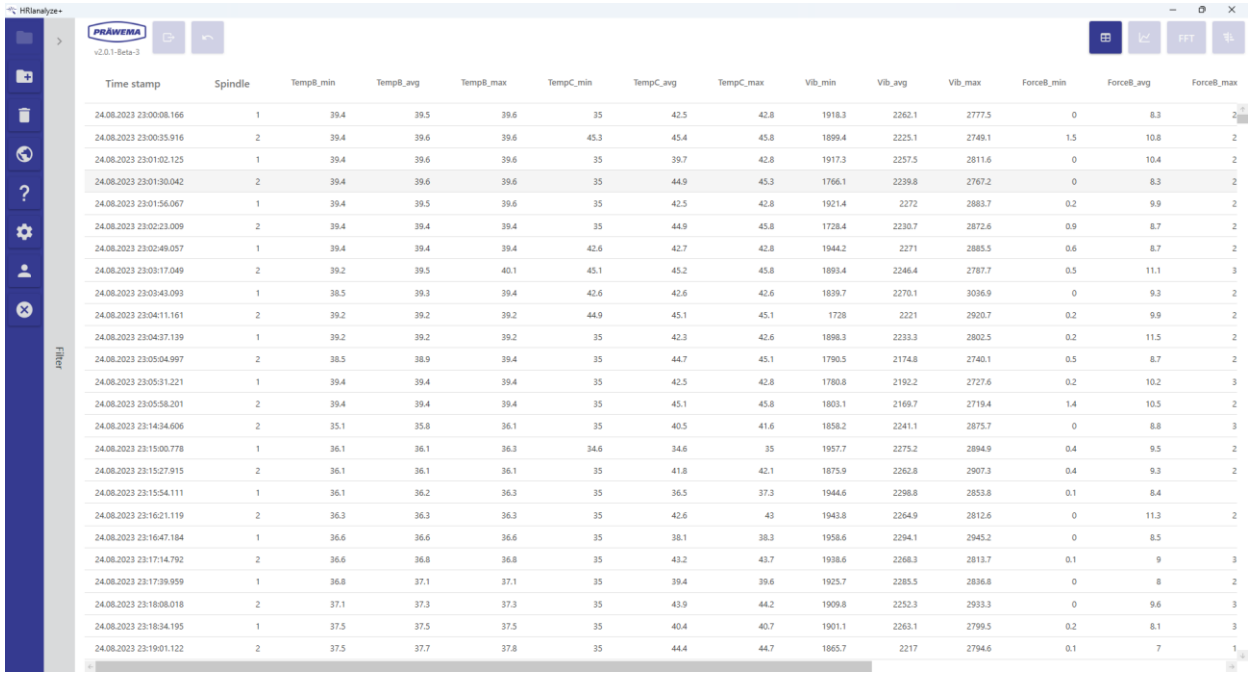
HriLog files

For each day, HRI creates a file for each type of workpiece machined on the machine.

Each row represents a produced workpiece.

All relevant information is stored in this file type. A separate column is created for each sensor for frequency objects.

Some columns are not displayed in HRIanalyze+. The columns are columns with text information. In this case, the HriLog files must be opened with a text editor or a spreadsheet program.



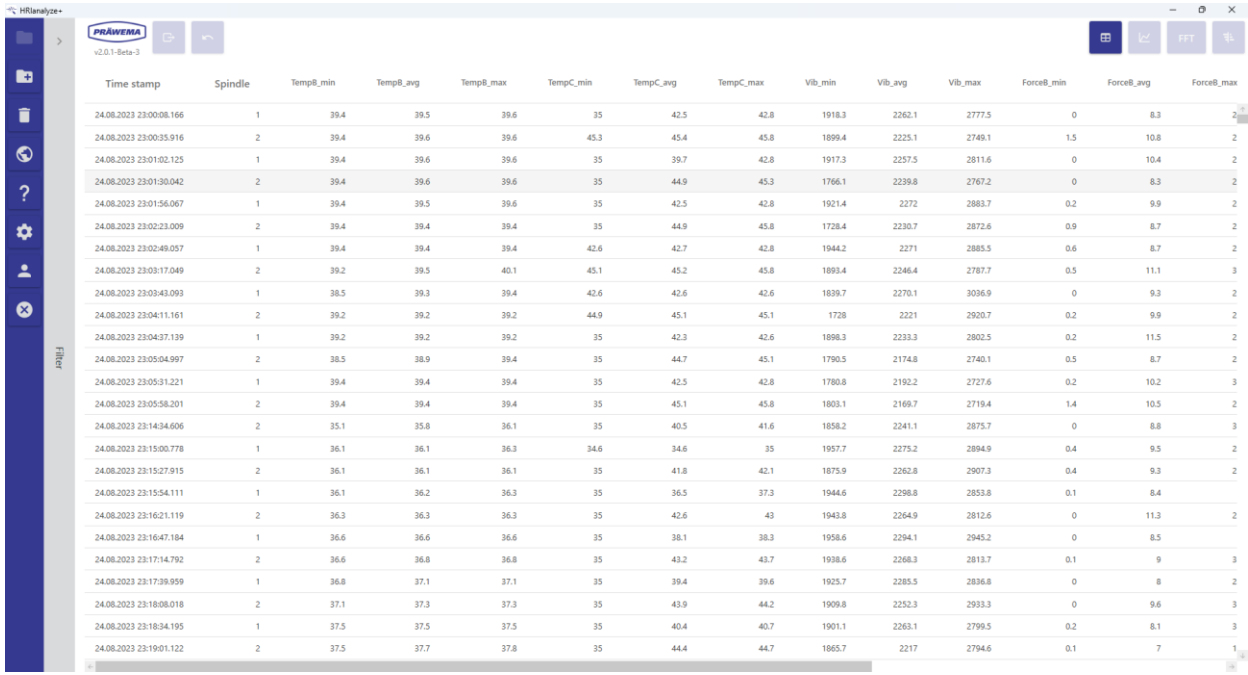
Software tool HRI®analyze+

HriLog files

For components that have been assigned a label via DMC, for example, this information is stored in the HriLog, HriFFTLog and HriShockLog.

Parts traceability from honing to the assembly line should be given.

Basically, the total part count is saved in all log files.



Software tool HRI®analyze+

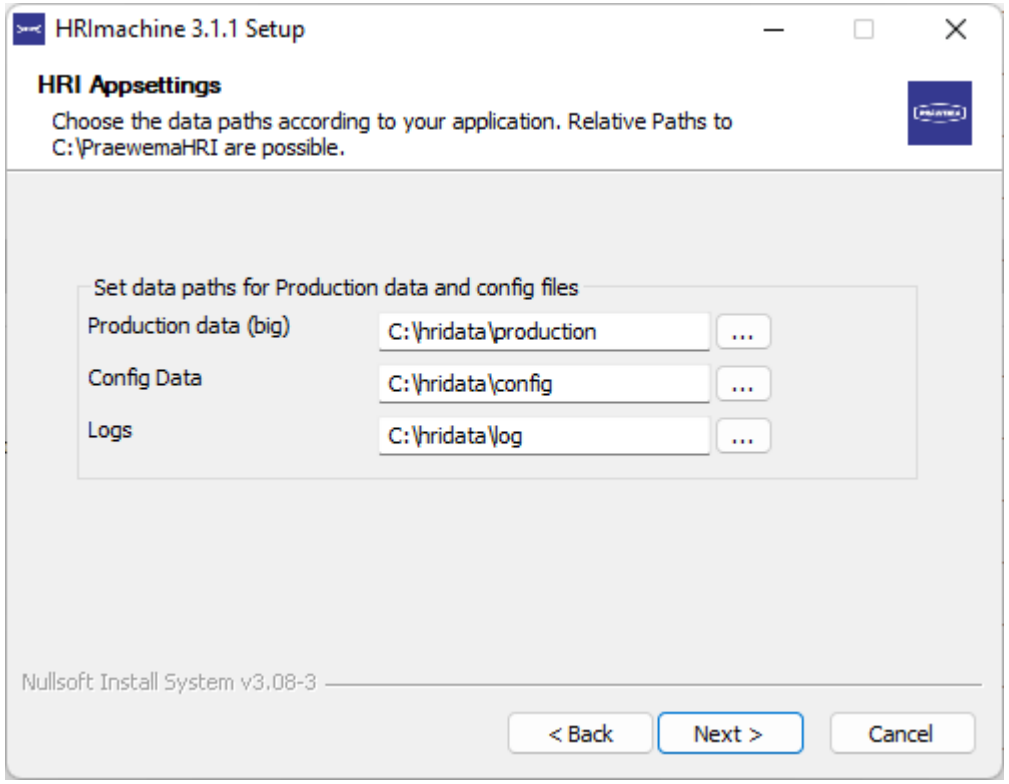
HriLog files

During the installation of HRImachine you will be asked for a storage path for the HRI data. This setting cannot be changed later.

In the folder Production the HRI files concerning the production are stored (HriLog, HriDebugLog, HriFFTLog, HriShockLog).

Under Config Data the settings, part programs and limit curves are stored. It is recommended to backup this folder with the Indra Works project backup.

In the Logs folder the logging files for error analysis are stored.



Software tool HRI®analyze+

HriLog files

The files are saved in the folder:

(C/D):\hridata\production\(left\right)HRILog

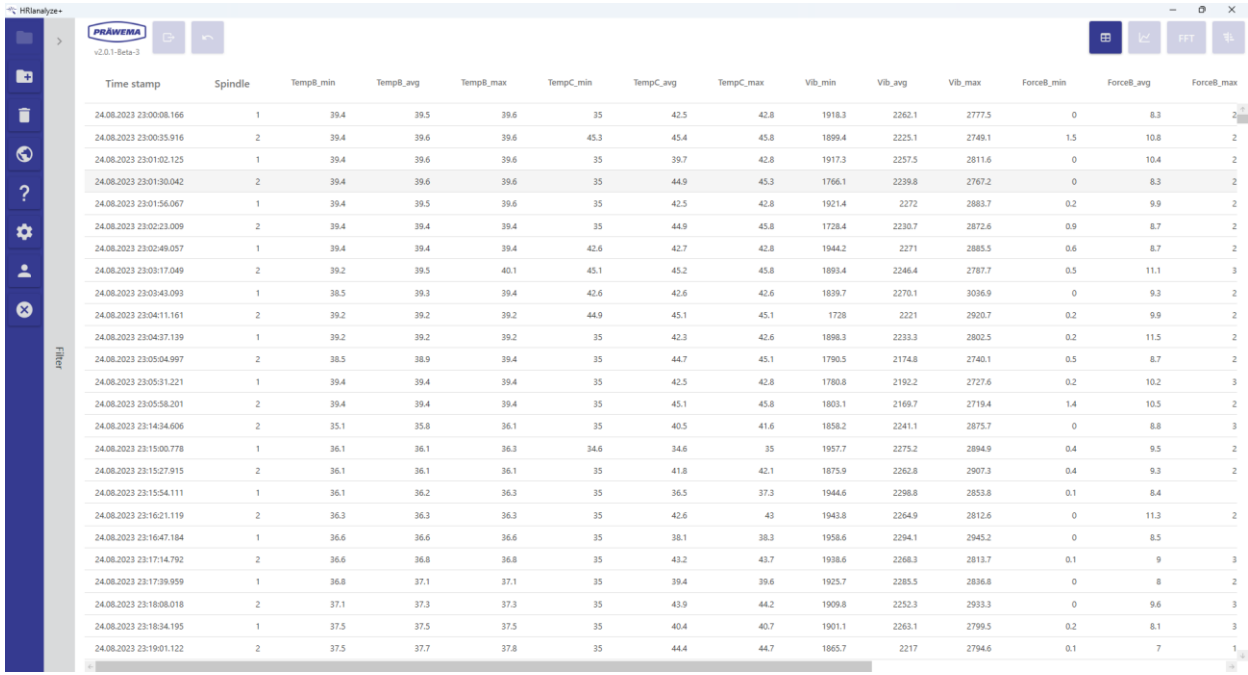
The file name is structured as follows:

File_type_channel_name_component_name_date_index

hrilog_50_Gear_rile_20200901_0

Should diagnostic objects be added or changed, a new file with an ascending index is created.

.

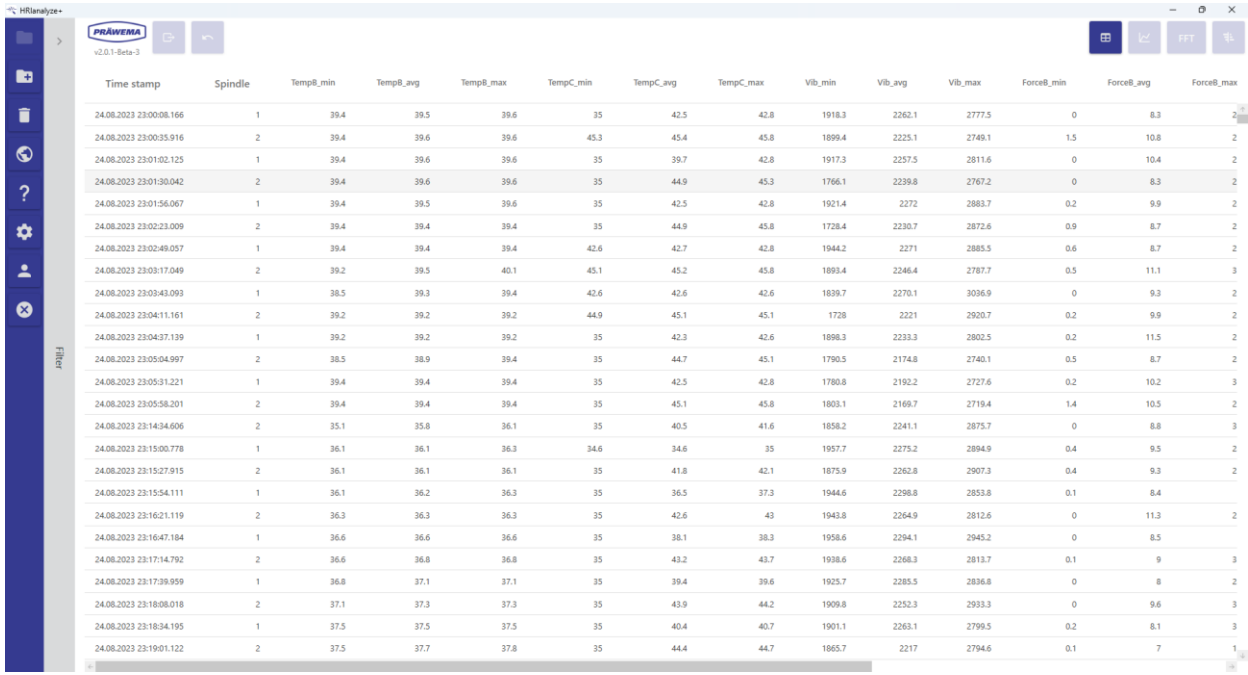


Software tool HRI®analyze+

HriLog files

When editing, a distinction is made between the following NC Progsub numbers:

NC program number	
1	Footprint / KM 0 measurement
2-9	Other programs (turning, drilling, etc.)
21	Honring measuring head
22	Honring measuring gear
31	Profiling head
32	Profiling gear

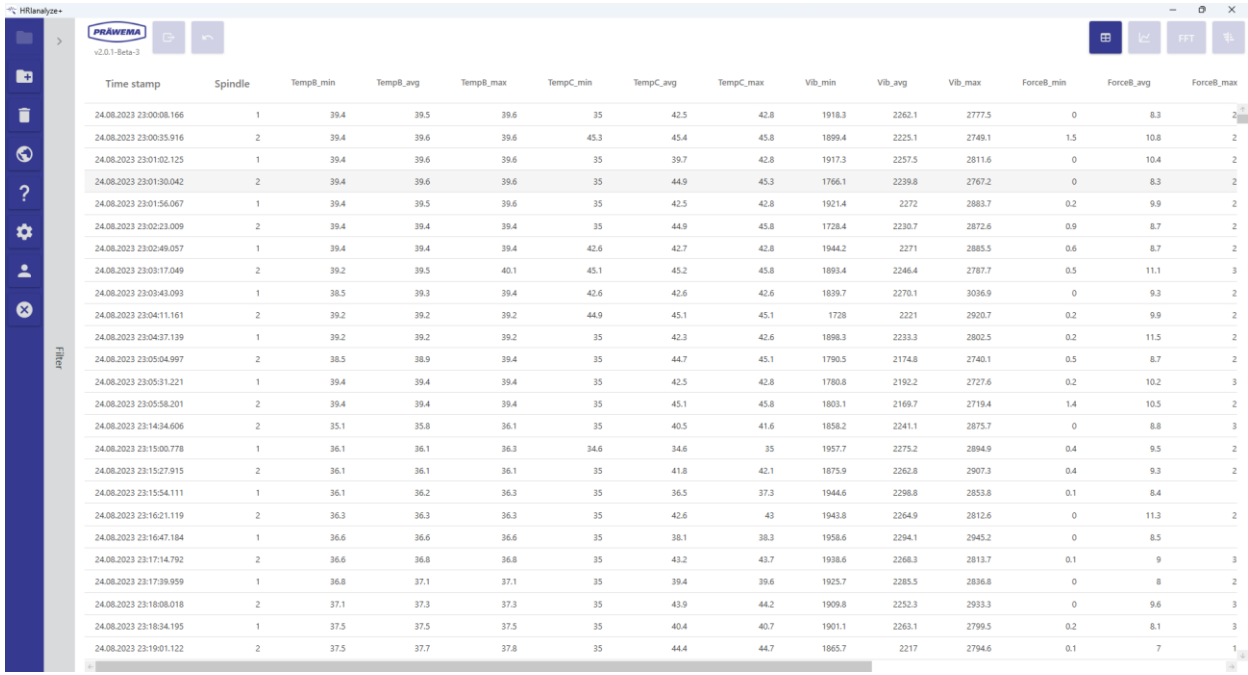


Software tool HRI®analyze+

HriLog files

When editing, a distinction is made between the following NC Progsub numbers:

NC program number	
33	Pre profiling only with Vario Speed Dresser
34	Profiling only with the Vario Speed Dresser
35	Skiving
40	Omit workpiece measurement
41	Workpiece measure left

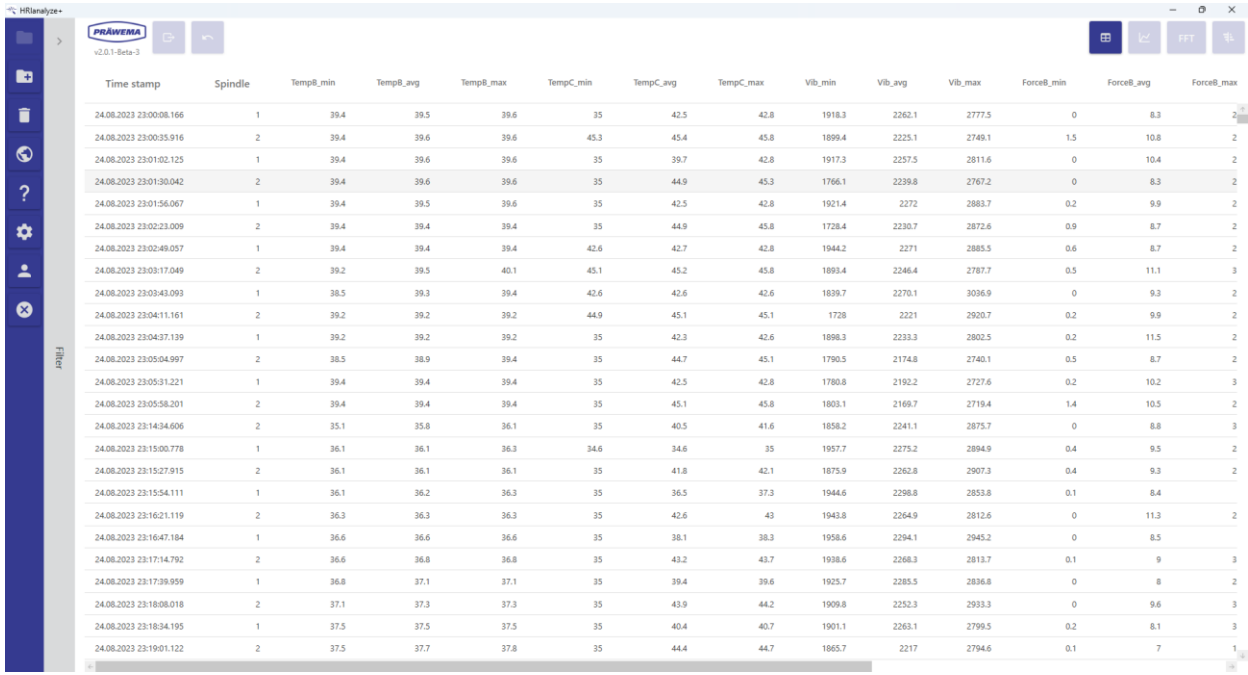


Software tool HRI®analyze+

HriLog files

When editing, a distinction is made between the following NC Progsub numbers:

NC program number	
42	Workpiece measure right
50	Honing
51	Dressing gearing with DDG
52	Dressing tip circle
53	Dressing with Vario Speed Dresser
60	Calibrate



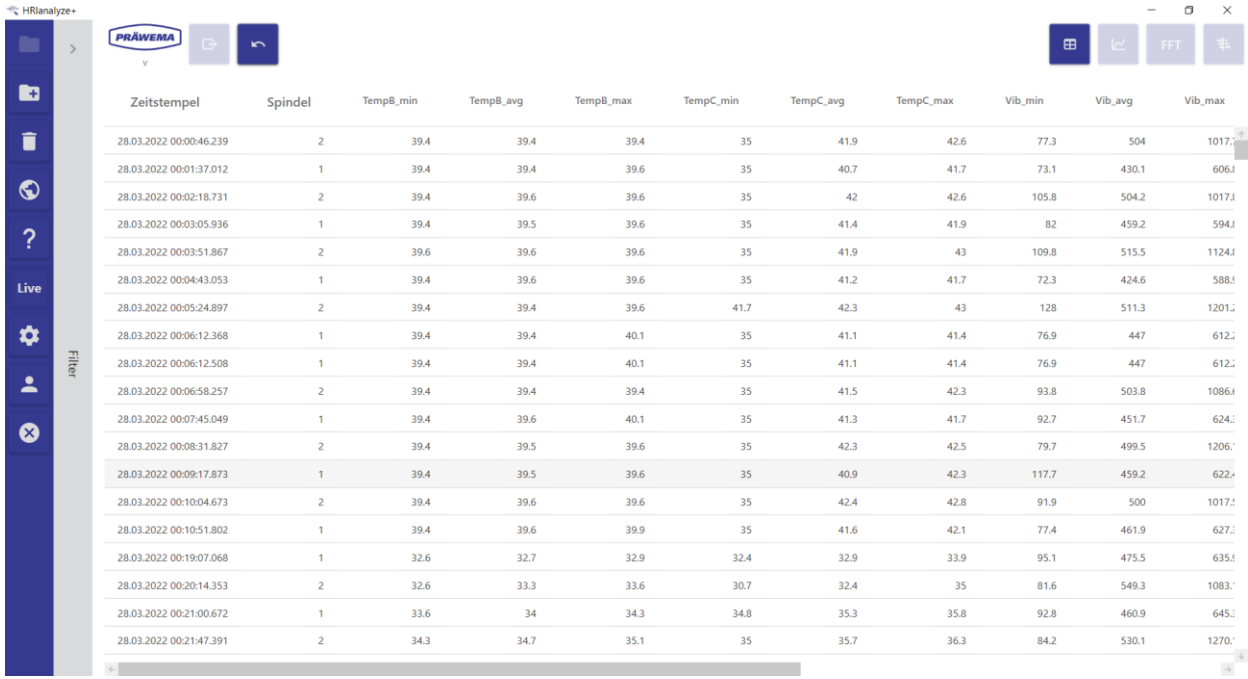
Software tool HRI®analyze+

HriLog files

Each row represents a workpiece that has been processed with the machine.

If the machine is working in simulation mode or on standby, the parts counter does not count them. This can lead to duplicate part numbers and DMC. This is suppressed from backend version 3.1.

If the processing is aborted via the emergency retraction (reset), current peaks occur and thus a high HRI value. Such components must be viewed separately via HriDebugLog files.



Zeitstempel	Spindel	TempB_min	TempB_avg	TempB_max	TempC_min	TempC_avg	TempC_max	Vib_min	Vib_avg	Vib_max
28.03.2022 00:00:46.239	2	39.4	39.4	39.4	35	41.9	42.6	77.3	504	1017.
28.03.2022 00:01:37.012	1	39.4	39.4	39.6	35	40.7	41.7	73.1	430.1	606.
28.03.2022 00:02:18.731	2	39.4	39.6	39.6	35	42	42.6	105.8	504.2	1017.
28.03.2022 00:03:05.936	1	39.4	39.5	39.6	35	41.4	41.9	82	459.2	594.
28.03.2022 00:03:51.867	2	39.6	39.6	39.6	35	41.9	43	109.8	515.5	1124.
28.03.2022 00:04:43.053	1	39.4	39.6	39.6	35	41.2	41.7	72.3	424.6	588.
28.03.2022 00:05:24.897	2	39.4	39.4	39.6	41.7	42.3	43	128	511.3	1201.
28.03.2022 00:06:12.368	1	39.4	39.4	40.1	35	41.1	41.4	76.9	447	612.
28.03.2022 00:06:12.508	1	39.4	39.4	40.1	35	41.1	41.4	76.9	447	612.
28.03.2022 00:06:58.257	2	39.4	39.4	39.4	35	41.5	42.3	93.8	503.8	1086.
28.03.2022 00:07:45.049	1	39.4	39.6	40.1	35	41.3	41.7	92.7	451.7	624.
28.03.2022 00:08:31.827	2	39.4	39.5	39.6	35	42.3	42.5	79.7	499.5	1206.
28.03.2022 00:09:17.873	1	39.4	39.5	39.6	35	40.9	42.3	117.7	459.2	622.
28.03.2022 00:10:04.673	2	39.4	39.6	39.6	35	42.4	42.8	91.9	500	1017.
28.03.2022 00:10:51.802	1	39.4	39.6	39.9	35	41.6	42.1	77.4	461.9	627.
28.03.2022 00:19:07.068	1	32.6	32.7	32.9	32.4	32.9	33.9	95.1	475.5	635.
28.03.2022 00:20:14.353	2	32.6	33.3	33.6	30.7	32.4	35	81.6	549.3	1083.
28.03.2022 00:21:00.672	1	33.6	34	34.3	34.8	35.3	35.8	92.8	460.9	645.
28.03.2022 00:21:47.391	2	34.3	34.7	35.1	35	35.7	36.3	84.2	530.1	1270.

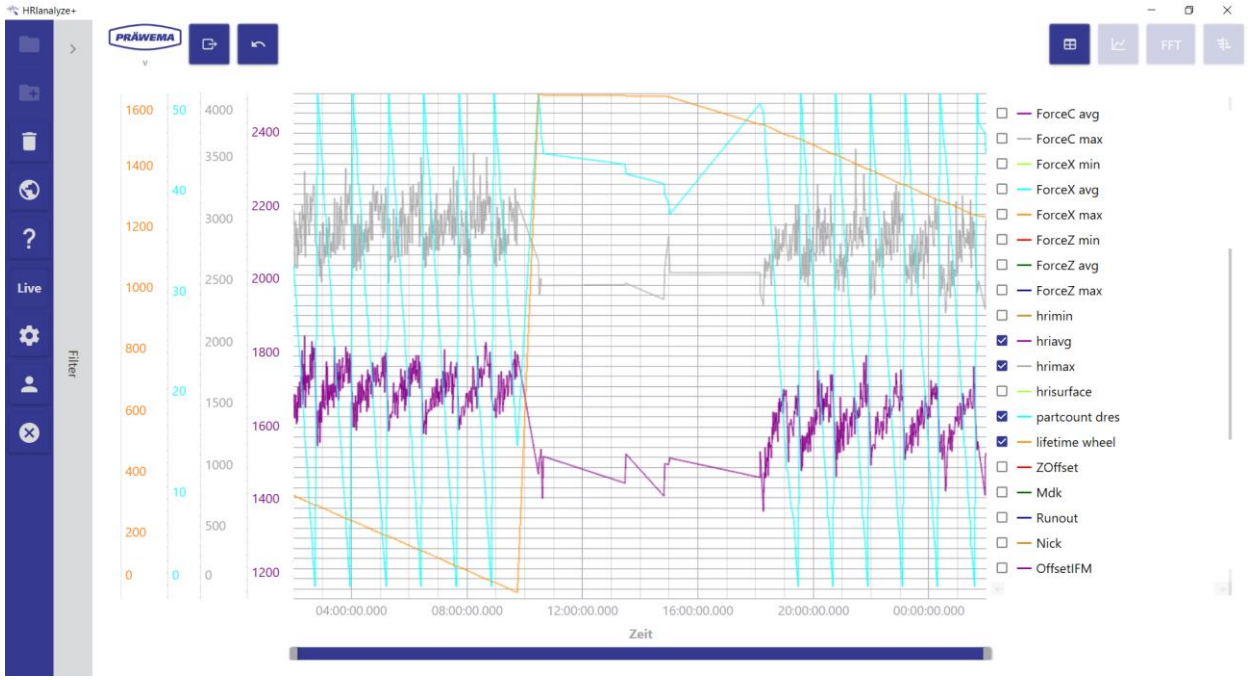
Software tool HRI®analyze+

HriLog files

On the right side of the chart, you can select and deselect the displayed parameter.

A pre-selection is made for HRImax, HRIavg, Partcount Dress and Lifetime Wheel.

A separate Y-axis is calculated for each column. For this reason, there can be longer waiting times for many order or diagnosis objects when the diagram is calculated.

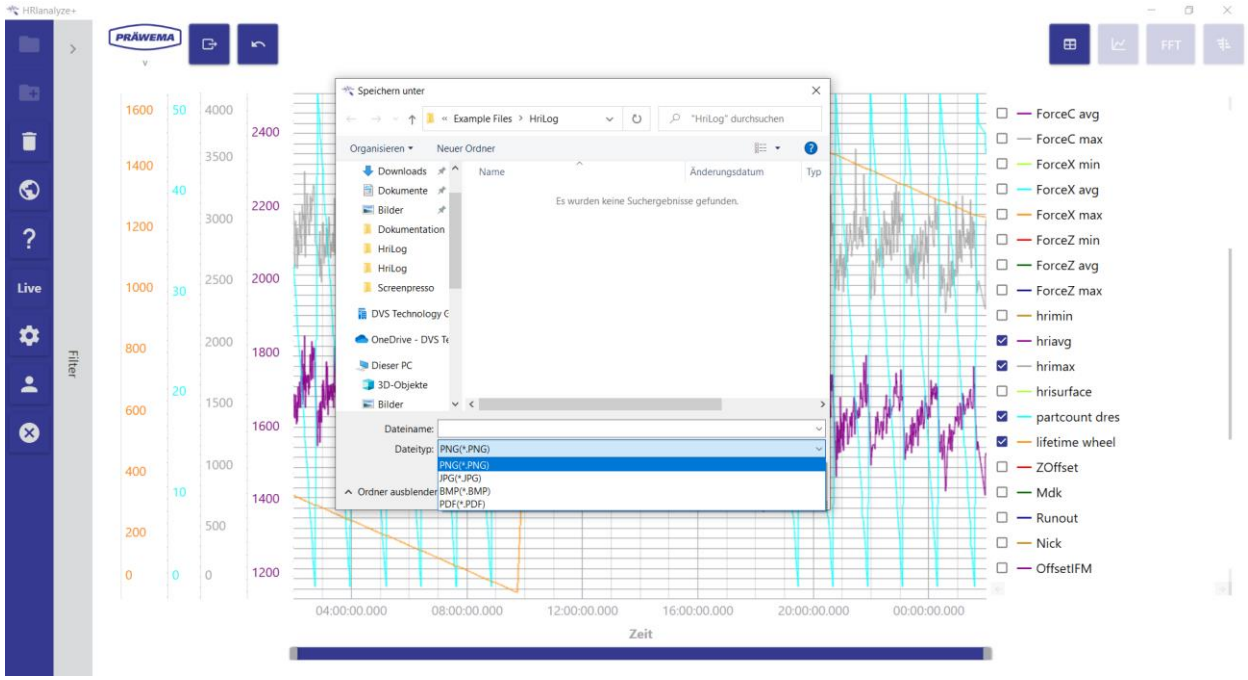


Software tool HRI®analyze+

Export Button

Files can be exported as PNG, JPG, BMP or PDF format.

Exports are performed in the current view.

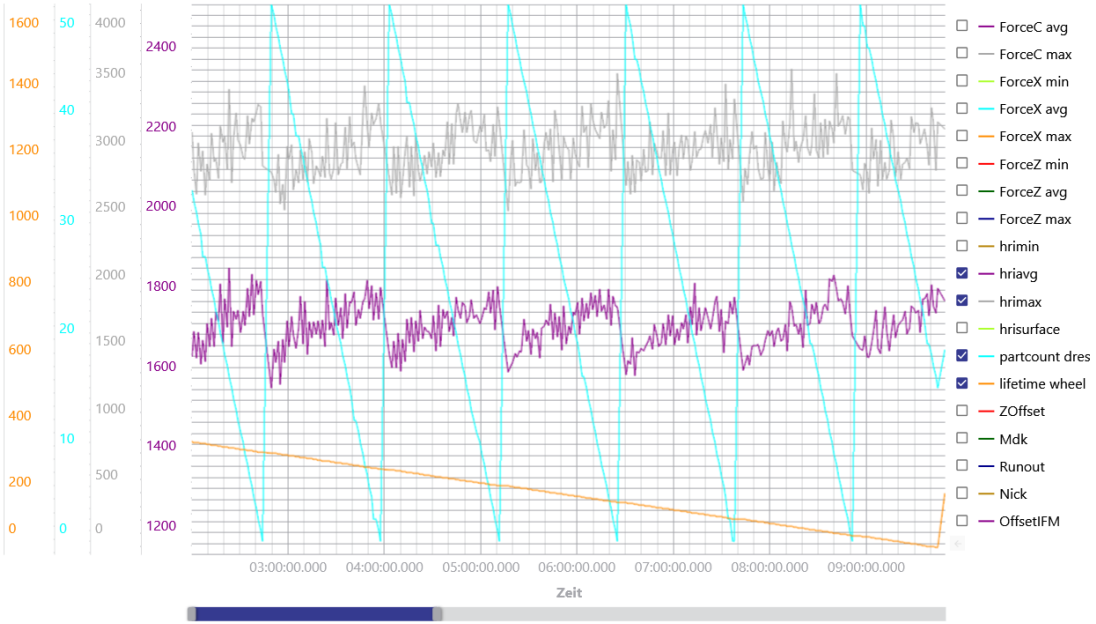


Software tool HRI®analyze+

Export Button

Example of an export in PNG format.

The time range up to the tool change was limited via the scroll bar below.



Software tool HRI®analyze+

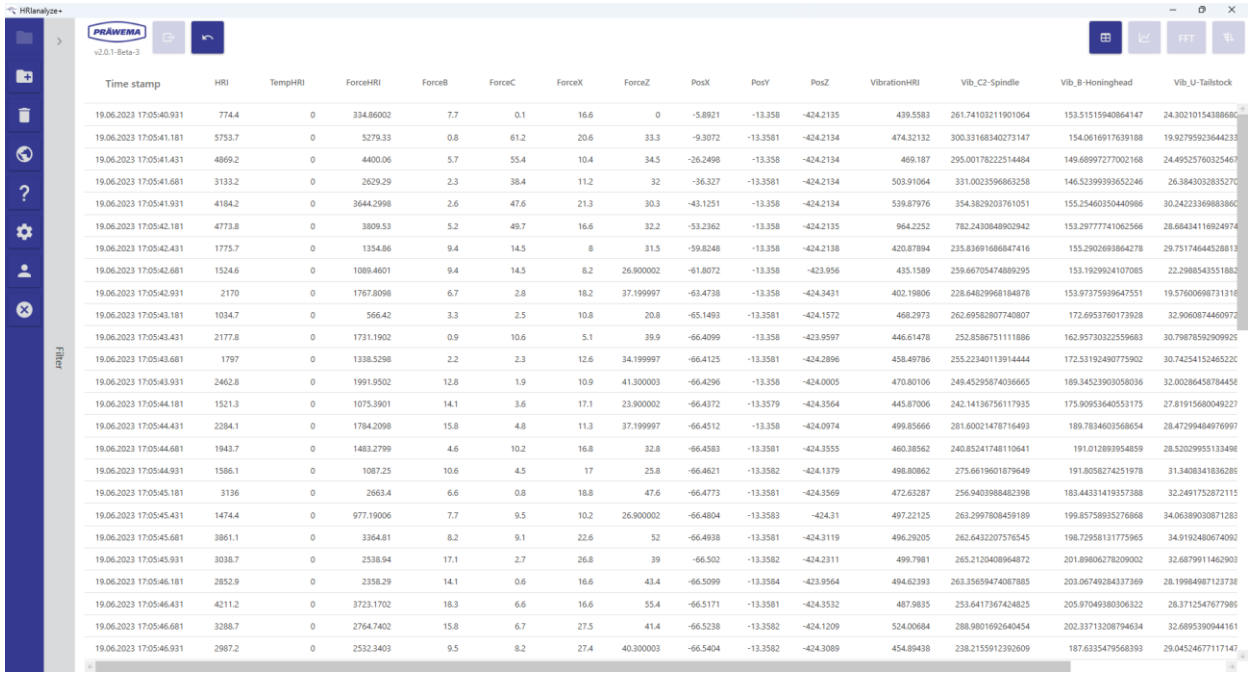
HriDebugLog files

For each part, HRI creates a debug file.

With these files it is possible to check the course of the temperature, the forces and the vibration during the machining process.

The positions of the linear axes X, Y, and Z are recorded.

With the SynchroFine, the W-axis is recorded instead of the Y-axis.



Time stamp	HRI	TempHRI	ForceHRI	ForceB	ForceC	ForceX	ForceZ	PosX	PosY	PosZ	VibrationHRI	Vib_C2-Spindle	Vib_B-Honinghead	Vib_U-Tailstock
19.06.2023 17:05:40.931	774.4	0	334.86002	7.7	0.1	16.6	0	-5.8921	-13.358	-424.2135	439.5583	261.741032119010	153.515159408641	24.302101543886
19.06.2023 17:05:41.181	5753.7	0	5279.33	0.8	61.2	20.6	33.3	-9.3072	-13.3581	-424.2134	474.32132	300.331683402731	154.061691763918	19.92795923644233
19.06.2023 17:05:41.431	4869.2	0	4400.06	5.7	55.4	10.4	34.5	-26.2498	-13.358	-424.2134	469.187	295.001782225144	149.689972770021	24.495257603254
19.06.2023 17:05:41.681	3133.2	0	2629.29	2.3	38.4	11.2	32	-36.327	-13.3581	-424.2134	503.91064	331.002359686258	146.523993936522	26.384303283527
19.06.2023 17:05:41.931	4184.2	0	3644.2998	2.6	47.6	21.3	30.3	-43.1251	-13.358	-424.2134	539.87976	354.382920376105	155.254603504409	30.242233698838
19.06.2023 17:05:42.181	4773.8	0	3809.53	5.2	49.7	16.6	32.2	-53.2362	-13.358	-424.2135	964.2252	782.243084890294	153.297777410625	28.684341169249
19.06.2023 17:05:42.431	1775.7	0	1354.86	9.4	14.5	8	31.5	-59.8248	-13.358	-424.2138	420.87894	235.836916868474	155.290269386427	29.751746445288
19.06.2023 17:05:42.681	1524.6	0	1089.4601	9.4	14.5	8.2	26.900002	-61.8072	-13.358	-423.956	435.1589	259.667054748892	153.192992410708	22.298854355188
19.06.2023 17:05:42.931	2170	0	1767.8098	6.7	2.8	18.2	37.199997	-63.4738	-13.358	-424.3431	402.19806	228.648299681848	153.973759396475	19.576006987313
19.06.2023 17:05:43.181	1034.7	0	566.42	3.3	2.5	10.8	20.8	-65.1493	-13.3581	-424.1572	468.2973	262.695828077408	172.695376017392	32.906087446097
19.06.2023 17:05:43.431	2177.8	0	1731.1902	0.9	10.6	5.1	39.9	-66.4099	-13.358	-423.9597	446.61478	252.858675111188	162.957303225596	30.798785929099
19.06.2023 17:05:43.681	1797	0	1338.5298	2.2	2.3	12.6	34.199997	-66.4125	-13.3581	-424.2896	458.49786	255.223401391444	172.531924977590	30.742541524652
19.06.2023 17:05:43.931	2462.8	0	1991.9502	12.8	1.9	10.9	41.300003	-66.4296	-13.358	-424.0005	470.80106	249.452958740366	189.345239305803	32.002864587844
19.06.2023 17:05:44.181	1521.3	0	1075.3901	14.1	3.6	17.1	23.900002	-66.4372	-13.3579	-424.3564	445.87006	242.141365761179	175.909536405531	27.819156800492
19.06.2023 17:05:44.431	2284.1	0	1784.2098	15.8	4.8	11.3	37.199997	-66.4512	-13.358	-424.0974	499.85666	281.600214787164	189.783460356865	28.472994849769
19.06.2023 17:05:44.681	1943.7	0	1483.2799	4.6	10.2	16.8	32.8	-66.4583	-13.3581	-424.3555	460.38562	240.852417481106	191.012893954859	28.520299551334
19.06.2023 17:05:44.931	1586.1	0	1087.25	10.6	4.5	17	25.8	-66.4621	-13.3582	-424.1379	498.80862	275.661960187964	191.805827425197	31.340834183628
19.06.2023 17:05:45.181	3136	0	2663.4	6.6	0.8	18.8	47.6	-66.4773	-13.3581	-424.3569	472.63287	256.940398482398	183.443331419357	32.249175287211
19.06.2023 17:05:45.431	1474.4	0	977.19006	7.7	9.5	10.2	26.900002	-66.4804	-13.3583	-424.31	497.22125	263.299780845918	199.857589352768	34.063890308712
19.06.2023 17:05:45.681	3861.1	0	3364.81	8.2	9.1	22.6	52	-66.4938	-13.3581	-424.3119	496.29205	262.643220757654	198.729581317759	34.919248067409
19.06.2023 17:05:45.931	3038.7	0	2538.94	17.1	2.7	26.8	39	-66.502	-13.3582	-424.2311	499.7981	265.212040896487	201.898062782090	32.687991146290
19.06.2023 17:05:46.181	2852.9	0	2358.29	14.1	0.6	16.6	43.4	-66.5099	-13.3584	-423.9564	494.62393	263.356594740878	203.067492843373	28.199849871237
19.06.2023 17:05:46.431	4211.2	0	3723.1702	18.3	6.6	16.6	55.4	-66.5171	-13.3581	-424.3532	487.9835	253.641736742482	205.970493803063	28.371254767798
19.06.2023 17:05:46.681	3288.7	0	2764.7402	15.8	6.7	27.5	41.4	-66.5238	-13.3582	-424.1209	524.00684	288.980169264045	202.337132087946	32.689539094416
19.06.2023 17:05:46.931	2987.2	0	2532.3403	9.5	8.2	27.4	40.300003	-66.5404	-13.3582	-424.3089	454.89438	238.215591239260	187.633547956839	29.045246771174

Software tool HRI®analyze+

HriDebugLog files

The files are saved in the folder:

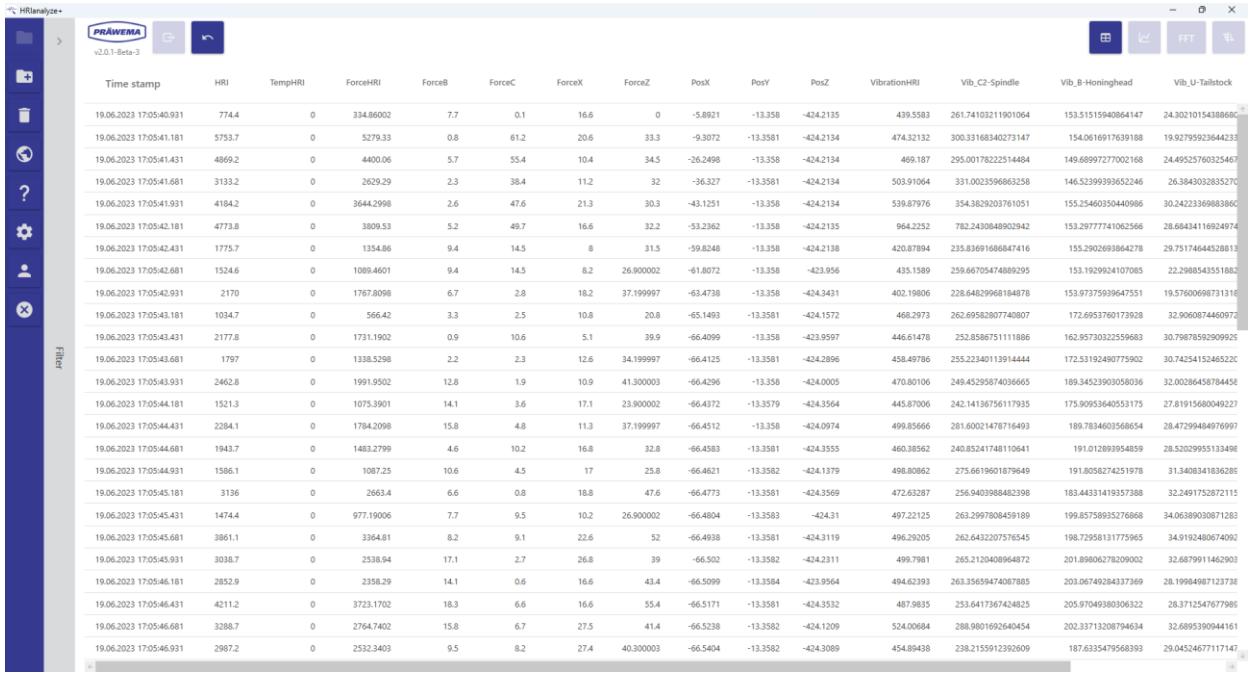
(C\D):\hridata\production\(left/right)\HriDebugLog

The file name is structured as follows:

hri_data_debug_2020-09-21T11-30-36_50_470

File_Type_Date_Time_Channel_Name_Counter

The components can be clearly assigned using the total part count.



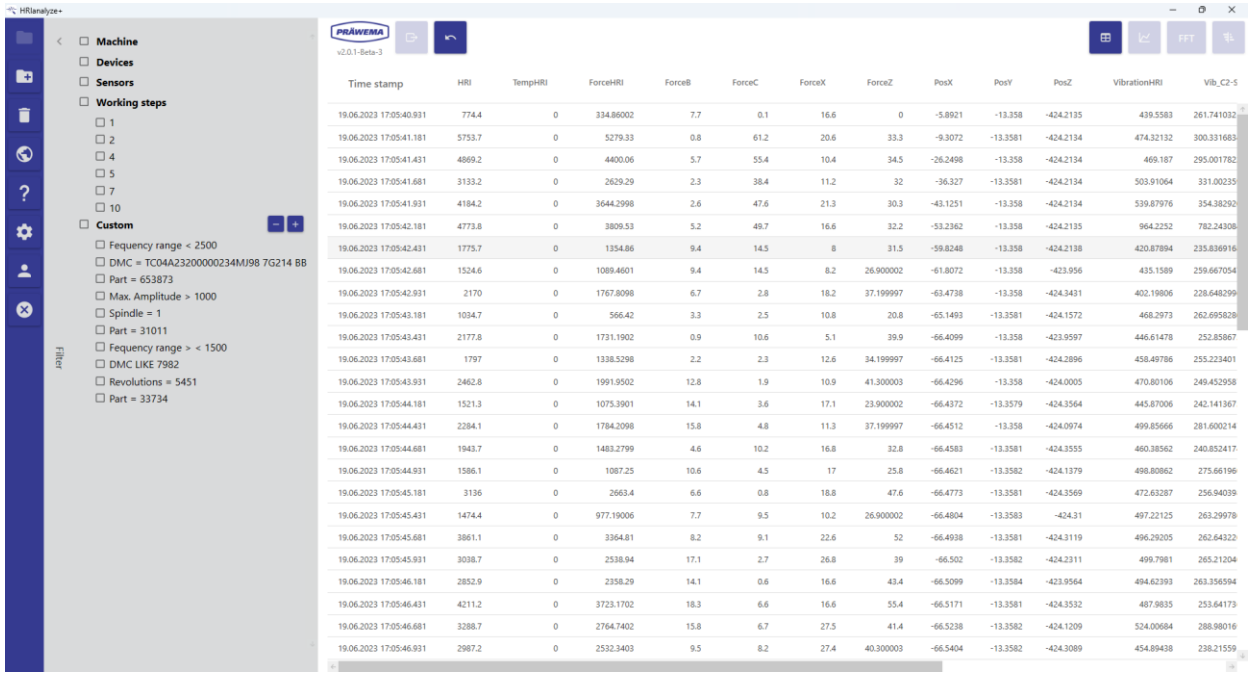
Software tool HRI®analyze+

HriDebugLog files

The process step of the machine can be restricted using the filter function. You can hide certain cuts when skiving or work steps when honing.

With the gear skiving machine, each skiving stroke is considered a separate process step. If, for example, a workpiece is to be processed with 15 skiving strokes, the machine records 15 process steps accordingly.

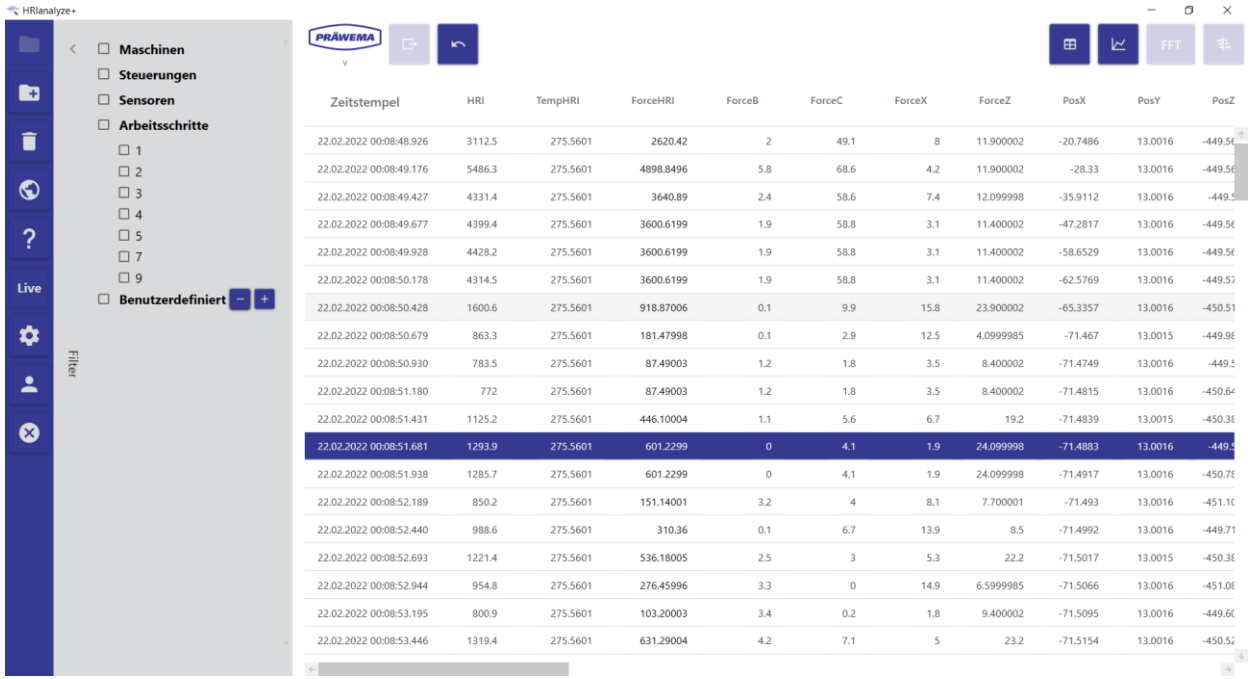
With other machines from the DVS Technology Group, the process steps are individually adapted to the processing of the machine.



Software tool HRI®analyze+

HriDebugLog files

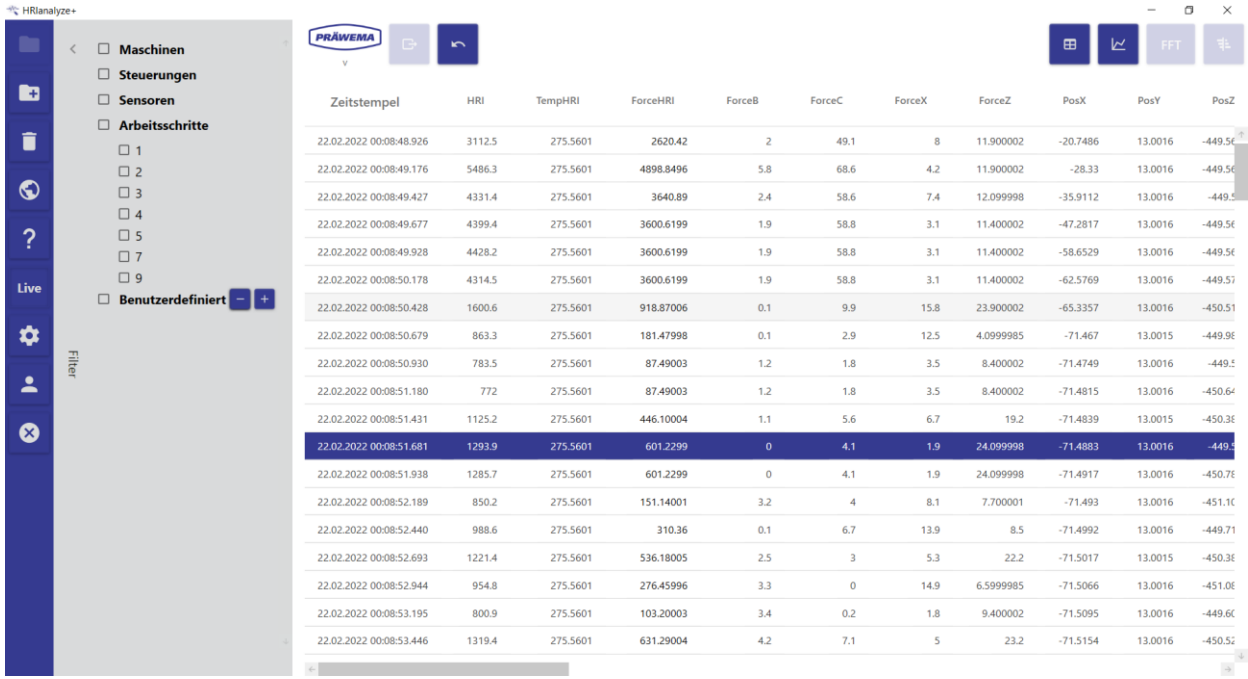
Proc steps honing	
0	inactive
1	way from 0 to tooth-tooth position (rapid)
2	way from tooth-tooth to "scratching point" (high feed of 1000 mm/min)
8	Prehoning, at Nick in gray range
3	touching (1)
7	touching (2) (optional)
9	lift distance (optional)



Software tool HRI®analyze+

HriDebugLog files

Proc steps honing	
4	working (1)
10	working (2) (optional)
5	Spark out (residence time on end distance with oscillation)
6	Retreat path
Proc steps dressing with VSD	
25	VSD cuts without correction
26	VSD cuts with correction



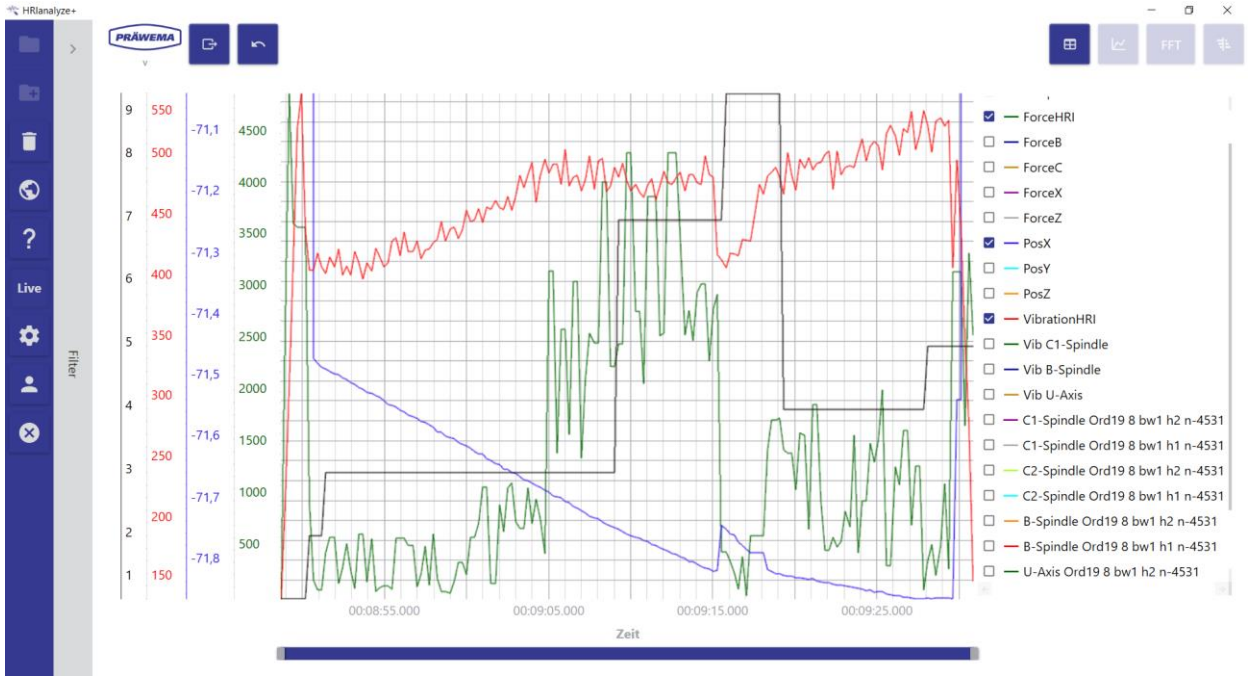
Software tool HRI®analyze+

HriDebugLog files

The example shows the honing of a workpiece.

The blue line is the x-axis position. During work step 9 (lift distance), the X-axis is retracted briefly. The force component and the vibration component on the HRI are significantly reduced during the lift distance .

After the component is in contact with the workpiece again, the forces are lower than before it was lifted off.

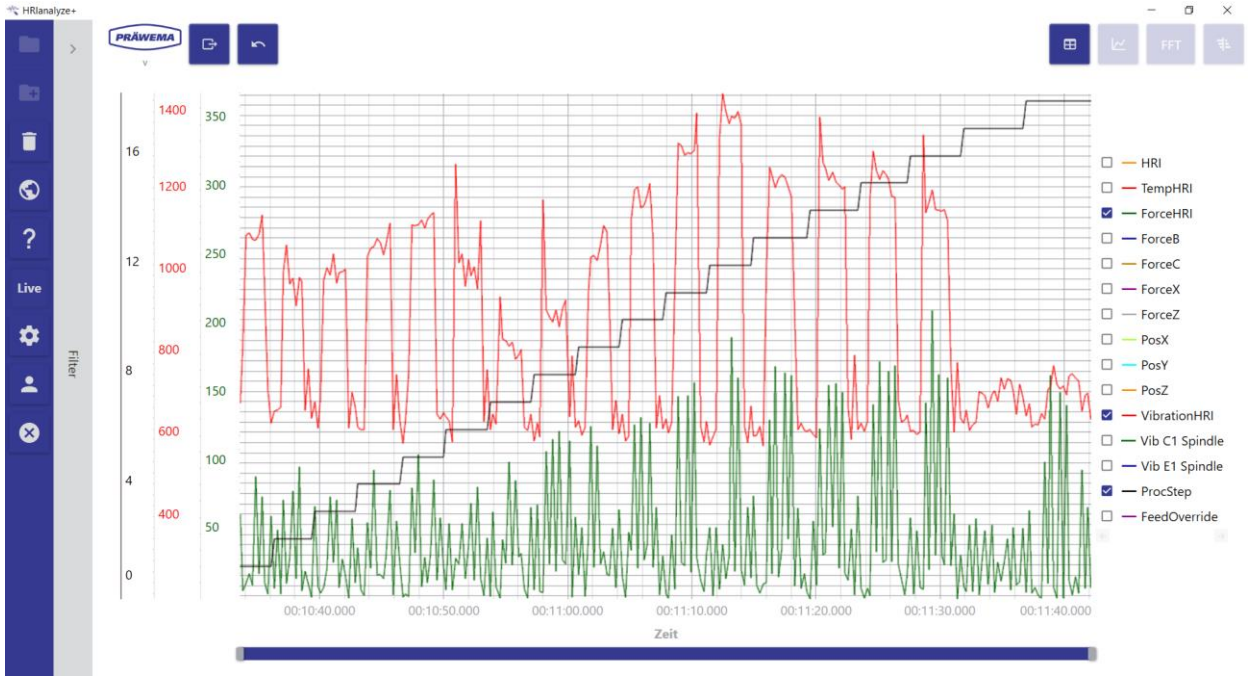


Software tool HRI®analyze+

HriDebugLog files

The example shows the skiving of a workpiece.

The workpiece is machined with 16 scrubbing strokes and 2 finishing strokes. During the 6th to 8th skiving stroke, the vibrations are lower than with the other skiving strokes. The process can be optimized using the debug files.



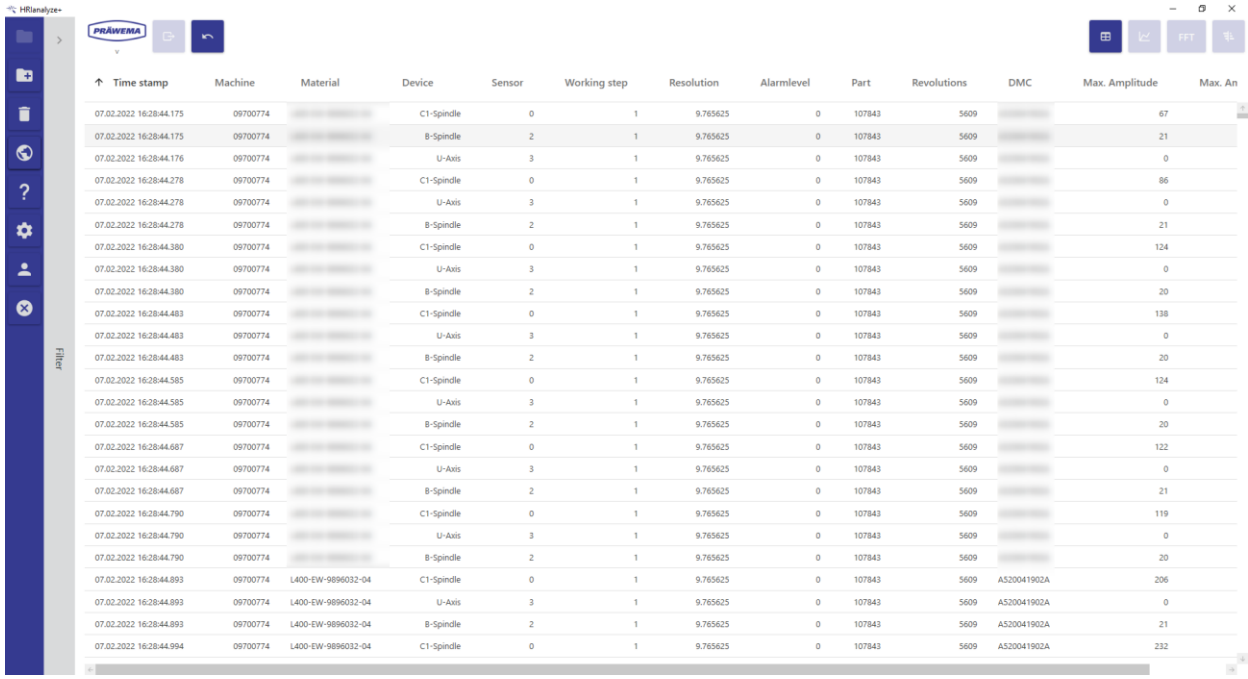
Software tool HRI®analyze+

HriFFTLog files

The vibration spectra are stored in the HriFFTLog files.

A complete spectrum of each sensor is stored every 120ms. Each line is a frequency spectrum.

The spectra can be visualized with HRI®analyze+ as a line diagram or as a Campbell diagram.



Time stamp	Machine	Material	Device	Sensor	Working step	Resolution	Alarmlevel	Part	Revolutions	DMC	Max. Amplitude	Max. An
07.02.2022 16:28:44.175	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		67	
07.02.2022 16:28:44.175	09700774		B-Spindle	2	1	9.765625	0	107843	5609		21	
07.02.2022 16:28:44.176	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.278	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		86	
07.02.2022 16:28:44.278	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.278	09700774		B-Spindle	2	1	9.765625	0	107843	5609		21	
07.02.2022 16:28:44.380	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		124	
07.02.2022 16:28:44.380	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.380	09700774		B-Spindle	2	1	9.765625	0	107843	5609		20	
07.02.2022 16:28:44.483	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		138	
07.02.2022 16:28:44.483	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.483	09700774		B-Spindle	2	1	9.765625	0	107843	5609		20	
07.02.2022 16:28:44.585	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		124	
07.02.2022 16:28:44.585	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.585	09700774		B-Spindle	2	1	9.765625	0	107843	5609		20	
07.02.2022 16:28:44.687	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		122	
07.02.2022 16:28:44.687	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.687	09700774		B-Spindle	2	1	9.765625	0	107843	5609		21	
07.02.2022 16:28:44.790	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		119	
07.02.2022 16:28:44.790	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.790	09700774		B-Spindle	2	1	9.765625	0	107843	5609		20	
07.02.2022 16:28:44.893	09700774	L400-EW-9896032-04	C1-Spindle	0	1	9.765625	0	107843	5609	A520041902A	206	
07.02.2022 16:28:44.893	09700774	L400-EW-9896032-04	U-Axis	3	1	9.765625	0	107843	5609	A520041902A	0	
07.02.2022 16:28:44.893	09700774	L400-EW-9896032-04	B-Spindle	2	1	9.765625	0	107843	5609	A520041902A	21	
07.02.2022 16:28:44.994	09700774	L400-EW-9896032-04	C1-Spindle	0	1	9.765625	0	107843	5609	A520041902A	232	

Software tool HRI®analyze+

HriFFTLog files

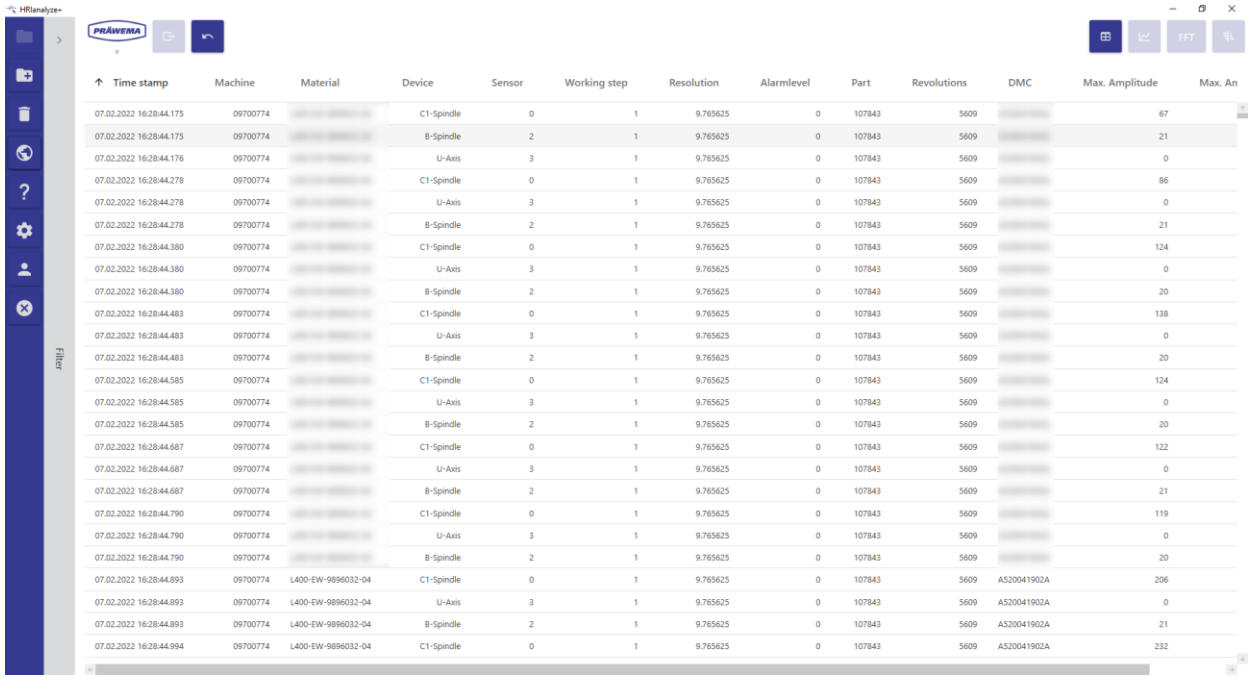
The files are stored in the folder:

(C\D):\hridata\production\(left\right)\HriFFTLog

The file name is set up as follows:

34_2020090208_partname_B_HoningHead_26_FFT

Channel_date_hour_partname_sensorname_
process step_fft

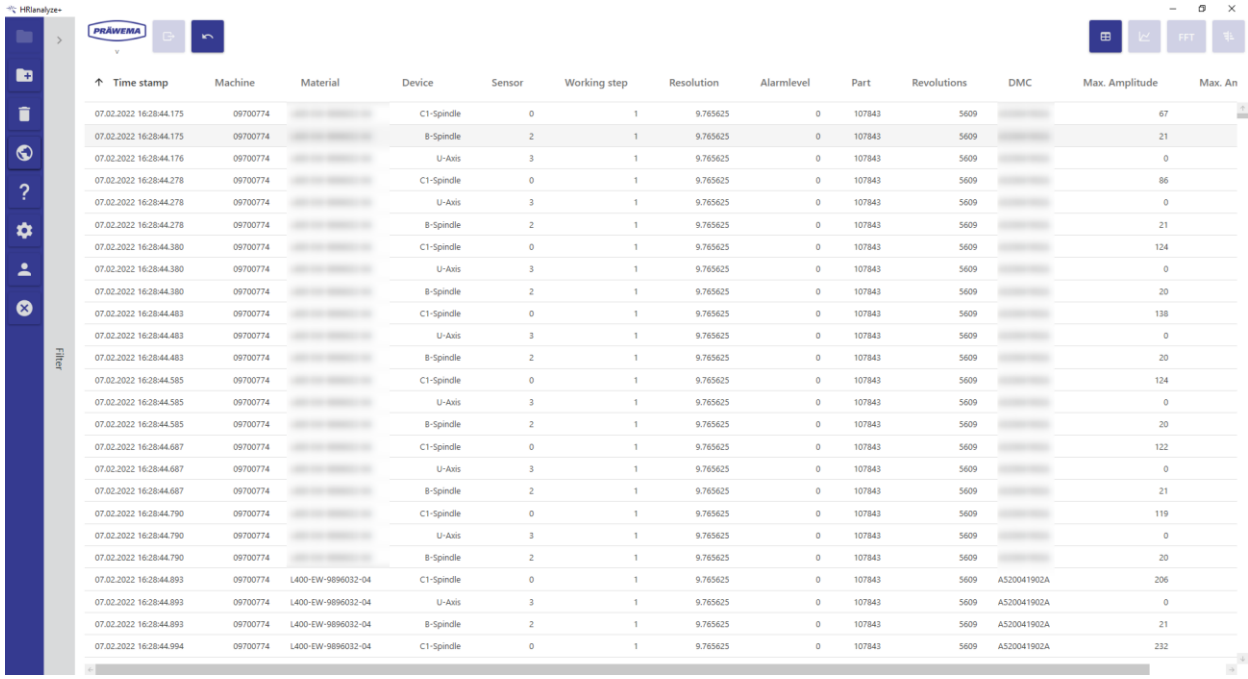


Software tool HRI®analyze+

HriFFTLog files

A new FFT and shock file is generated every two hours to divide up the data volume. The amount of data for one day can exceed one gigabyte for a processing machine with 4 sensors.

This amount of data must be loaded completely in order to analyze the vibrations. Therefore, the splitting of the data is carried out every 2 hours.



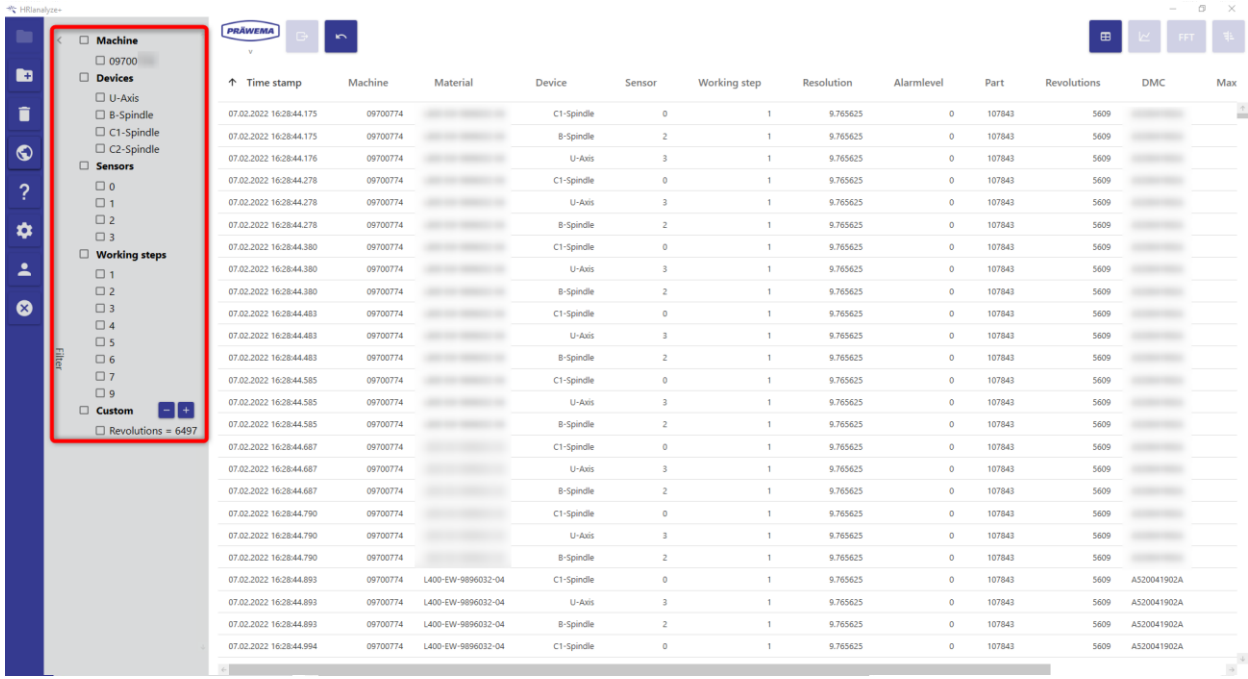
Time stamp	Machine	Material	Device	Sensor	Working step	Resolution	Alarmlevel	Part	Revolutions	DMC	Max. Amplitude	Max. An
07.02.2022 16:28:44.175	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		67	
07.02.2022 16:28:44.175	09700774		B-Spindle	2	1	9.765625	0	107843	5609		21	
07.02.2022 16:28:44.176	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.278	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		86	
07.02.2022 16:28:44.278	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.278	09700774		B-Spindle	2	1	9.765625	0	107843	5609		21	
07.02.2022 16:28:44.380	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		124	
07.02.2022 16:28:44.380	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.380	09700774		B-Spindle	2	1	9.765625	0	107843	5609		20	
07.02.2022 16:28:44.483	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		138	
07.02.2022 16:28:44.483	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.483	09700774		B-Spindle	2	1	9.765625	0	107843	5609		20	
07.02.2022 16:28:44.585	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		124	
07.02.2022 16:28:44.585	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.585	09700774		B-Spindle	2	1	9.765625	0	107843	5609		20	
07.02.2022 16:28:44.687	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		122	
07.02.2022 16:28:44.687	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.687	09700774		B-Spindle	2	1	9.765625	0	107843	5609		21	
07.02.2022 16:28:44.790	09700774		C1-Spindle	0	1	9.765625	0	107843	5609		119	
07.02.2022 16:28:44.790	09700774		U-Axis	3	1	9.765625	0	107843	5609		0	
07.02.2022 16:28:44.790	09700774		B-Spindle	2	1	9.765625	0	107843	5609		20	
07.02.2022 16:28:44.893	09700774	L400-EW-9896032-04	C1-Spindle	0	1	9.765625	0	107843	5609	A520041902A	206	
07.02.2022 16:28:44.893	09700774	L400-EW-9896032-04	U-Axis	3	1	9.765625	0	107843	5609	A520041902A	0	
07.02.2022 16:28:44.893	09700774	L400-EW-9896032-04	B-Spindle	2	1	9.765625	0	107843	5609	A520041902A	21	
07.02.2022 16:28:44.994	09700774	L400-EW-9896032-04	C1-Spindle	0	1	9.765625	0	107843	5609	A520041902A	232	

Software tool HRI®analyze+

HriFFTLog files

On the left side of the overview, filters for the files HriFFTLog and HriShockLog can be defined.

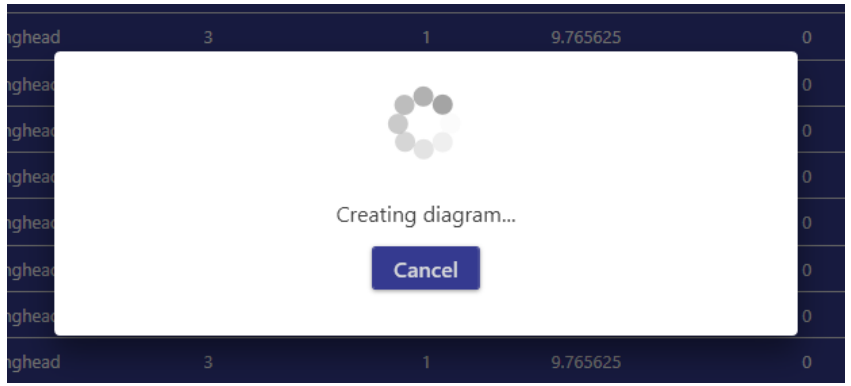
The name of the sensors is displayed in the text.

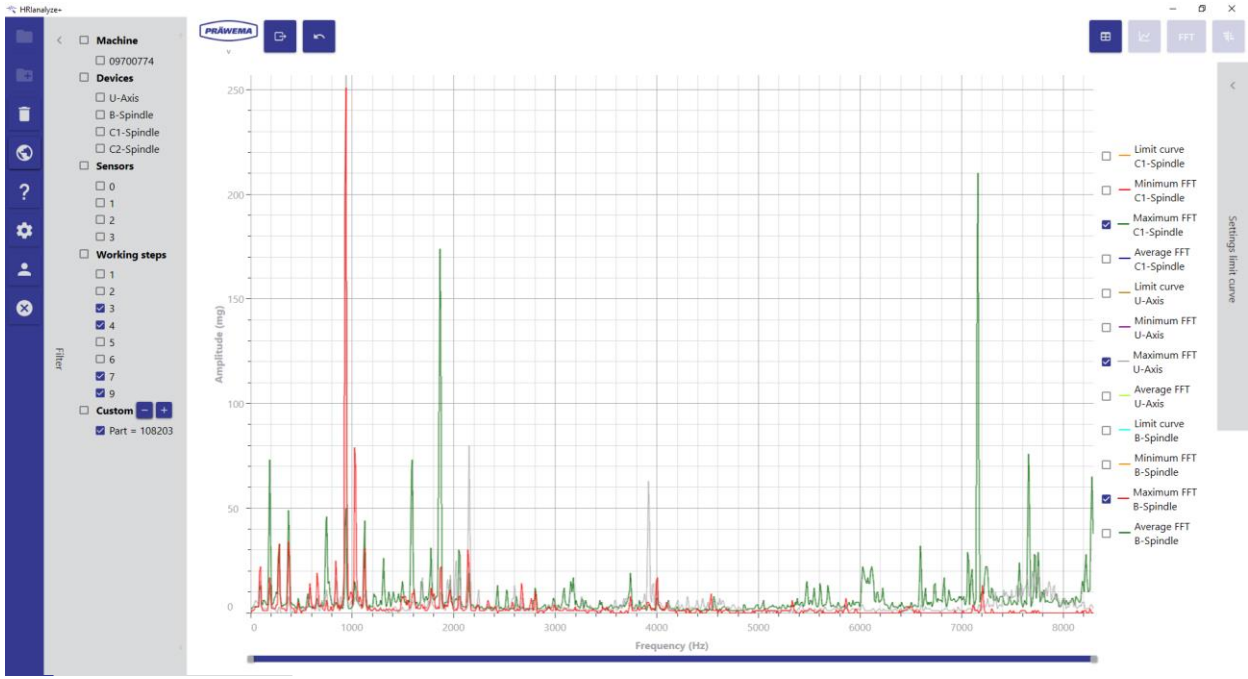


Software tool HRI®analyze+

HriFFTLog files

It is always recommended to view only a few components in the line chart. The calculation of the minimum, average and maximum value need a lot of CPU power and can take a long time for many components.



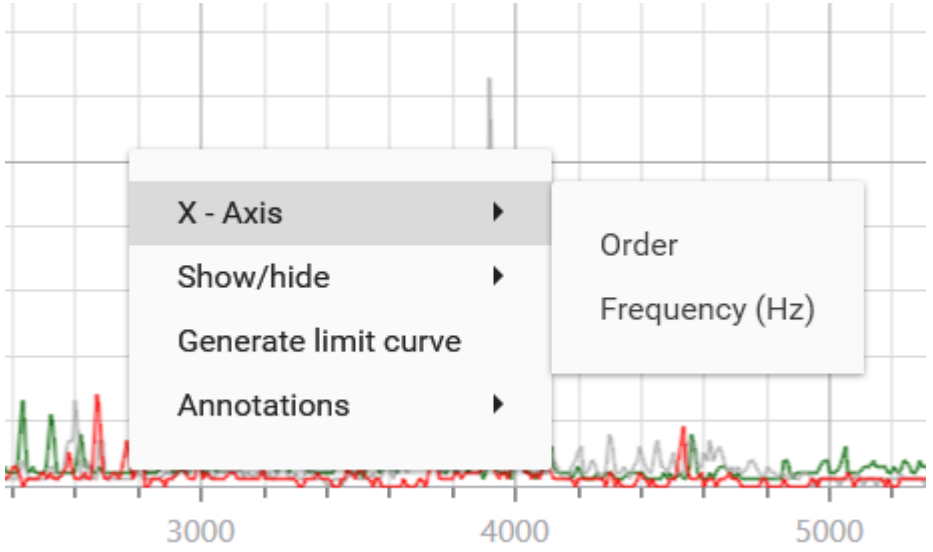


Software tool HRI®analyze+

HriFFTLog files

A dialog box opens with the right mouse button. Here, among other things, the scaling of the X-axis can be switched between orders and frequencies.

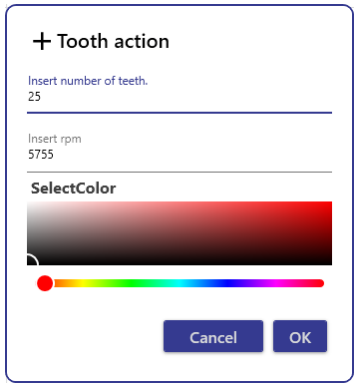
Additional markings can be displayed, such as the meshing frequency or the rotational frequency.



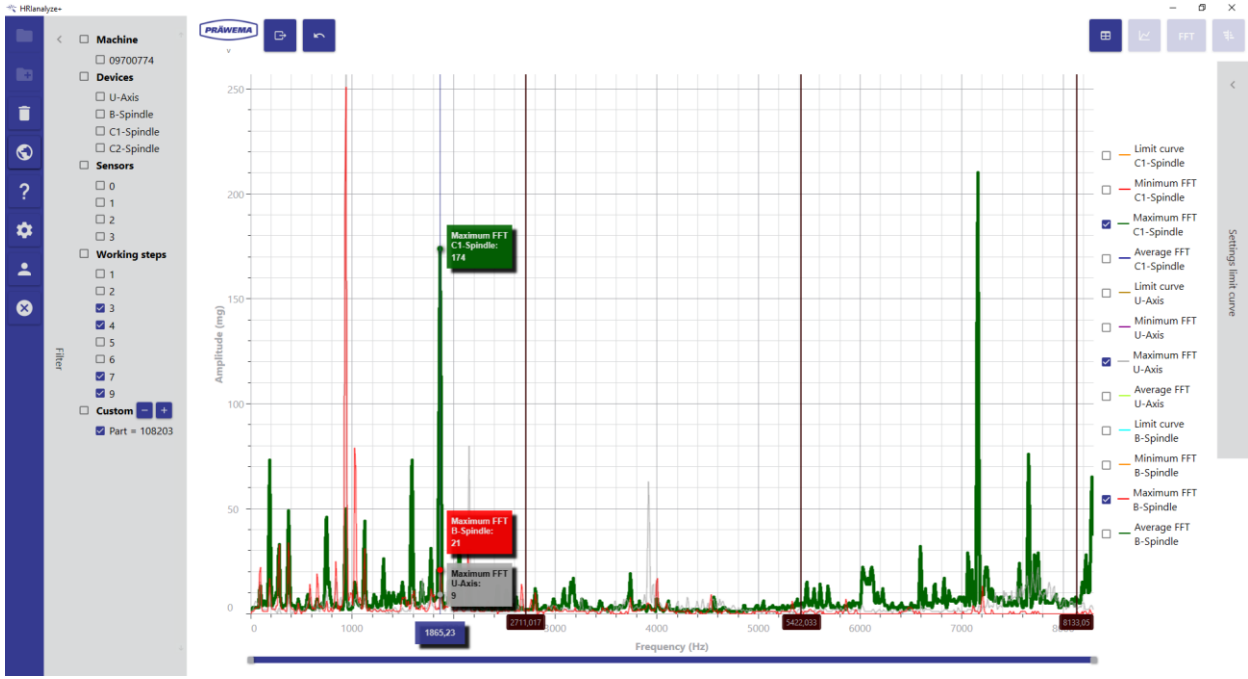
Software tool HRI®analyze+

HriFFTLog files

In the example, a component with 25 teeth is processed. The first three tooth engagement frequencies can be represented by the "Mark" function => “Tooth action".



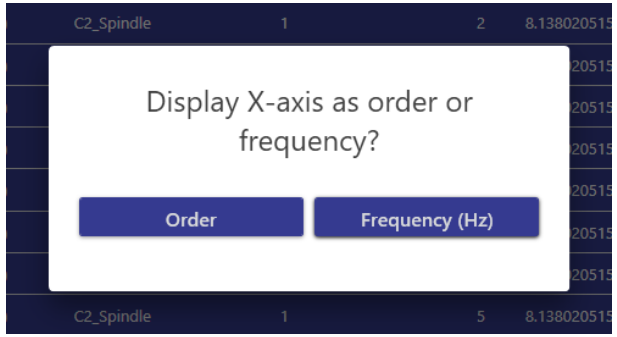
By clicking on a line, the display is highlighted, and the line is displayed thicker.



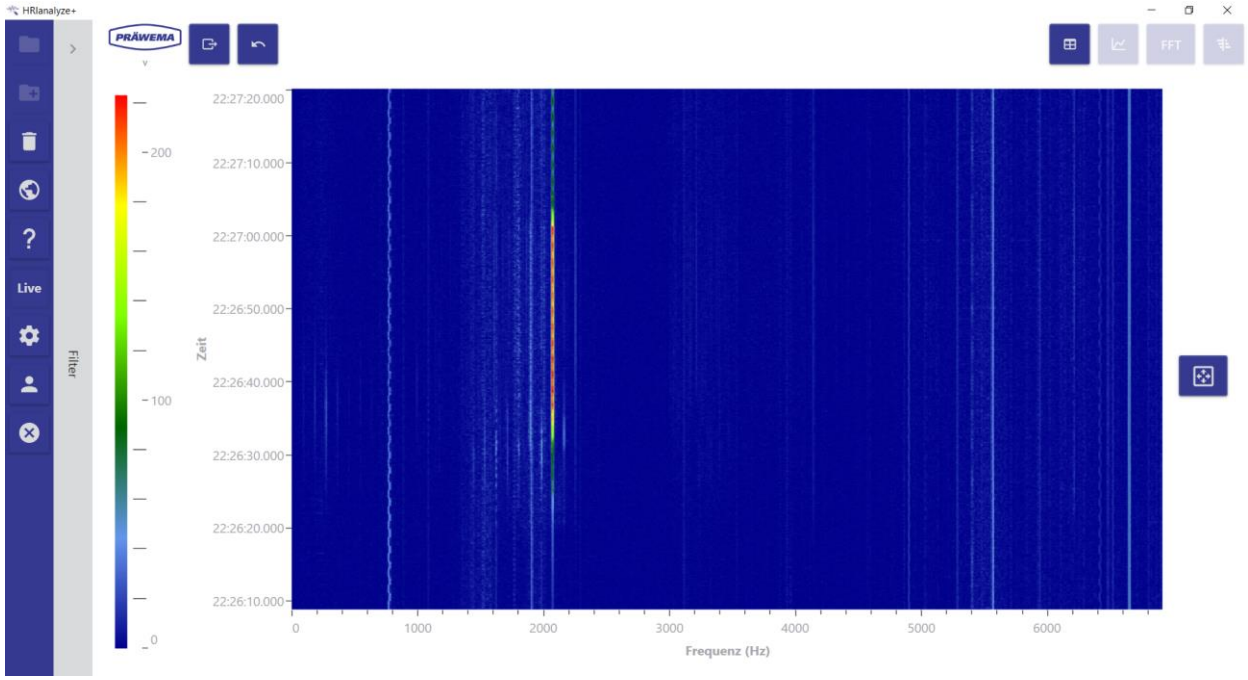
Software tool HRI®analyze+

HriFFTLog files

If a Campbell diagram is to be created, a query comes, as the X-axis is to be displayed:



When creating a Campbell diagram, make sure that only one sensor is selected for the filter. Otherwise, the creation will be aborted with an error message.

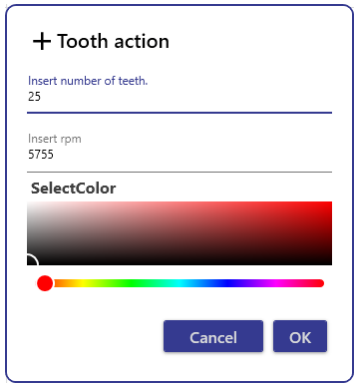


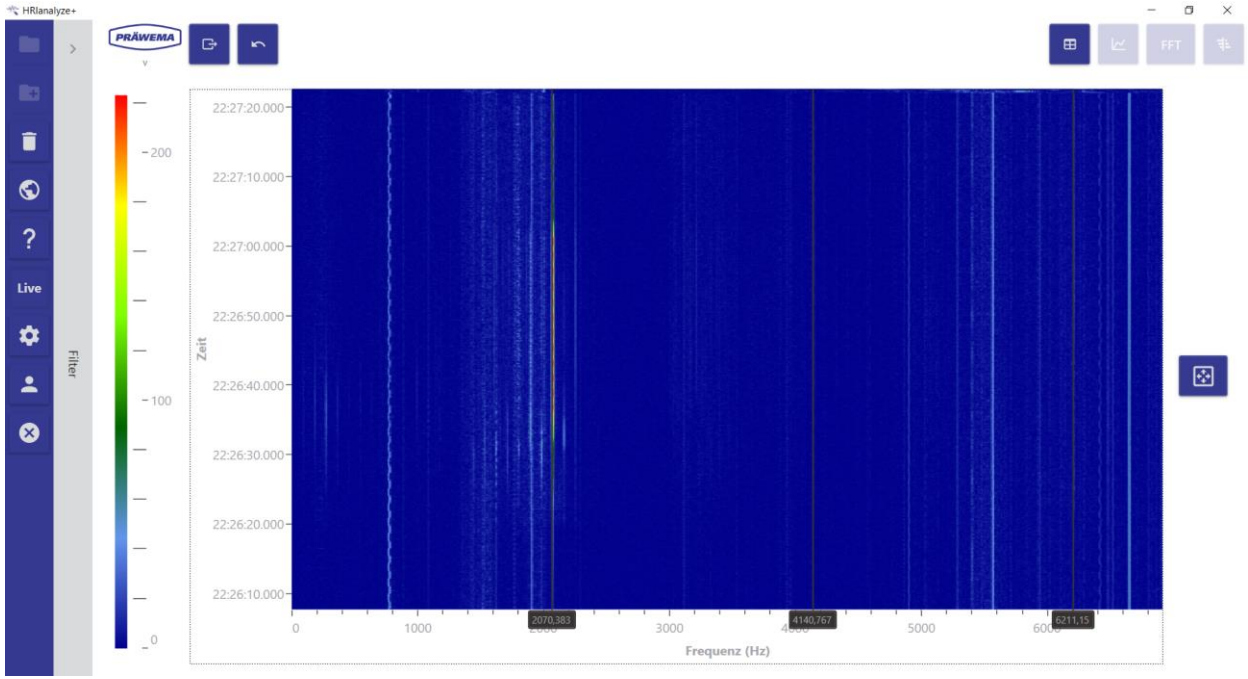
Software tool HRI®analyze+

HriFFTLog files

The meshing frequency and rotation frequencies can also be displayed in the Campbell diagrams via the dialog menu.

In the example, the 1st meshing frequency is very pronounced during machining.

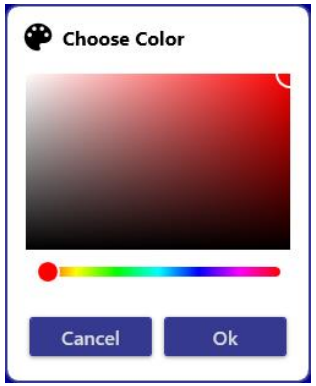




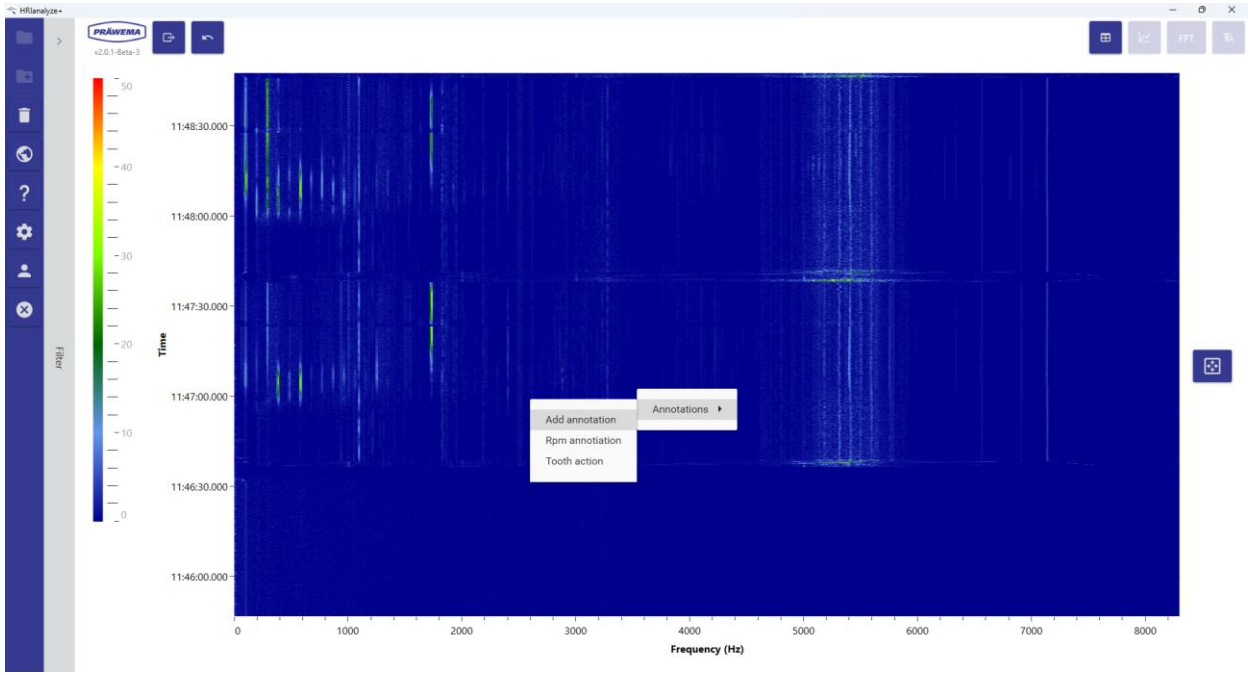
Software tool HRI®analyze+

HriFFTLog files

You can open a pop-up menu with the right mouse button and add specific markers. After selecting, you will be asked for the color of the marker.



Set the desired color and confirm with OK.

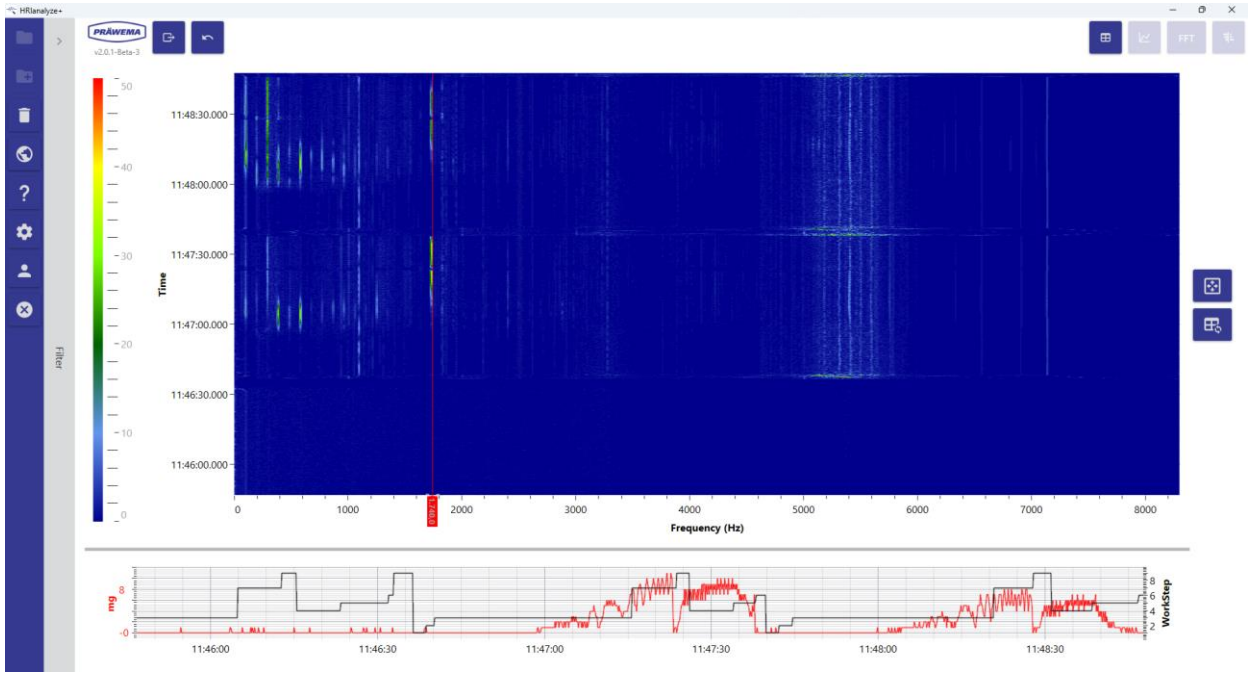


Software tool HRI®analyze+

HriFFTLog files

Another line diagram appears below the Campbell diagram. The marker can be moved to the desired position with the mouse, or a pop-up menu can be opened by double-clicking on the frequency or order specification.

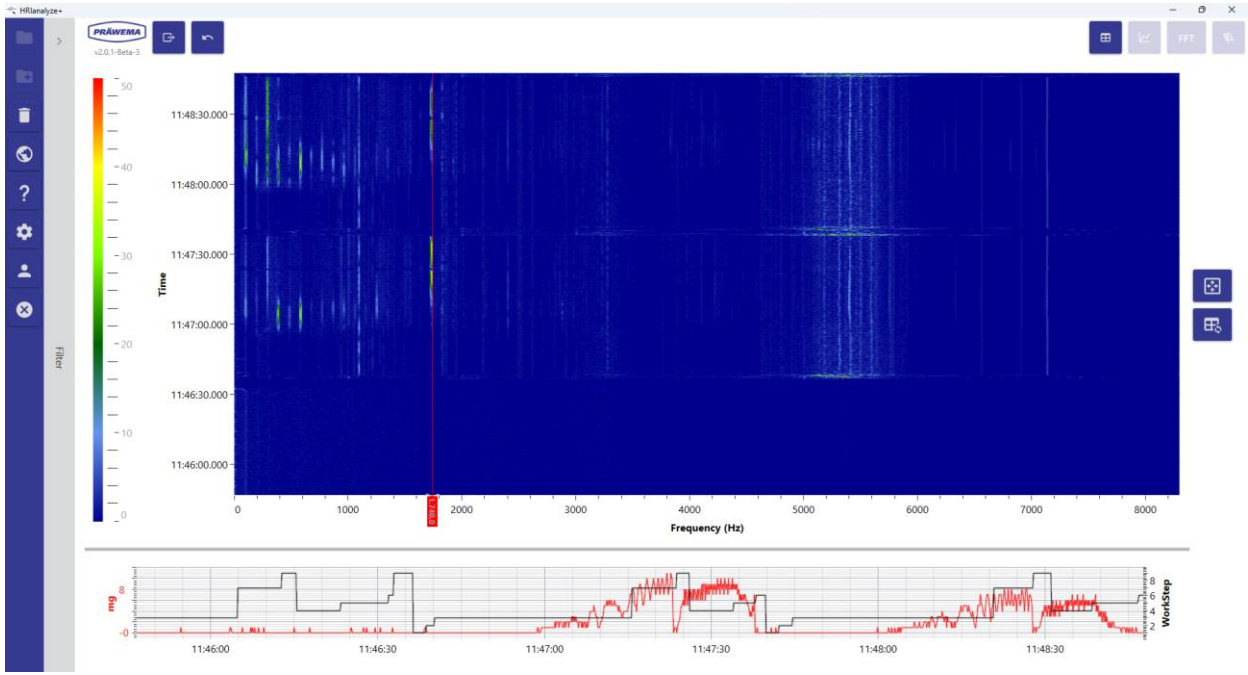
Here you can enter the desired frequency or order directly and change the color if necessary.



Software tool HRI®analyze+

HriFFTLog files

The line diagram shows the progression of a certain frequency or order over time. The work steps are also displayed. This allows you to differentiate between the components and you can see how long a component has been processed.

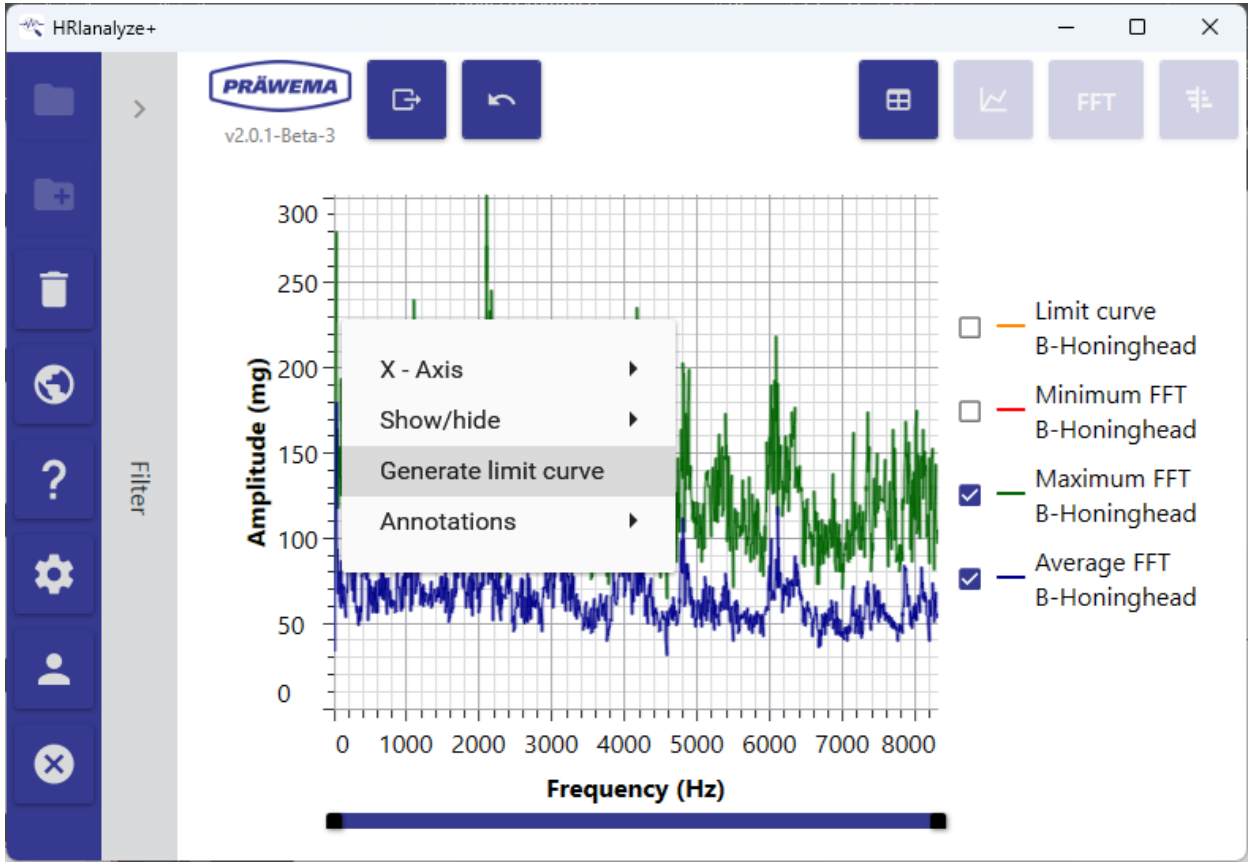


Software tool HRI®analyze+

HriFFTLog files – Limiting curve

In the line chart of the FFT the dialog window can be opened with the right mouse button.

There you can create a limiting curve.



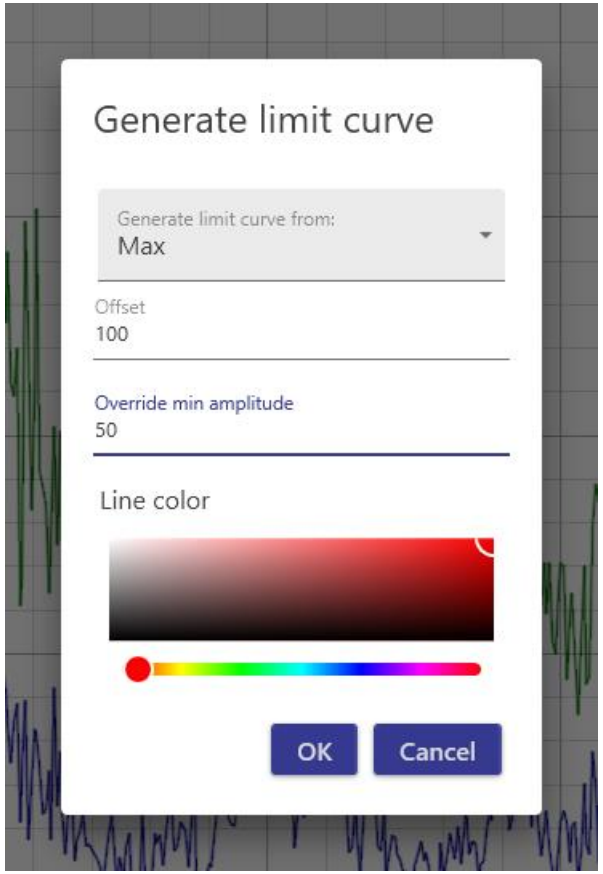
Software tool HRI®analyze+

HriFFTLog files – Limiting curve

There you can select from which spectrum the limiting curve should be created.

Furthermore, an offset is defined and a minimum limit for the limit curve.

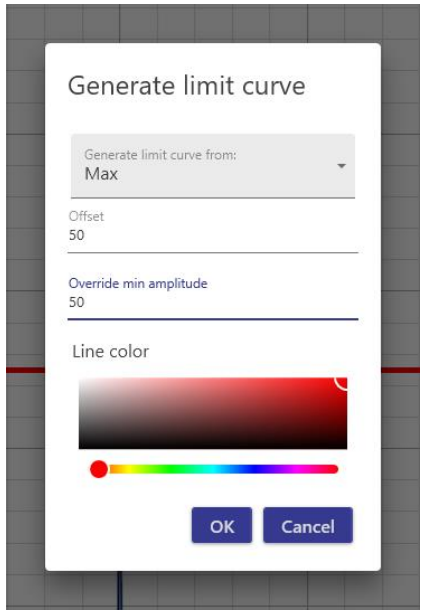
In addition, the line color of the limit curve can be set.

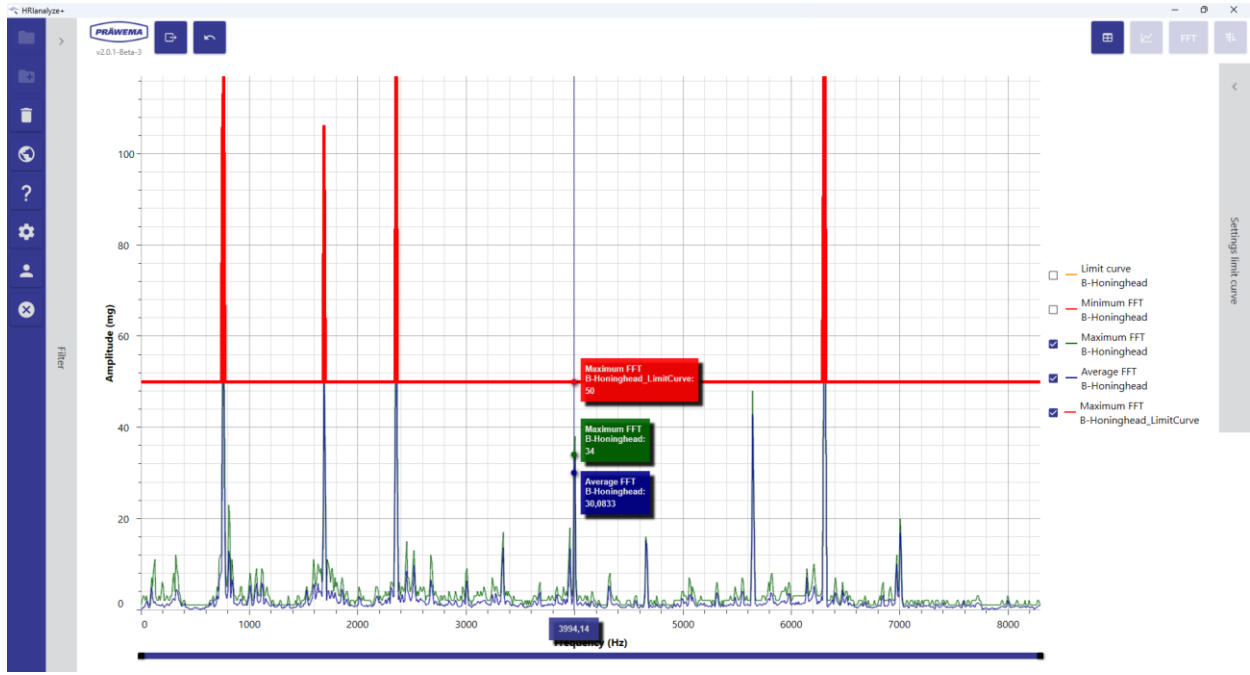


Software tool HRI®analyze+

HriFFTLog files – Limiting curve

The following settings were used to create the limit curve.

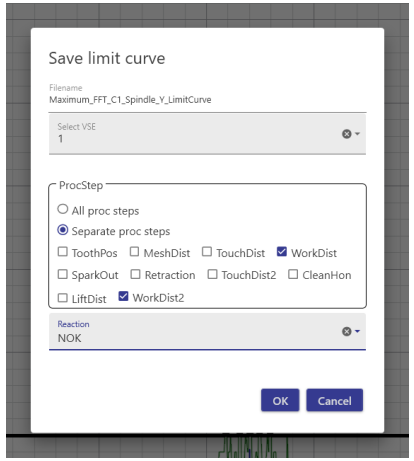


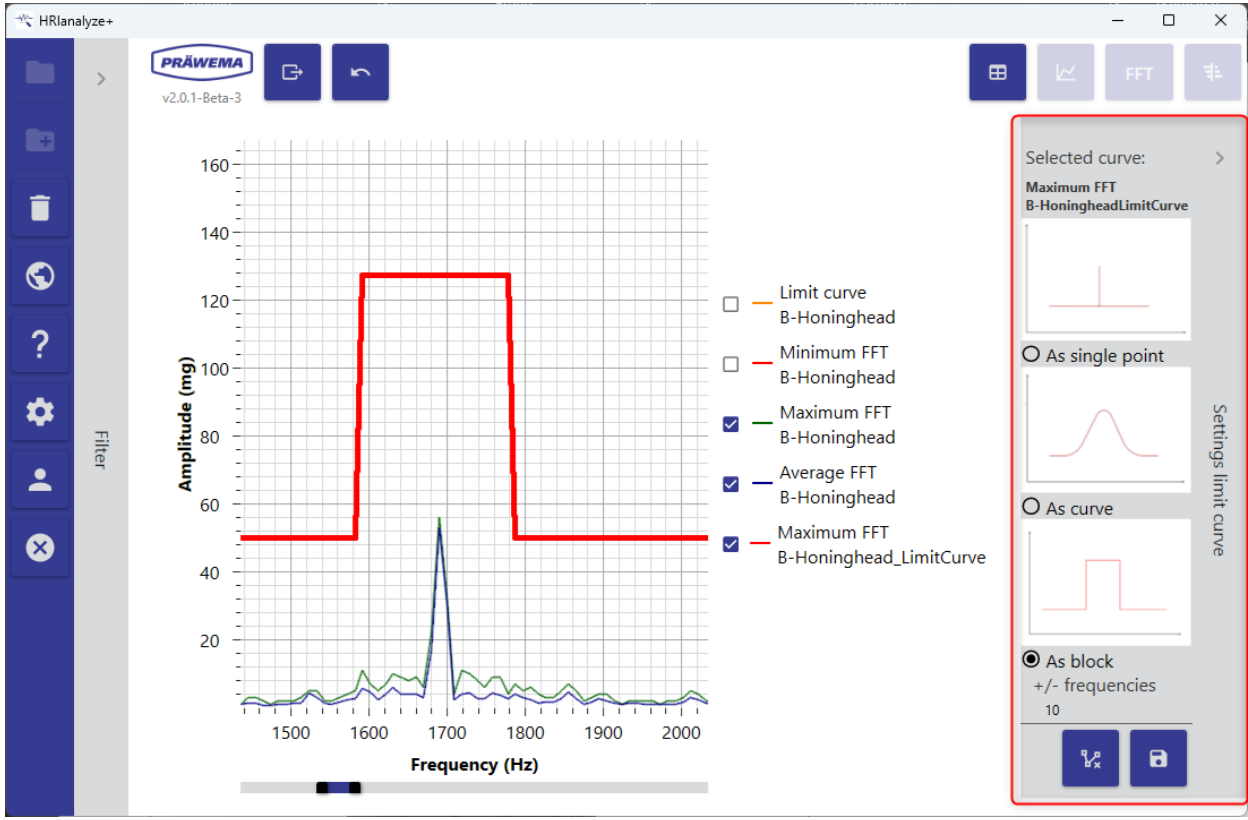


Software tool HRI®analyze+

HriFFTLog files – Limiting curve

After creating the limiting curve, a menu appears on the right side of the screen. Here you can make fine adjustments to the limiting curve.





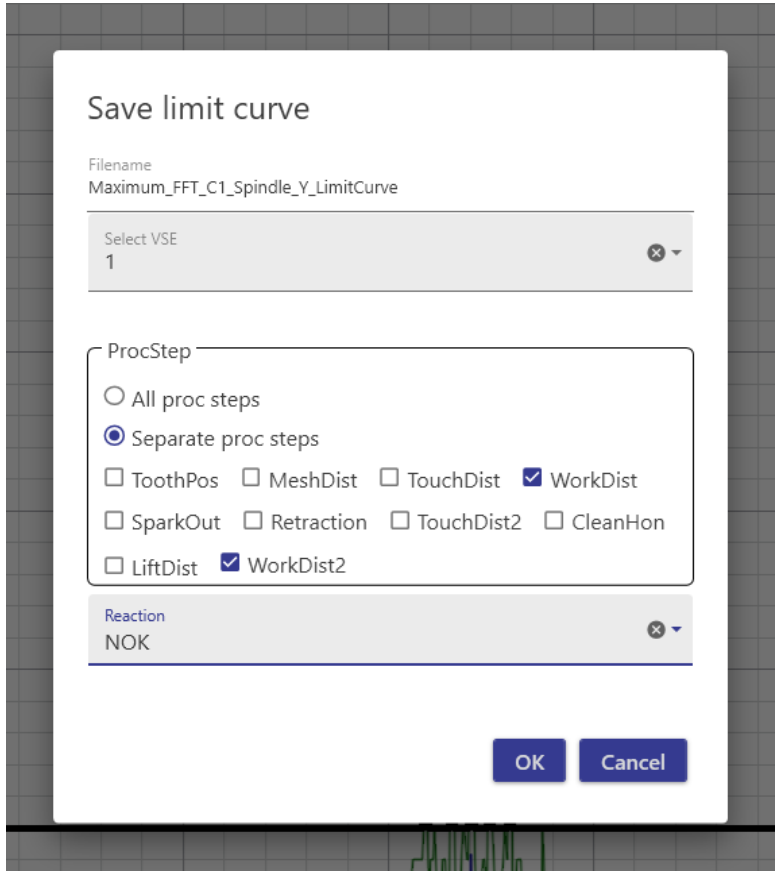
Software tool HRI®analyze+

HriFFTLog files – Limiting curve

The file name of the limit curve and the file name of the component for which the limit curve is to apply must be identical. Otherwise HRImachine cannot assign the limit curve.

The process steps, the sensors and the error response are defined in the window. These settings can no longer be changed later on the machine.

Click OK to generate a file that can be loaded onto the machine for the corresponding component.

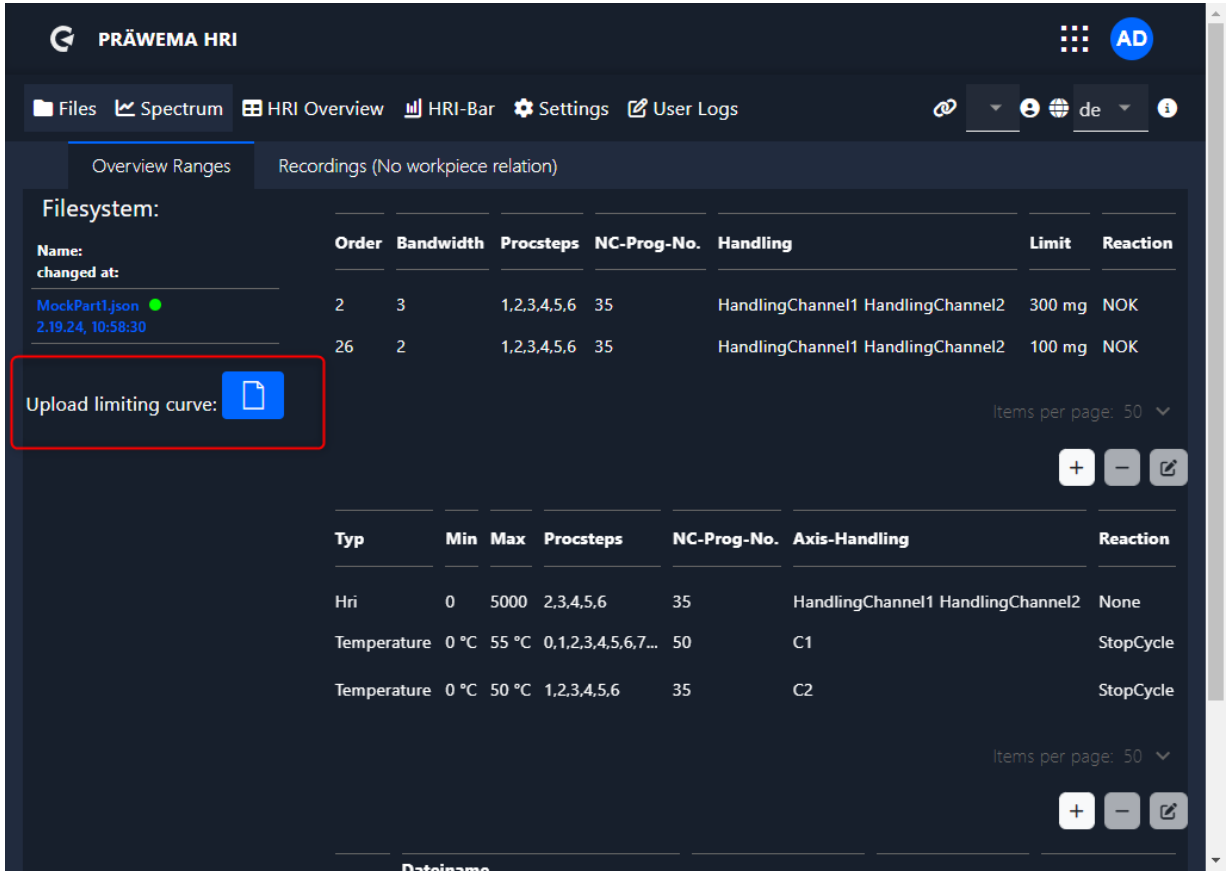


Software tool HRI®analyze+

HriFFTLog files – Limiting curve

With HRI®analyze+ a limiting curve can be created and saved as JSON file.

This limit curve can be read in and visualized with HRImachine.

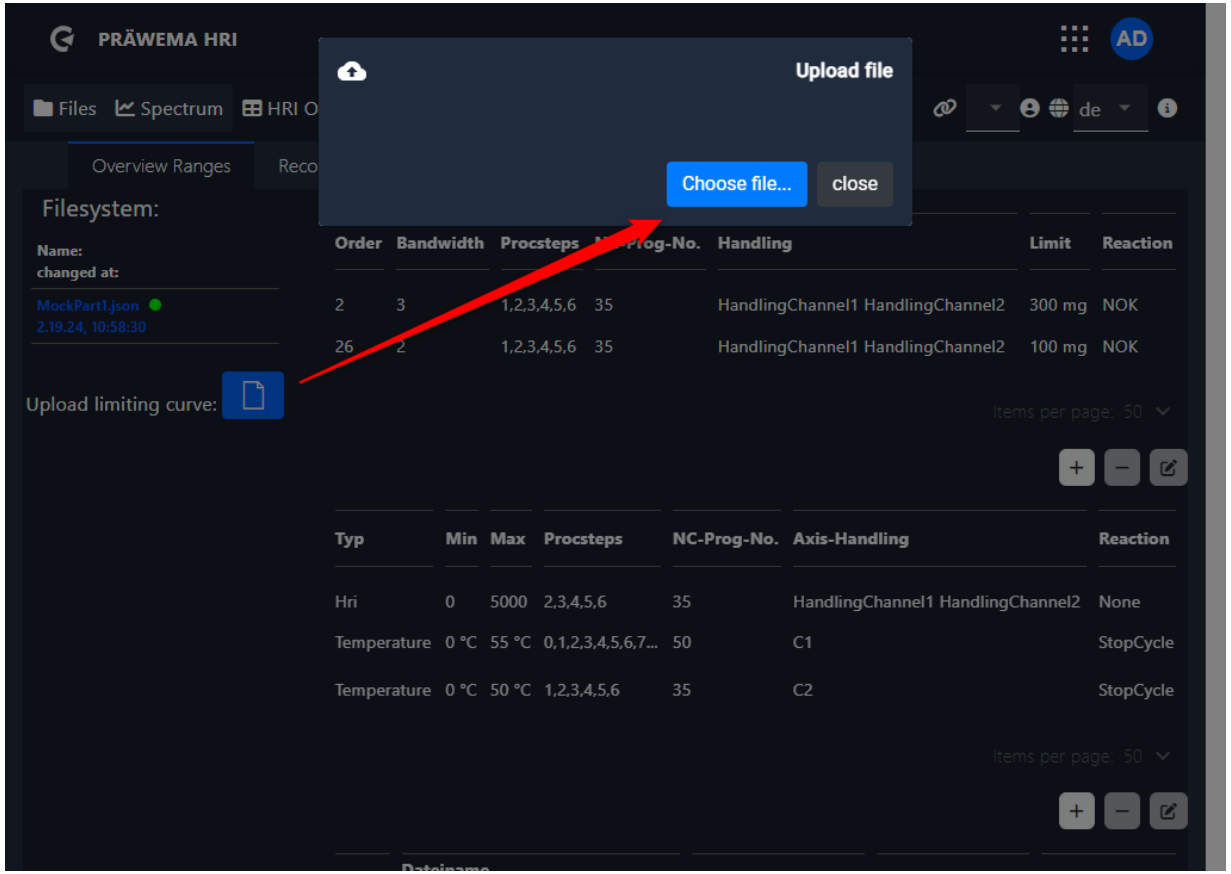


Software tool HRI®analyze+

HriFFTLog files – Limiting curve

Clicking the button opens a new window.

Here you can select the corresponding file to be loaded.

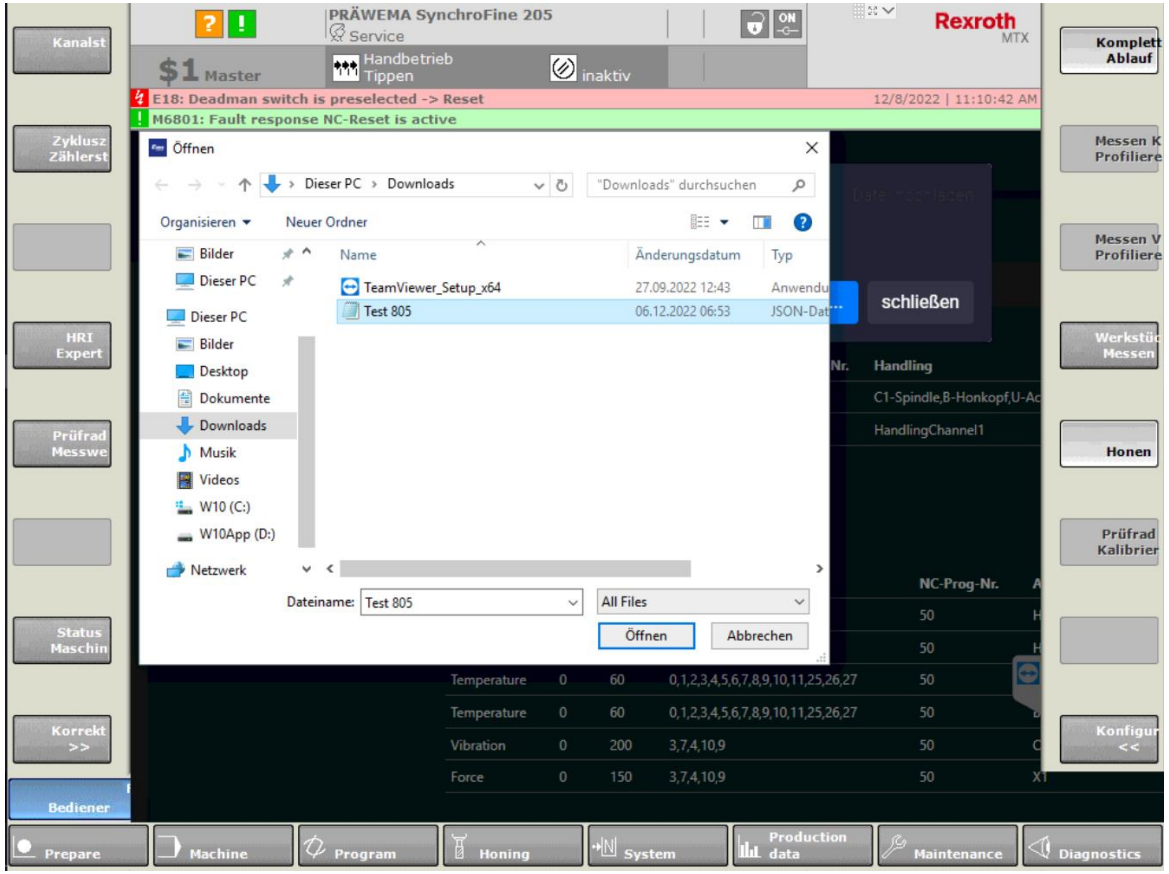


Software tool HRI®analyze+

HriFFTLog files – Limiting curve

A file has been saved in the Downloads folder. The file name of the limit curve must have the same name as the corresponding component.

Otherwise, the limit curve cannot be assigned to any component.

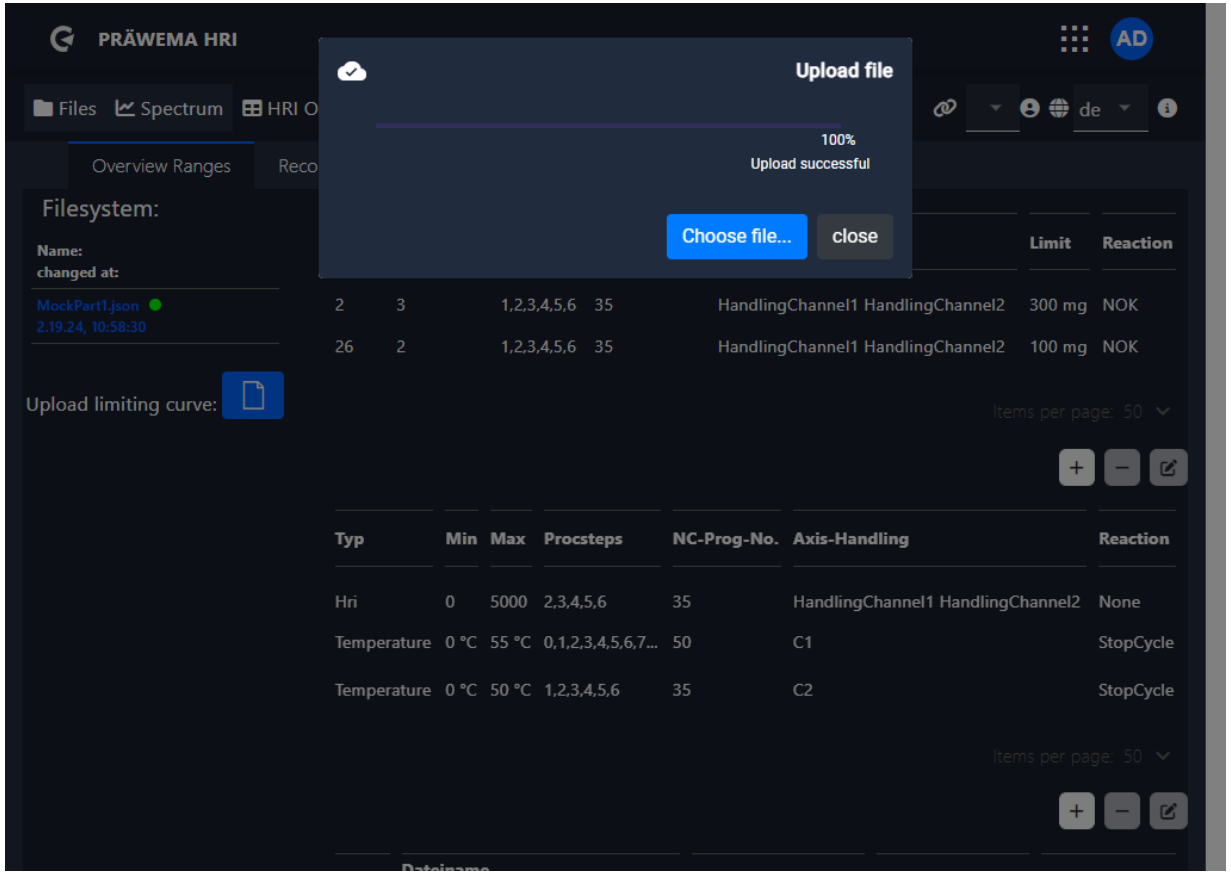


Software tool HRI®analyze+

HriFFTLog files – Limiting curve

After the file has been loaded, the loading bar changes color and confirmation is given that the file has been loaded.

After the file has been loaded successfully, you can switch to the spectrum page.

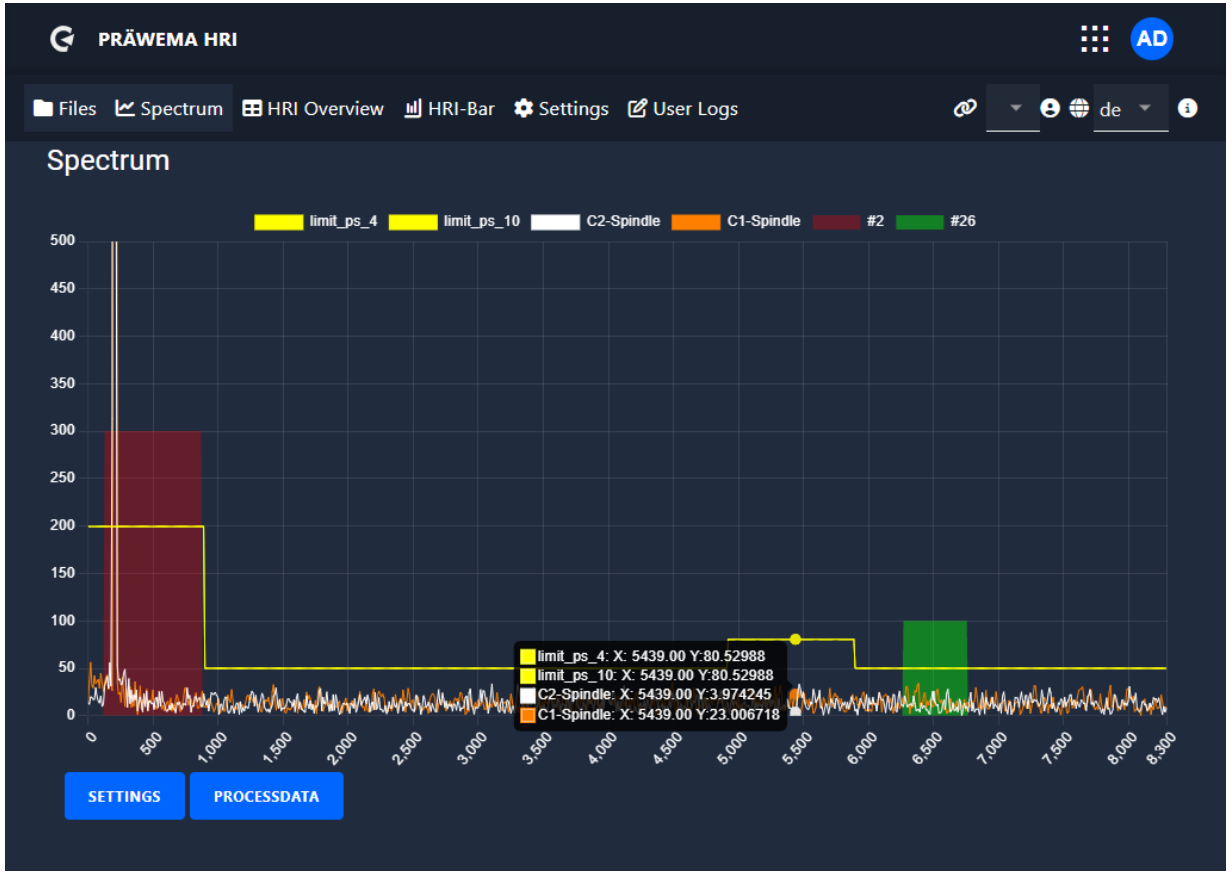


Software tool HRI®analyze+

HriFFTLog files – Limiting curve

The limiting curve is shown in the spectrum as a yellow limit line.

Each active process step has been given its own limit curve.



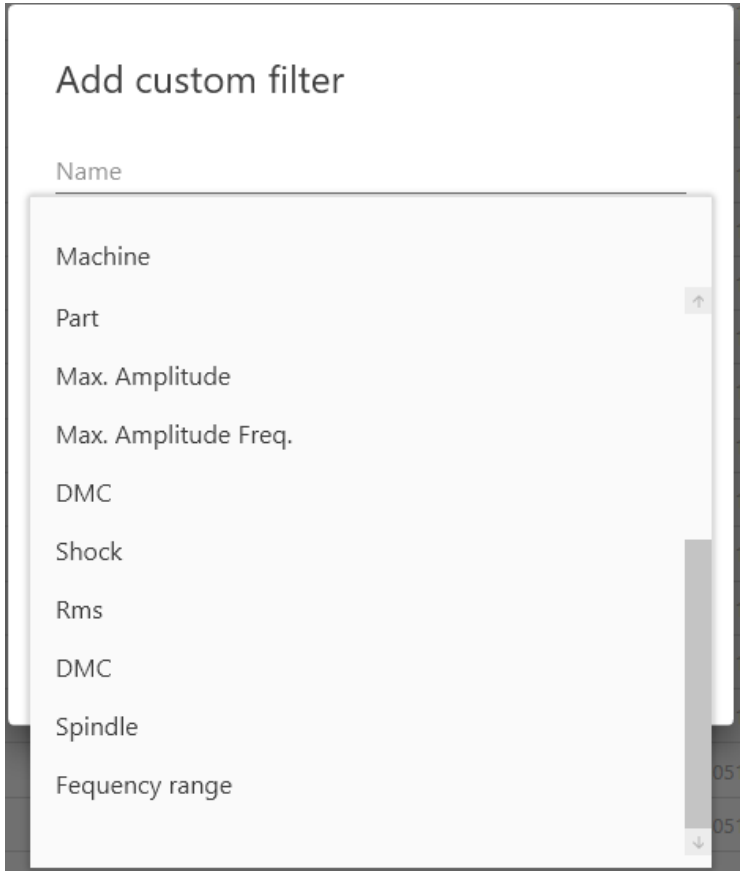
Software tool HRI®analyze+

Filter options

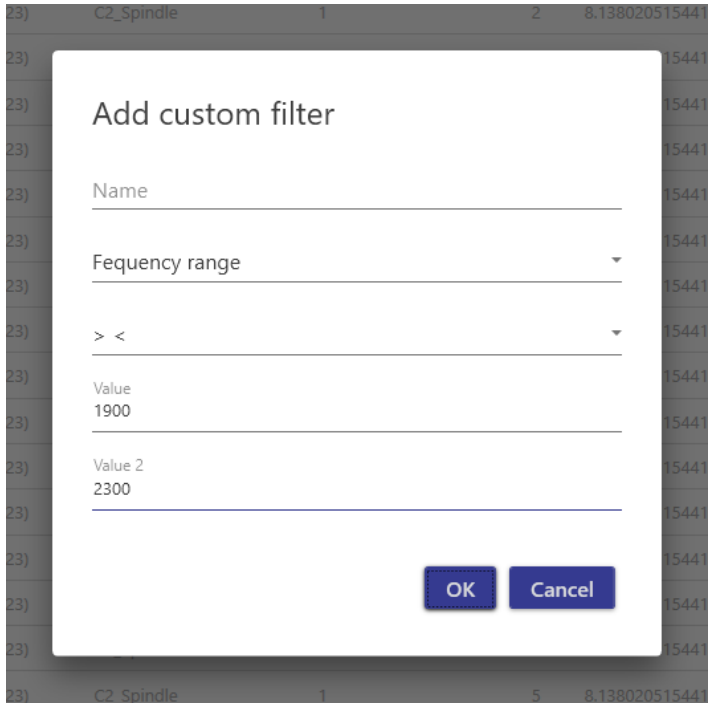
Filters can be set to analyze the FFT and shock files better.

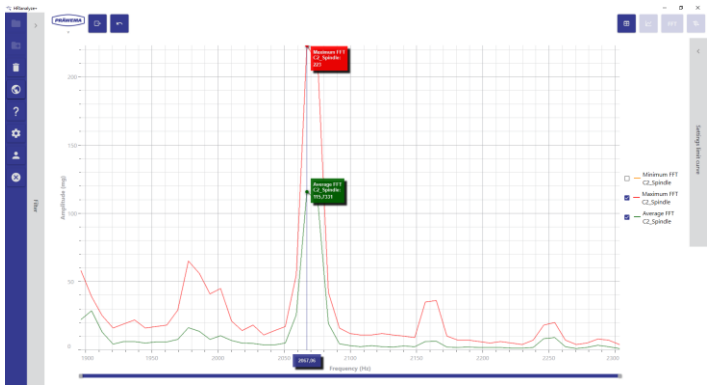
In addition to the filters for sensors and work steps, a wide range of user-defined filters are possible.

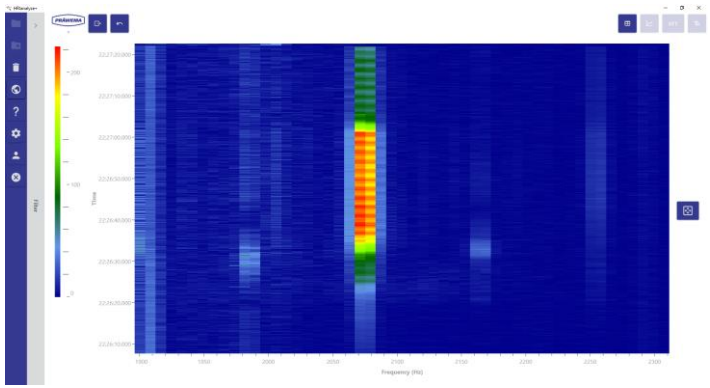
Certain frequency ranges can also be filtered. Only these frequency ranges are then displayed in the line or Campbell diagram.



Software tool HRI®analyze+





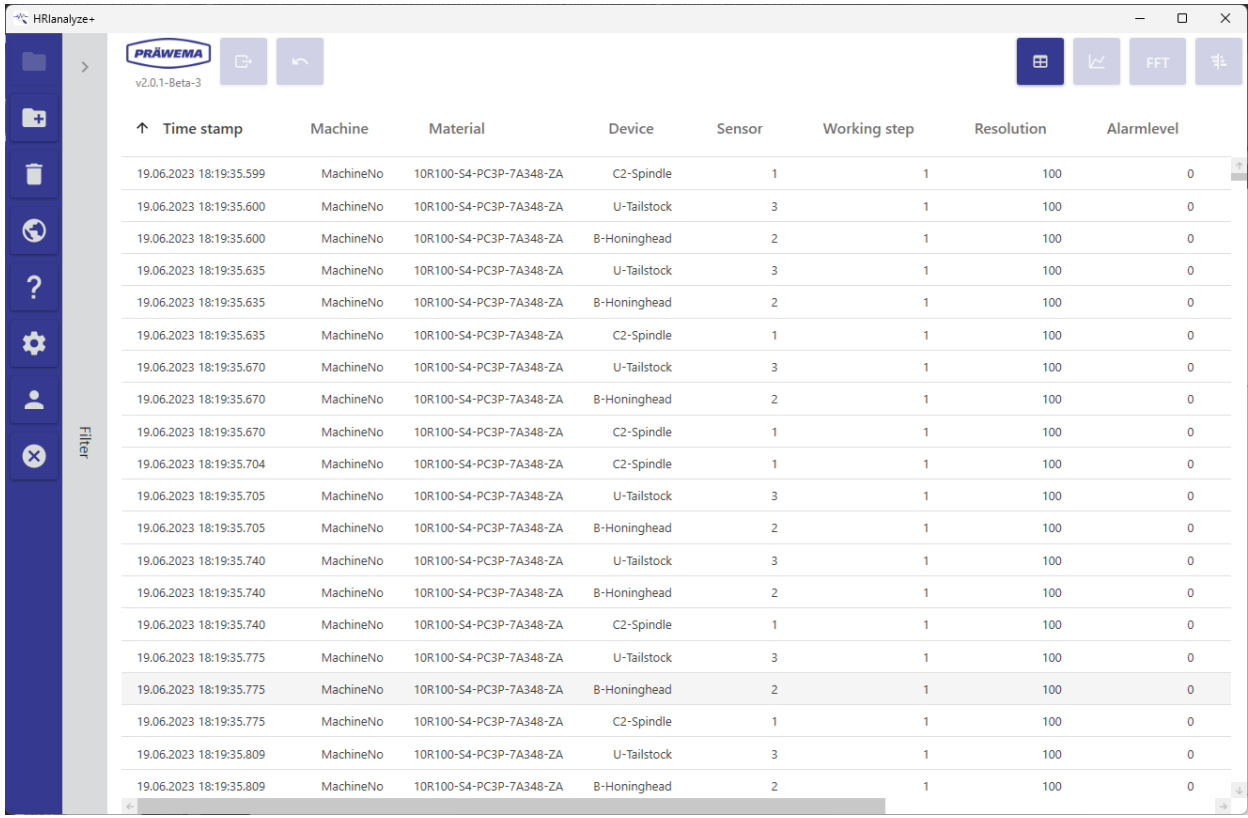


Software tool HRI®analyze+

HriShockLog files

The fourth type of the logging files are the HriShockLog files.

With these files, a breakage of a tool can be detected.



Time stamp	Machine	Material	Device	Sensor	Working step	Resolution	Alarmlevel
19.06.2023 18:19:35.599	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.600	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.600	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.635	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.635	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.635	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.670	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.670	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.670	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.704	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.705	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.705	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.740	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.740	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.740	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.775	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.775	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.775	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.809	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.809	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0

Software tool HRI®analyze+

HriShockLog files

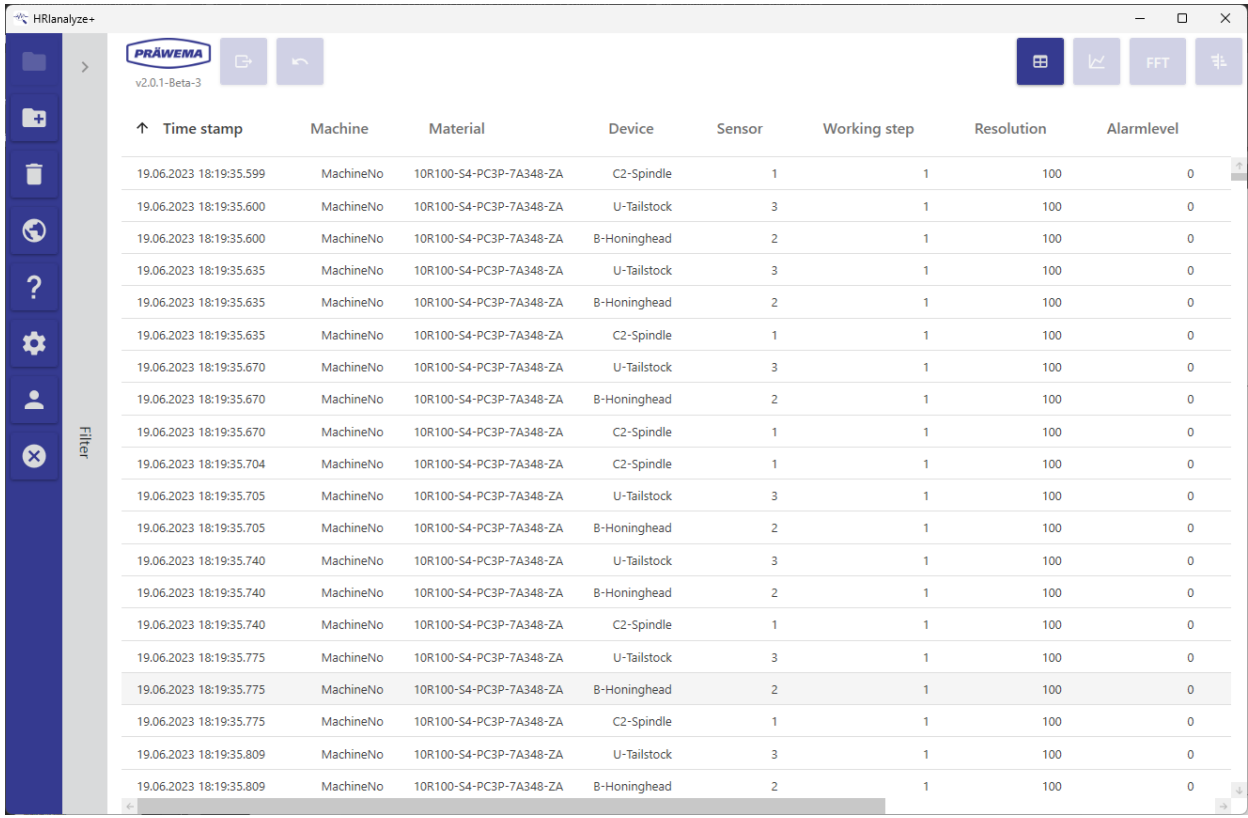
The files are stored in the folder:

(C/D):\hridata\production\(left\right)\HriShockLog

The file name is set up as follows:

50_2020090208_partame_B_HoningHead_2_Shock

Channel_date_hour_partname_
sensorname_procstep_Shock



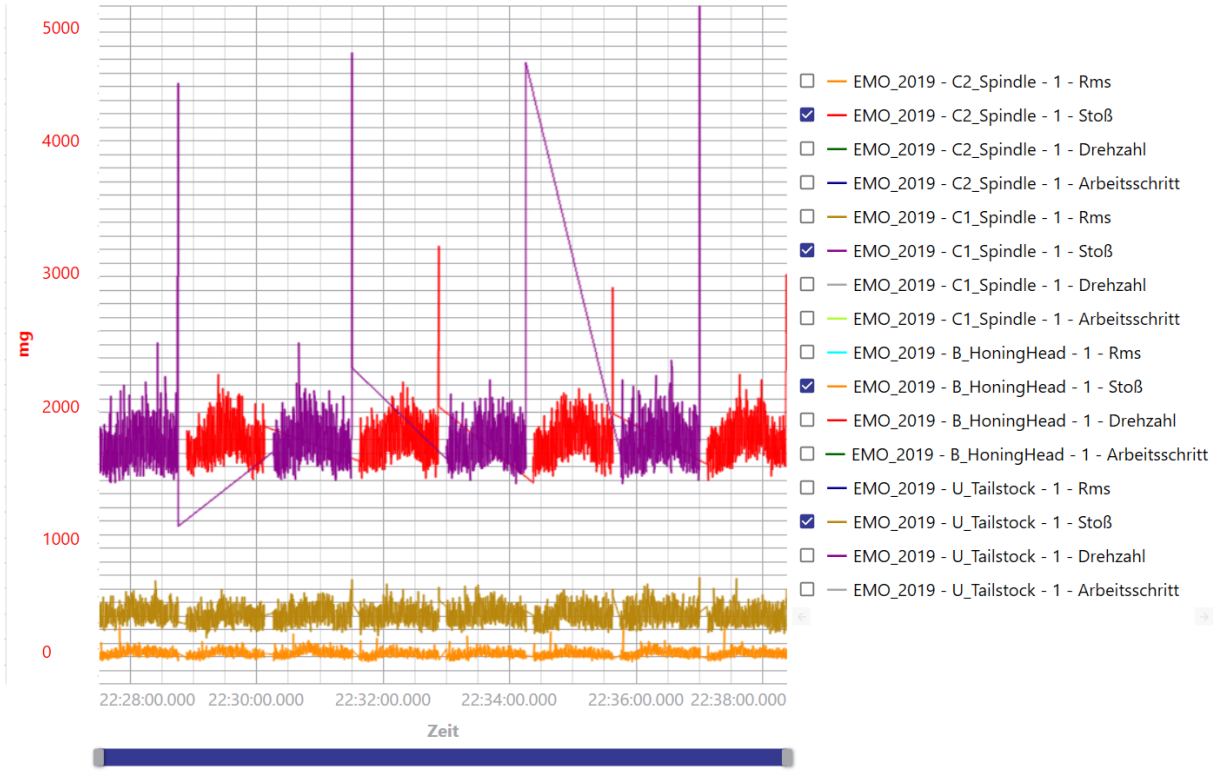
Time stamp	Machine	Material	Device	Sensor	Working step	Resolution	Alarmlevel
19.06.2023 18:19:35.599	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.600	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.600	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.635	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.635	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.635	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.670	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.670	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.670	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.704	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.705	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.705	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.740	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.740	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.740	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.775	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.775	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0
19.06.2023 18:19:35.775	MachineNo	10R100-S4-PC3P-7A348-ZA	C2-Spindle	1	1	100	0
19.06.2023 18:19:35.809	MachineNo	10R100-S4-PC3P-7A348-ZA	U-Tailstock	3	1	100	0
19.06.2023 18:19:35.809	MachineNo	10R100-S4-PC3P-7A348-ZA	B-Honinghead	2	1	100	0

Software tool HRI®analyze+

HriShockLog files

The example of a shock file shows a SynchroFine with two workpiece spindles.

When processing, only one spindle is engaged in each case.



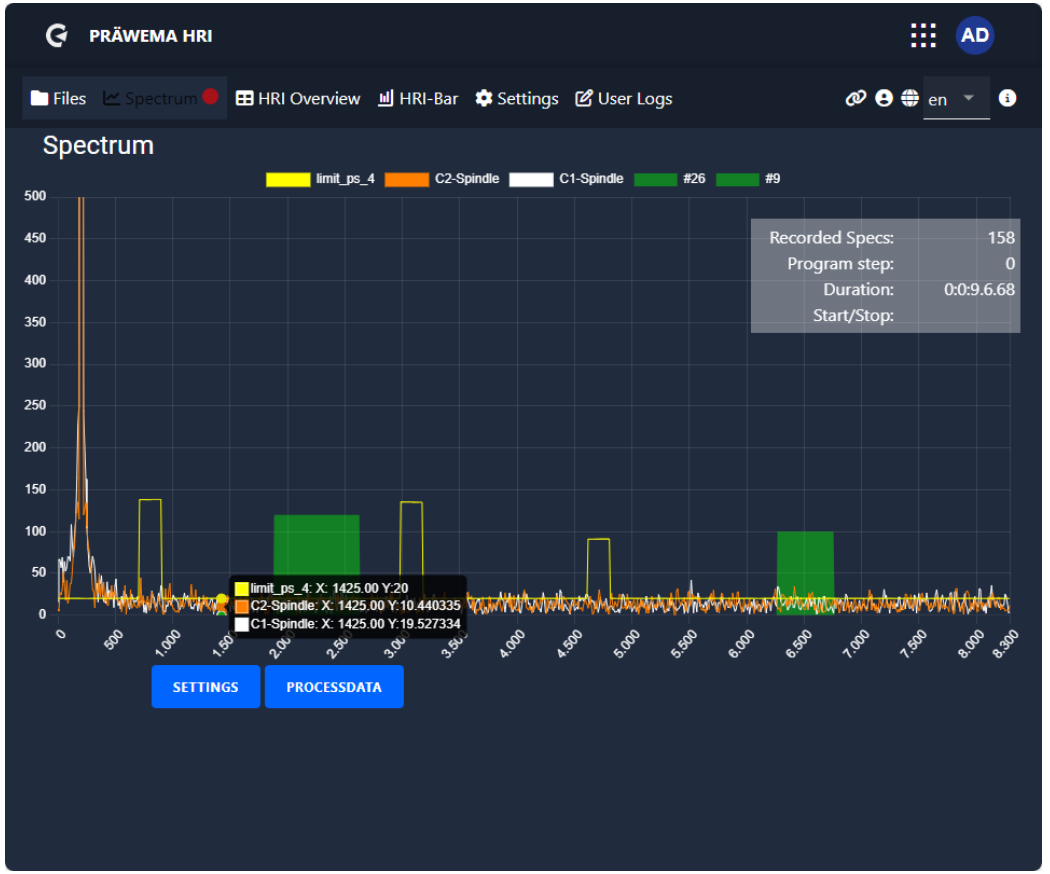
Software tool HRI®analyze+

Spectrum display

Vibrations can be recorded with HRImachine. The recordings are saved as a compressed folder. A file is stored in the folders as a binary database.

The data can be analyzed with HRIanalyze+.

As with the HriFFTLog files, line diagrams and Campbell diagrams can be created.

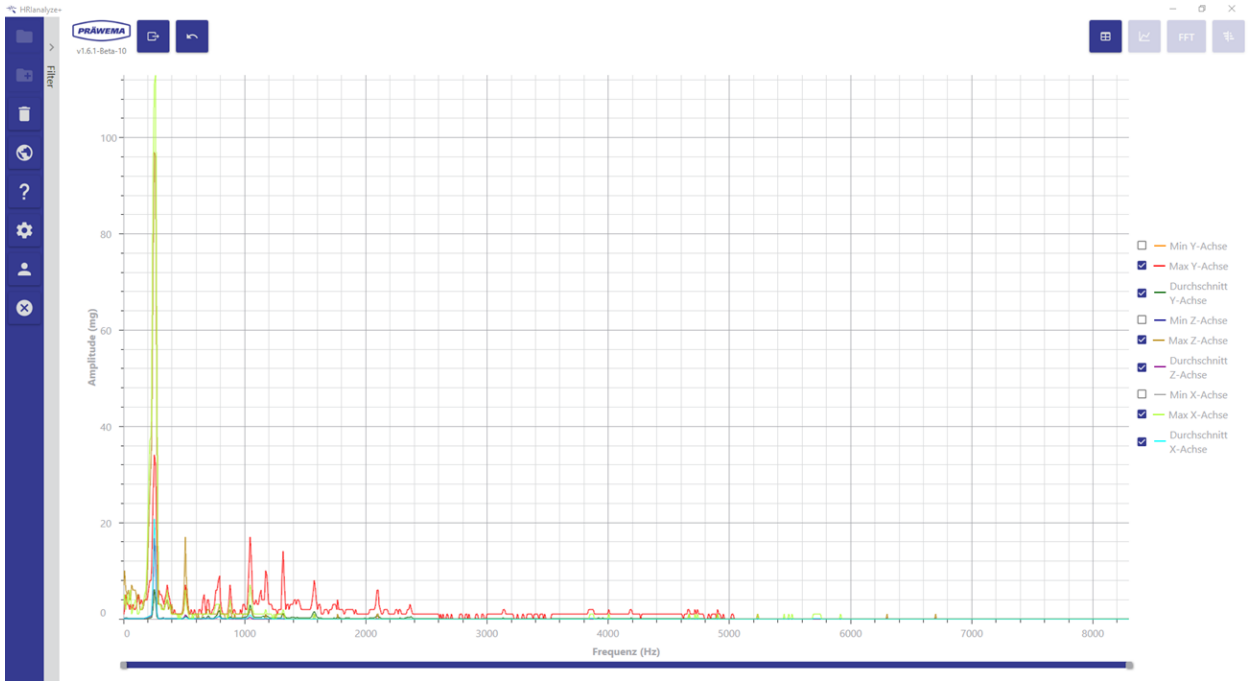


Software tool HRI®analyze+

Spectrum display

Example of recording with a three-axis sensor.

The sensor names are taken from the settings of the HRImachine.

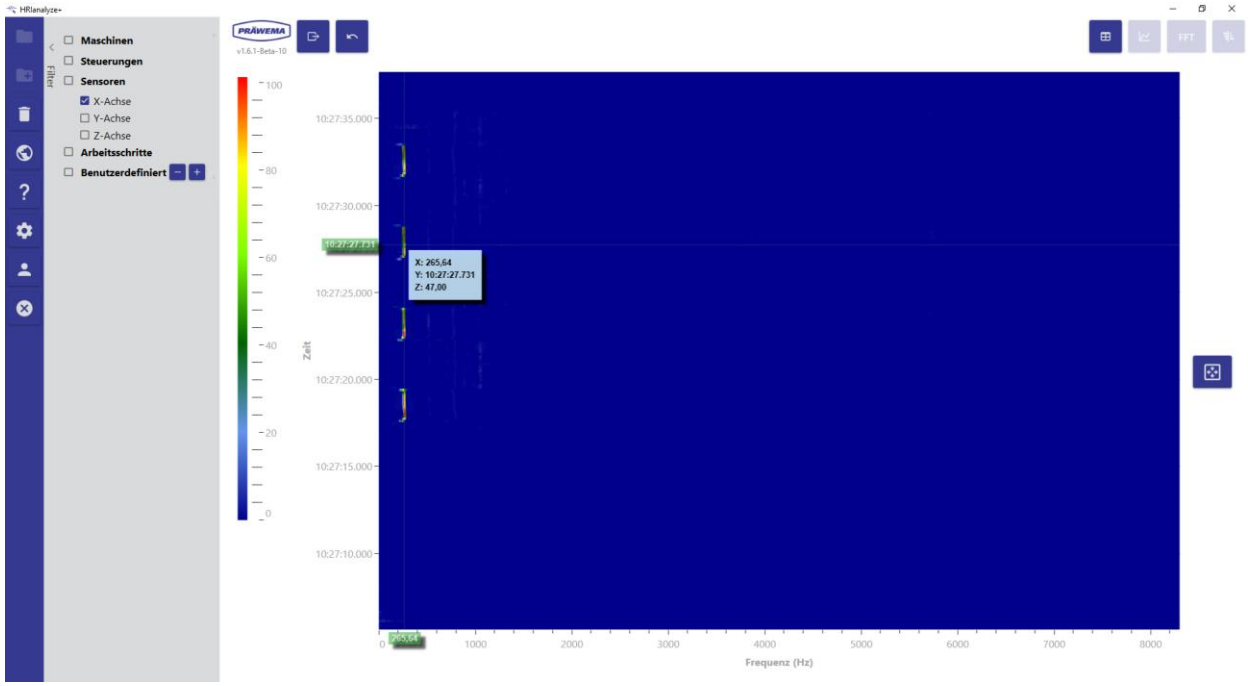


Software tool HRI®analyze+

Spectrum display

Example of recording with a three-axis sensor.

The sensor names are taken from the settings of the HRImachine.



Software tool HRI®analyze+

measurements from other sources

Measurement files from other programs can also be opened with the HRI®analyze+.

Currently, measurements from

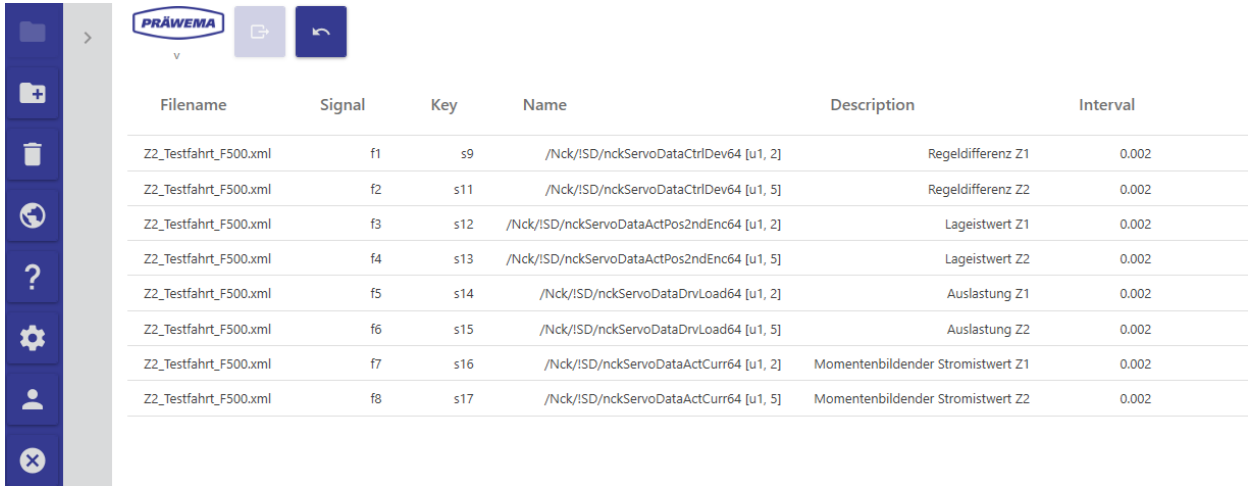
- Siemens Trace
- Bosch Rexroth INDRA Works drive oscilloscope
- Digital Way SP Visu C
- Open Attocube IDS 3010.

The measurements from the Bosch Rexroth drive oscilloscope and Attocube must be converted into a CSV format before being read.

Software tool HRI®analyze+

Siemens Trace

After opening, the measured signals are displayed. The signals to be visualized must be marked and then a distinction can be made between a line diagram or an FFT calculation.



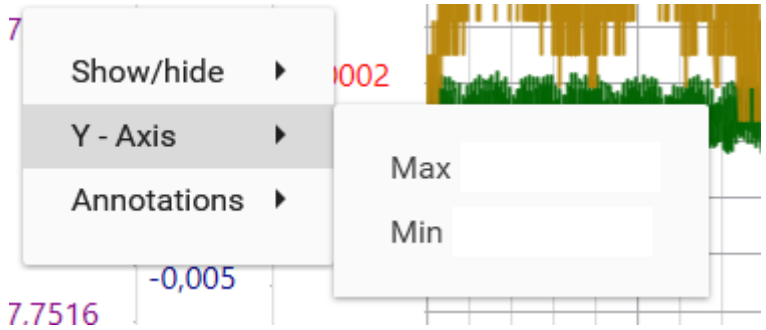
Filename	Signal	Key	Name	Description	Interval
Z2_Testfahrt_F500.xml	f1	s9	/Nck/!SD/nckServoDataCtrlDev64 [u1, 2]	Regeldifferenz Z1	0.002
Z2_Testfahrt_F500.xml	f2	s11	/Nck/!SD/nckServoDataCtrlDev64 [u1, 5]	Regeldifferenz Z2	0.002
Z2_Testfahrt_F500.xml	f3	s12	/Nck/!SD/nckServoDataActPos2ndEnc64 [u1, 2]	Lageistwert Z1	0.002
Z2_Testfahrt_F500.xml	f4	s13	/Nck/!SD/nckServoDataActPos2ndEnc64 [u1, 5]	Lageistwert Z2	0.002
Z2_Testfahrt_F500.xml	f5	s14	/Nck/!SD/nckServoDataDrvLoad64 [u1, 2]	Auslastung Z1	0.002
Z2_Testfahrt_F500.xml	f6	s15	/Nck/!SD/nckServoDataDrvLoad64 [u1, 5]	Auslastung Z2	0.002
Z2_Testfahrt_F500.xml	f7	s16	/Nck/!SD/nckServoDataActCurr64 [u1, 2]	Momentenbildender Stromistwert Z1	0.002
Z2_Testfahrt_F500.xml	f8	s17	/Nck/!SD/nckServoDataActCurr64 [u1, 5]	Momentenbildender Stromistwert Z2	0.002

Software tool HRI®analyze+

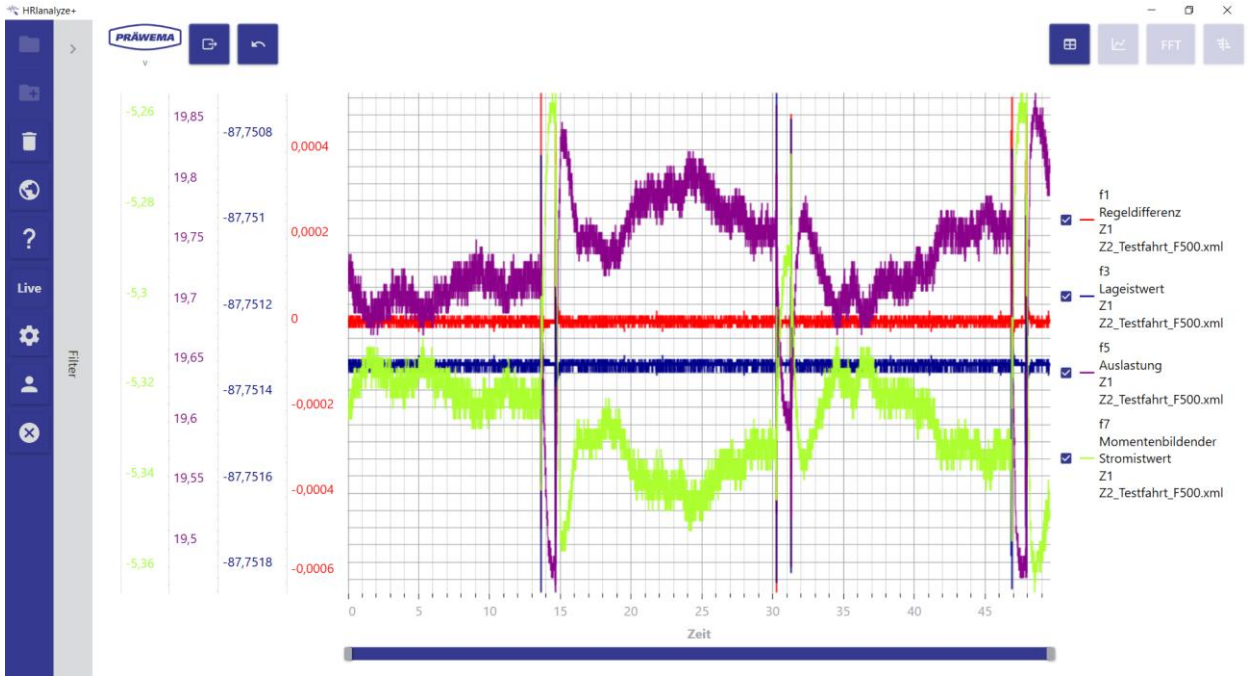
Siemens Trace

Example of a line chart.

The individual signals can be shown and hidden. A pop-up menu opens with the right mouse button.



Here you can set the scale from the y-axis.



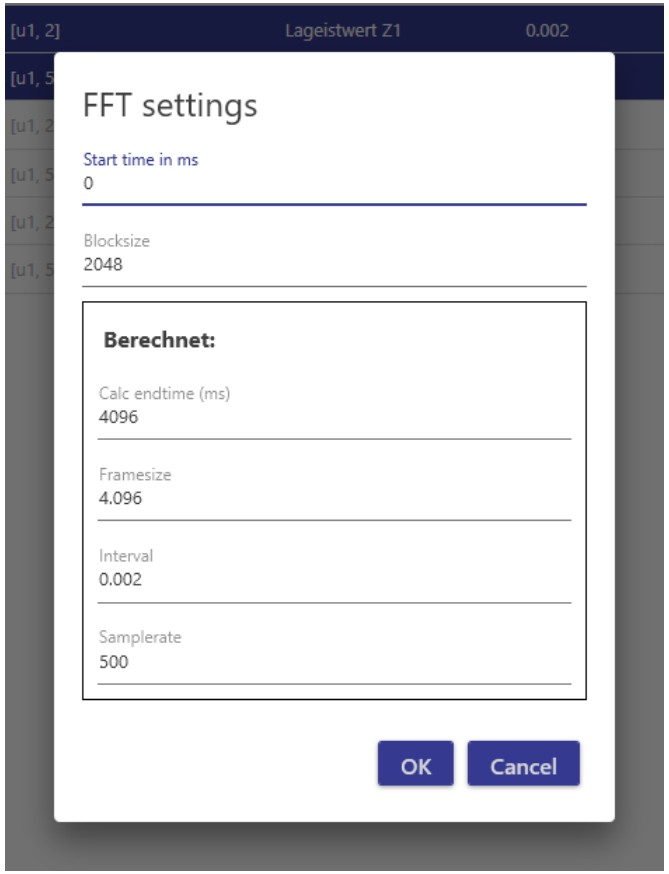
Software tool HRI®analyze+

Siemens Trace

Spectra can be calculated from the signals of the trace.

Before starting the calculation, the period must be limited. The amplitudes of the oscillations and the frequencies change over the process. With the time limitation, certain anomalies can be examined in a targeted manner.

The block size must be an exponent of 2.



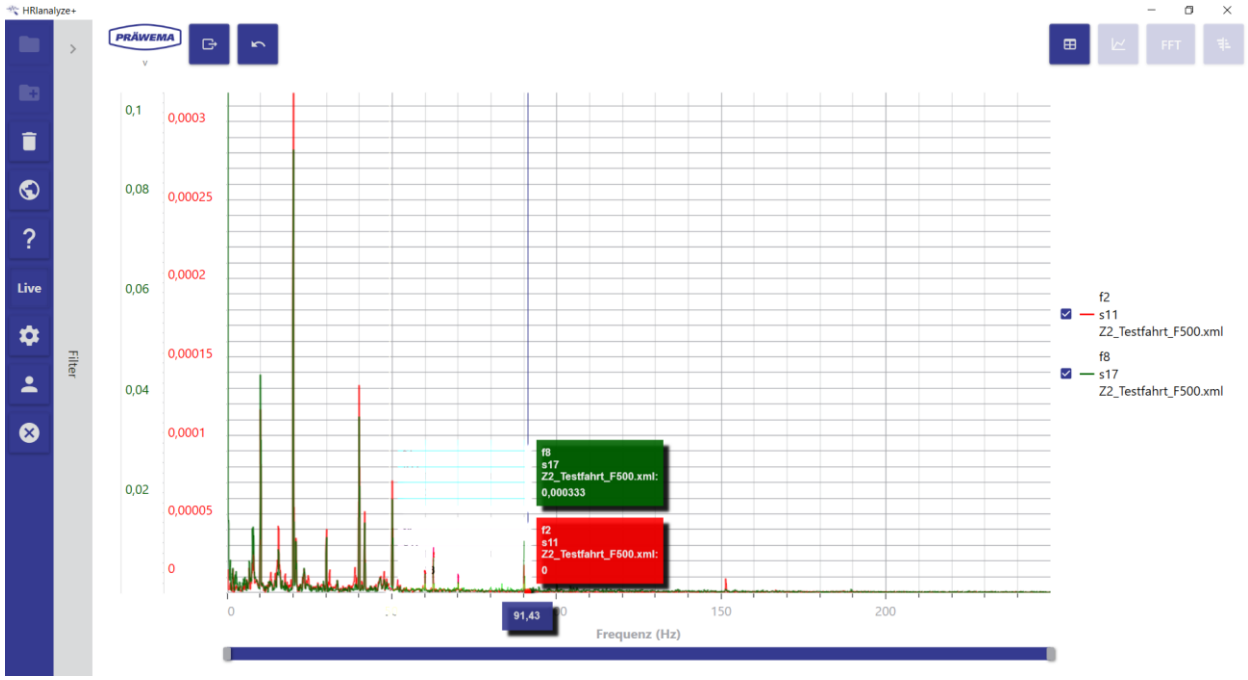
Software tool HRI®analyze+

Siemens Trace

Example of an FFT.

Here the trip to Z+ was considered, with the following settings:

- Start time 16,000ms
- Block length 4096

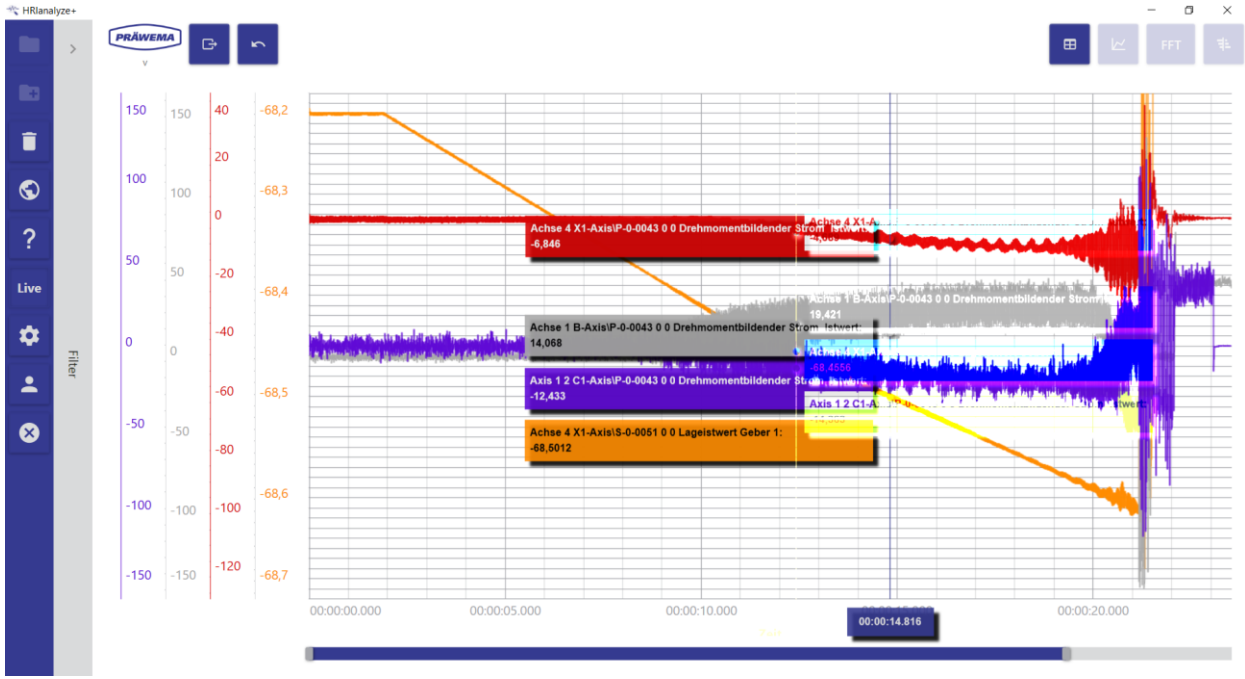


Software tool HRI®analyze+

Bosch Rexroth INDRA Works

During the measurement, the honing ring broke shortly before the end of the machining.

The position of the X-axis shows how the process gets out of control and leads to the breakage of the honing ring.



Known phenomena

SynchroFine
Known problematic frequencies

- 240 - 300 Hz as self-resonance of the cross slide, (nom. 280Hz)
- approx. 1,040 Hz as self-resonance of the spindle box (unlikely)
- approx. 1,050-1,850 Hz as self-resonance clamping device / clamping system
- approx. 3,000 - 4,000 Hz as self-resonance of the clamping system incl. tail stock

All frequencies are based on the sensor from the C spindle.

SynchroFine
Known problematic orders

1st	Order as round run / unbalance
2nd / 3rd	Order as tumbling and/or false position of the tailstock
3rd / 4th	Order as an indication of worn guides of the X- or Z-axis

All order information is based on the rotation frequency of the C spindle.

SynchroFine
Bearing orders of the spindles

B - Honing head 205

Outer ring	26.36
Inner ring	28.61
rolling body	22.64

C - spindle ZX05-039-00K front

Outer ring	9.9
Inner ring	12.2
rolling body	7.47

B - Honing head 305

Outer ring	30.65
Inner ring	32.43
rolling body	15.73

C - spindle ZX05-039-00K back

Outer ring	8.73
Inner ring	11.27
rolling body	6.66

SynchroFine
Bearing orders of the spindles

C - spindle ZX05-053-00K front

Outer ring	11.93
Inner ring	13.07
rolling body	19.13

U - tailstock front

Outer ring	8.08
Inner ring	8.92
rolling body	17.7

C - spindle ZX05-053-00K back

Outer ring	9.42
Inner ring	10.58
rolling body	15.64

U - tailstock back

Outer ring	8.0
Inner ring	11.98
rolling body	3.95

SynchroFine
possible causes of current peaks

Axis	Causes
B-axis (Tooling spindle)	• Current tips in the honing head are caused by oversized raw parts or parts with hardening delay • One-sided honing of a flank creates current peaks during honing.
C-axis (Workpiece spindle)	• Small outbreaks in the honing stone or to high following distance cause current peaks in the C axis
X-axis (infeed axis)	• Chips in the tooth base create peaks in the current of the X axis
Z-axis (oscillating axis)	• A burr on the tooth flank creates a current peak on the Z axis. • If the pneumatic pressure of the tailstock is too high, the Z-axis is overloaded. • A broken spring on the splash guard door creates an overload on the Z axis

SynchroForm
Bearing orders of the spindles

ZZ0507800K + ZZ0507900K + ZZ0507900K

Bearing front

Outer ring	9.74
Inner ring	12.26
rolling body	7.77

Bearing back

Outer ring	8.72
Inner ring	11.27
rolling body	3.73

ZX0518200K + ZX0520100K + ZX0520400K

Bearing front

Outer ring	10.92
Inner ring	13.07
rolling body	4.99

Bearing back

Outer ring	8.26
Inner ring	10.73
rolling body	3.64

SynchroForm
Bearing orders of the spindles

ZX0501800K + ZF0509800K

Bearing front

Outer ring	9.79
Inner ring	12.2
rolling body	4.09

Bearing back

Outer ring	9.23
Inner ring	12.76
rolling body	3.93

Unique selling points and further developments

Unique selling points HRI® and HRIexpert®

- Machine and process diagnostics
- “Self Diagnosis”
- High machine integration (homogeneous, directly from a single source)
- Support through own program development
- No dependency on external companies

Unique selling points HRI® and HRIexpert®

- Operation in the HMI on the machine
- Detecting the causes of errors as a system goal
- The original function of the vibration sensor system is retained
- Reporting and documentation of all parameters recorded for direct investigation of failure causes
- Create limiting curve via HRI®analyze+ and activate in HRI®machine

Differences between HRI® und HRIexpert®

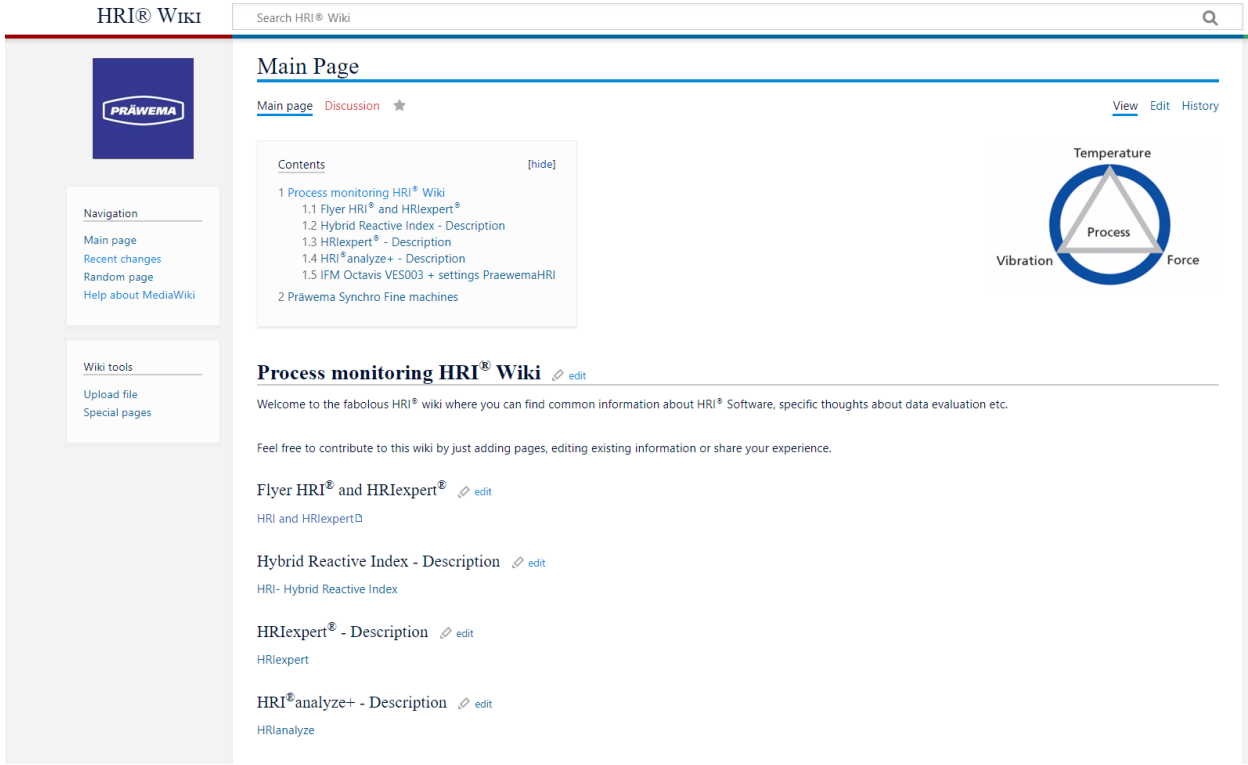
HRI® options	HRI®	HRIexpert®
Feed limitation via currents and vibrations	✓	✓
Vibration measurement, the currents / forces and the spindle temperature as a time signal	✓	✓
Individual limit values for each sensor / each axis	✓	✓
Individual error reaction for each sensor / each axis	✓	✓
Logging files with the minimum, average and maximum values for all sensors / axes	✓	✓
Feed limitation via orders	✗	✓
Display of the orders on the machine and individual limit values for the orders	✗	✓
FFT and shock logging files for all sensors	✗	✓

Unique selling points HRI® and HRIexpert®

HRI® Wikipedia

Own wiki page for sharing experiences about HRI® and HRIexpert® at

https://ekon.praewema.de/hriwiki



Further developments

- Help functionality in HRI ® machine
- Remote diagnosis via HRI®analyze+ and DVS Edge

Thank you for your attention!

Matthias Mänz

Eschwege, 2/7/2025

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Index of keywords

Index

Key word	Explanation
Honing	Honing is a fine machining or hard finishing process and represents the final manufacturing process in production.
Skiving	Gear skiving is a soft machining process for the production of gears.
HRI®	Basic version of the DVS Group's process monitoring program.
HRIexpert®	Extension of HRI with the possibility to monitor orders and limit curves.
Feed Limiter	Active procedure for reducing the machining feed rate during the process.
Data-Matrix-Code	2-D codes for marking the components, each component receives an individual code.

Index

Key word	Explanation
1-Wire Bus	1-Wire is a digital, serial bus with one data line and one earth line. It is used to record the spindle bearing temperature.
Temperature (HRI)	The temperature component is recorded in °Celsius. The temperature sensors of the spindle motors are used.
current / forces (HRI)	The currents / forces is the percentage utilization of the individual motor and refers to the nominal current. The value is given as a percentage.
Vibration (HRI)	The vibrations are recorded via sensors. The unit of vibration is mg (thousandths of the acceleration due to gravity).

Overview NC program number

The table lists various NC program numbers that represent different subroutines. Each number represents a specific subroutine that performs a specific machining task, such as honing, profiling or calibrating.

NC-Prog. Nr.	Erläuterung
1	Footprint / KM 0 measurement
2-9	Other programs (turning, drilling, etc.)
21	Honring measuring head
22	Honring measuring gear
31	Profiling head
32	Profiling gear
33	Pre profiling only with Vario Speed Dresser
34	Profiling only with the Vario Speed Dresser

Overview NC program number

NC program number	Explanation
35	Skiving
36	reprofiling head circle
40	Omit workpiece measurement
41	Workpiece measure left
42	Workpiece measure right
50	Honing
51	Dressing gearing with DDG
52	Dressing head circle
53	Dressing with Vario Speed Dresser
60	Calibrate

Overview Honing machines – Proc steps

During honing, various program steps are carried out. Each of these steps, such as: touch distance, immersion distance and working distance, represents a specific process within the honing process.

Prozessschritte	Erläuterung
0	inactive
1	way from 0 to tooth-tooth position (rapid)
2	way from tooth-tooth to "scratching point" (high feed of 1000 mm/min)
8	Prehoning, at Nick in gray range
3	touching (1)
7	touching (2) (optional)
9	lift distance (optional)

Overview Honing machines – Proc steps

Proc steps	Explanation
4	working (1)
10	working (2) (optional)
5	Spark out (residence time on end distance with oscillation)
6	Retreat path

Overview Proc steps dressing and skiving

Proc steps	Explanation
25	VSD cuts without correction
26	VSD cuts with correction

With the skiving machine, each skiving stroke is considered a separate process step. If, for example, a workpiece is to be processed with 15 skiving strokes, 15 process steps are recorded on the machine accordingly.
No distinction is made between roughing and finishing strokes.

Overview error reaction

The following is a description of the error reactions that are triggered when certain values are exceeded or not reached. These error reactions could include various actions such as stopping the process, triggering an alarm or displaying a warning message to indicate deviations or problems in the machining process.

Status	Explantation
None	No reaction from the machine.
NOK	The part is discharged as NOK part.
SPC	The part is discharged as SPC part.
StopCycle	The machine will be stop after the cycle.
Reset	Emergency stop and retraction to X 0 position
Feed Limiter	Feed limitation from the infeed axis

Overview part status

Status	Explantation
1	Measurement is OK - limit value was not exceeded
2	The limit was exceeded during processing
4	The average value was not reached during processing
8	The integral was not reached during processing
16	Error message via HRI® (vibration, force or temperature)
32	Error message via HRIexpert® (order object or limiting curve)
64	stop after the end of cycle
128	Eject workpiece (SPC)
256	Reset - Emergency retraction to X0 position
512	Eject workpiece (NOK)

Overview Status Value

The status value is sent to the HoningHMI and displayed there for the ejected workpieces. This allows the operator at the machine to determine the reason why a workpiece was ejected. The texts in the status value can be expanded.

Status Value	Explantation
18	HRI max exceeded
19	HRI min not reached
20	HRI surface exceeded
21	HRI surface not reached
22	HRI order analysis
23	HRI reserve