

A member of the DVS Technology Group

# **Operating Manual**

HRI<sup>®</sup> / HRIexpert<sup>®</sup> and HRI<sup>®</sup> analyze+



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# Foreword

These operating instructions refer to the HRI software program (Hybrid Reactive Index – Process Diagnostics) installed in the machine. The manual contains information about the menu windows dialogs, commands and buttons of the software program, and describes typical sequences and operator actions.

For information going beyond the contents of this manual, please contact the manufacturer or customer services.

When using the HRI software, not only these operating instructions but also the operating instructions of the machines involved must be followed without fail!

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We have taken the greatest possible care in compiling the information contained in this documentation. Nonetheless, we may not exclude non-conformances, and reserve the right to make any technical change to the product without prior notice.

We do not assume any legal responsibility or liability for any damage or loss which may be caused thereby. Necessary changes will be incorporated in the following issue.

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# **1 General Notes**

## 1.1 Representation in the document

 $HRI^{\ensuremath{\mathbb{R}}}$  and  $HRlexpert^{\ensuremath{\mathbb{R}}}$  are registered trademarks. The registered trademark symbol is used in trademark law to identify registered trademarks. The registered trademark symbol  $\ensuremath{\mathbb{R}}$  is shown as a superscript R in a circle.

In the following text, for short only **HRI** is written.

The HRI software is designed for the PRÄWEMA **SynchroFine**<sup>®</sup> external honing machines and the PRÄWEMA **SynchroForm**® hob cutting and interior honing machines. In the following text, for simplicity only the short forms **SynchroFine** and **SynchroForm are** written.



# 1.2 Explanation of symbols used

In these operating instructions, concrete safety instructions are given to inform about the unavoidable residual risks when using the HRI software. These residual risks pose a danger to:

- People
- Product and machine
- Environment

Please heed these safety instructions at all times and the measures specified to avoid the dangers.



#### WARNING!

... indicates a possibly dangerous situation which <u>can lead to fatal or severe</u> injuries if not avoided.



#### CAUTION!

... indicates a possibly dangerous situation which <u>can result in minor or</u> <u>slight injuries</u> if it is not avoided.



#### NOTICE!

... indicates a possible hazardous situation that <u>can lead to damage of</u> <u>property</u> if it is not avoided.



#### NOTE!

... highlights useful tips and recommendations as well as information for efficient and fault-free operation.



#### INSTRUCTION

Handling instruction for executing a program step or making a program input.



#### SynchroFine

All data for SynchroFine are on a BLUE background and marked by a honing tool pictogram.



#### SynchroForm

All data for SynchroForm are on a RED background and marked by a milling tool pictogram.



# 1.3 List of abbreviations

Abbreviation	Meaning
BIN	Binary file
CNC	Computerized Numerical Control
CPU	Central Processor Unit
CSV	File format (Comma-Separated Values)
DDG	Diamond Dressing Gear (gearing dresser)
DDR	Diamond Dressing Ring (head dresser)
DMC	Data Matrix Code
ForceAvg	Average drive utilization in %
FFT	Frequency analysis
НМІ	Human Machine Interface
HRI	Hybrid Reactive Index
HRIAvg	Average HRI value
HRILog	Logging file type, an HRILog file is generated daily.
HRIDebugLog	Logging file type, a file is generated for each workpiece.
HRIFFTLog	Logging file type with the recorded frequency ranges of the vi- bration sensors
HRIShockLog	Logging file type with the time signal of the vibration sensors
HRISurface	Integral of the HRI curve
IP	Internet protocol
IFM	Sensor-manufacturer
IEPE	Integrated Electronics Piezo Electric. Industry standard for pie- zoelectric sensors
LRQ	File for generating a license (License Request File)
MAC address	Media Access Control - Address
MAX	Maximal
MB	Megabyte
MIN	Minimal
mg	Milli G (thousandth of the acceleration due to gravity) $g = 9.81$ m/s <sup>2</sup>
ms	Millisecond
МТХ	MTX from Bosch Rexroth is a high-performance CNC system for controlling machine tools
MQTT	Message Queuing Telemetry Transport - open message proto- col
NC	Numerical Control
NOK	NOK part (not in order)
OPC	Open Plattform Communications



OPCUA	OPC Unified Architecture	
OCTAVIS	IFM Software	
URL	Uniform Resource Locator	
VSD	Vario Speed Dresser (Gearing dresser)	
XML	File format (Extensible Markup Language)	

Tab. 1 List of abbreviations



# 1.4 Glossary

Term	Meaning
Spark out	Dwell time at end axis distance without additional feed with os- cillation.
Bandwidth	Characteristic value in the signal processing that specifies the width in the intervals in a frequency spectrum
Data-Matrix-Code	2-D codes for marking the workpieces, each workpiece is given an individual code
Feed Limiter	Active method for reducing the machining feed during the pro- cess
Frequency analysis	Targeted monitoring of specific orders to prevent quality failures in the workpieces
Limit curves	Limit curves can be shown graphically in the spectrum as col- ored lines.
Honing	Honing is a fine machining or hard fine machining process, and in the production is the last manufacturing a workpiece, gear wheel or similar.
Order analysis	In the order analysis, the noises or vibrations of rotating ma- chines or vibrating components. The analysis is based on vibra- tion and speed measurements, that require at least an accelera- tion sensor in order to evaluate the vibration of the test object. Additionally, the determined or estimated speed is required. In contrast to the frequency analysis the energy content of the noises or vibrations are not applied against the frequency, but against die order. In this connection, the order refers to the har- monic components of vibration signals.
Orders	Each order corresponds to a multiple of the basic speed of the rotor. This means that the first order corresponds to the speed of the rotor itself, the second order to the double speed, and so on. Each order stands for a harmonic component in the vibration signal.
Port	A port in a network is a software-defined number, this assigned to a network protocol, and communication for a specific service receives or transmits.
Nick	A nick is a fault measured with a hobbing test (chip or burr) on the tooth flank.
Offset	An offset (relative position) is a number, that is subtracted from all coordinates, so that only positive values remain.
1-Wire Bus	1-Wire is a digital, serial bus that only needs a data line and a ground line. Is used to record the spindle bearing temperature.
Temperature (HRI)	The temperature proportion of HRI is recorded in degrees Celsi- us. The temperature sensors of the spindle motors are used.
Current / Force (HRI)	The currents / forces is the percentage utilization of the individu- al motor and refers to the nominal current. Specification in per- cent.
Oscillations / vibra- tions (HRI)	The vibrations are recorded by sensors. The unit of vibrations is mg (thousandth of the acceleration due to gravity).



Gear Cutting / Pow- er Skiving	Skiving is a soft machining process for manufacturing gearings.
Spectrum	The spectrum of a signal is composed of various frequencies.
Туре	HRI variable for monitoring
Reaction	Fault response of the machine that is triggered when the value is exceeded
Status Value	Input status text number for display in the HMI.

Tab. 2 Glossary



## 1.5 Copyright

The copyright in this operating instructions remains with **PRÄWEMA Antriebstechnik GmbH**.

This operating instructions and all associated technical documents contain regulations and drawings of a technical nature. They must not be, in whole or in part, duplicated, distributed or used for purposes of competition or disclosed to third parties.

## 1.6 Training

As only thoroughly trained persons can operate a machine economically, as well as the training by PRÄWEMA Antriebstechnik GmbH Service Technicians on site, we also recommend specific training for HRI by PRÄWEMA Antriebstechnik GmbH in Eschwege. This manual serves as a complement to this training.

More detailed information about the training program is available from the sales representatives of PRÄWEMA Antriebstechnik GmbH.

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antriebstechnik	

HRI<sup>®</sup> Operating Manual

# 2 Process Monitoring HRI

## 2.1 Functional description

Before using the operating instructions read them carefully from beginning to end to become familiar with the possible functions step-by-step.

The operating instructions are intended for qualified personnel and assumes corresponding specialist knowledge. Basic knowledge of the operation of software is assumed.

These operating instructions cover information about HRI monitoring which should enable the user to use the software consistently for its intended purpose and without operating errors.

The HRI software may only be operated by the Technical Customer Service of PRÄWEMA and authorized, trained and certified personal (for example machine setters)!

The document presents all the functions present in the system. Depending on the workplace and users rights the scope of available functions can vary.

The HRI software is pre-installed on all PRÄWEMA machines



## 2.2 What is HRI?

HRI means - Hybrid Reactive Index.

HRI reflects the process in a dimensionless value as a scalar variable.



Fig. 1 HRI process parameters

HRI is an index which is created by the combination of three process parameters: temperature, force and vibration (oscillation), with the aid of a formula:

#### HRI = temperatureHRI + forceHRI + vibrationSHRI

This index allows a unit-free representation of the process.

The HRI value reflects a characterization of the process.

The HRI software is a browser-based web application, which communicates via an interface. The application can be installed on all operating systems, e.g. on a Windows PC of the machine or on a separate Linux PC.

## 2.2.1 Added value with HRI

The HRI process monitoring system offers comprehensive control of every step of the machining process of a workpiece in the machine.

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

By implementing the extended status, limiting value breaches and fault responses are displayed in plain text on the HMI display.

Feed control allows precise process control.

There is also the option of recording component markings, e.g. by means of a data matrix code to ensure efficient tracking.



# 2.2.2 Goals of HRI

The goal of implementing HRI is to use only high-quality components (no raw or bad parts) in the assembly in order to ensure a trouble-free production process.

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

The implementation of preventive maintenance ensures that potential problems are dealt with proactively, and rectified.



# 2.2.3 HRI and HRIexpert

Functions	HRI	HRIexpert
Feed limitation by means of currents and vibrations	$\checkmark$	$\checkmark$
The measurement of the vibrations, currents / forces and the spindle temperature as a time signal	$\checkmark$	~
Individual limiting values for each sensor / each axis	$\checkmark$	$\checkmark$
Individual fault reaction for each sensor / each axis	$\checkmark$	$\checkmark$
Logging files with the minimum, average and maximum values for all sensor / axes	$\checkmark$	~
Feed limitation by orders	x	$\checkmark$
Display of the orders on the machine and individual limit- ing values for the orders	x	~
FFT and Shock Logging files for all sensors	x	$\checkmark$

Tab. 3 Differences between HRI and HRIexpert



### NOTE!

The installed and licensed software component is displayed in the *License management* menu. See section 3.6.6, item 6.



## 2.3 Range of applications of the HRI software



Fig. 2 Range of applications of the HRI software

- 1 External honing machine SynchroFine
- Interior honing / skiving machine SynchroForm

The HRI software is pre-installed on all **SynchroFine** and **SynchroForm** machines from **PRÄWEMA** before delivery.

2



Fig. 3 HRI software components

In order to activate the HRI software, a license must be purchased. Depending on the license, you may be able to use the **HRI** component **HRIexpert** on the machine.

The **HRIexpert** component expands the range of **HRI** functions to include the frequency analysis (FFT) high-frequency data.

The **HRIanalyze+** component was developed to analyze the recorded HRI data. The program detects independently whether they are Log-, DebugLog-, FFTLog- or ShockLog files. For better readability and evaluation of the data, we also recommend that the component is installed on an external PC or laptop.



# 2.4 Parameter for calculating the HRI value

## 2.4.1 Temperature parameter

Changes to the temperatures of the tool and workpiece spindles have a negative effect on the quality of the workpieces.

The higher temperatures change the length and height of the spindle.

The temperature sensors are installed in the motors, and the individual values are set by the BOSCH Rexroth controller or the Siemens controller as available parameters.

The temperature can be individually monitored. If the set value is exceeded, a corresponding fault reply (response) is triggered. See chapter 3.2.1.2

G PRÄWEMA HRI							III (8)
🖿 Files 🗠 Spectrum 🎛 HRI Ov	verview <u>I</u>	🛿 HRI-Bar 🔹 Se	ettings ピ Use	r Logs		Ø	🌐 en 👻 🕄
Overview Ranges Recor	dings (No v	vorkpiece relation	)				
Filesystem:							
Name: changed at:	Order	Bandwidth	Procsteps	NC-Prog-No.	Handling	Limit	Reaction
MockPart1.json ● 3.24.25, 2:12:06	1	2	4,10	ы 50 н	landlingChannel1 landlingChannel2	100r	ng NOK
MockPart2.json							
none.json 3.20.25, 7:47:30							+ - C
Upload limiting curve:	Тур	Min Max	Procsteps	NC-Prog-No.	Axis-Handling		Reaction
	Hri		5000 3,7,4,10,9	50	D Hand	llingChannel1	NOK 2
	Temper	ature 0°C 5	50°C 0,1,2,3,4,5	5,6,7 50	0 C1		StopCycle
							+ - 0
	ID	Dateiname Limiting Curve		Reaktion	Update		öschen

Fig. 4 Example of vibration parameters

Max. limiting value

2 Reaction

In the example, the machine with "StopCycle" is stopped if the limiting value of 50  $^\circ\text{C}$  is exceeded.

1



# 2.4.2 Parameter current / force

The current values of the axes involved in the process are recorded. These correspond to the process forces.

The current values are made available by the controller as parameters. The values are percentages of the **rated current**.

As well as recording the individual forces, the HRI also offers the opportunity of monitoring the average value of these forces. This average value is calculated at the end of the machining process, and enables the monitoring of a minimum and maximum range.

This monitoring is crucial in detecting deviations in the force behavior during the process, and for being able to respond at an early stage when required.

#### NOTICE!



At the beginning of the machining process, there must not be any direct contact between workpiece and tool. In this phase, an HRI monitoring on an absolute minimum value would not be appropriate, because this does not deliver useful information.

The absolute minimum value to start, is not different to the value that would occur after a tool breakage.

- Therefore activate the HRI monitoring for an average value.

🖿 Files 🗠 Spectrum 🕮 HRI Overview 🔟 HRI-Bar 🌩 Settings 😰 User Logs								Ø 🕀 en 👻 🚯		
	Overview Ranges Re	ecordings (No workpi	ece relation)							
Filesystem										
Name: changed at:		Order	Bandwidth	Procsteps		NC-Prog	-No.	Handling	Limit	Reaction
MockPartLjson 0 3/24/25,2/12/06										
MockPart2.json 3.20.25, 10:34:30			0	)						Einträge pro Selter 50 👻
nonejson 3.20.25, 7:47:30	•									
	United limiting sympt	Typ Mir	Max	Procsteps	NC-Prog-No.		Axis-Handling			Reaction
6		Force 0%	120 %	3.7.4.10.9			X1,32			NOK
		ForceAvg 20	60	3.7.4,10.9						StopCycle
										<b>₽ = 0</b>

Fig. 5 Example current parameter

1 MIN limiting value

2 MAX limiting value



#### NOTE!

Depending on controller type and machine equipment, various overloadings of the individual axes can occur. See additional information in the attachment of the desired machine type



#### 2.4.2.1 Parameter force - SynchroFine

The motors may be briefly overloaded, for example during the acceleration process. On Bosch Rexroth controllers, measured values of over 100% can occur.

The workpiece spindles can be overloaded by up to 350% and the linear axes up to 450%.

On SynchroFine machines with activated dollies, an offset of 30% is subtracted on the Zaxis. This adaptation takes into account the fact that the dolly and Z-axis work against each other. The utilization of the Z-axis with activated dolly on average some 30% higher in comparison to machines without an active dolly.

In the Settings menu, an offset can be adjusted. These are stored in the HRI data.

With no offset, the Z-axis is too heavily weighted in the calculation of the HRI index, changes in the other axes are not detected.

When calculating the current of the Z-axis, results less than zero are not accepted and written as zero.

Ģ	PRÄWEMA HRI	III (8)
File	s 🗠 Spectrum ⊞ HRI Overview 🔟 HRI-Bar 🂠 Settings 🖉 User Logs	Ø ⊕ en - 6
<b>¢</b> ≅	Base settings	
*	OPCUAServeripf BridgeCredentials BridgeTopic MachineClient AdaptivHonServ Channel 127.0.0.1 Ctrl2MqttBridge:Ctrl2MqttBridge ctrl2mqttbridgv ctrl2mqtt 127.0.0.1 S7Connectik 1	
i •	NetworkCredentials ActiveFrofile MinimumfreeSpace08 BackupPath 2011setHRI HRIO11setIFM Username:passv SynchroFc 4 BackupPath 30 0	
? ₽ ->	HRIFactorIFM MachineNo DeletaHriLogAfterDays DeletaHriDebugLogAfterDays DeletaHriFFTLogAfterDays 1 MachineN 365 60 60	
	DeleteHriShockLogAfterDays DeleteHriAlertLogAfterDays DeleteHriAvgMaxLogAfterDays DeleteHriRawAfterDays 60 0 0 60	
	ReadDMCArrayFromS7     ForceOrderMonitoring     InvertHRICommMonitor     FeedOverrideInPercent     GenerateWave     Overstanding Content of the State of the	
	Generatewaveolizippeu Compressuatagianis Enablekawoata RononProgChange DeleteAnterbackup Deuo	J
	DefaultLanguage MenuUri en javascript:location.reload()	
	Debug	
	Control tags	~
		8

Fig. 6 Basic settings menu - example of setting of the offsets - SynchroFine

1 Input field ZOffsetHRI

Example of normal state for a SynchroFine machine:

 $F_{HRI} = 1,269.07$ 

Example of shaft machining with a SynchroFine machine without offset:

 $F_{HRI}$  = 3,297.07



#### 2.4.2.2 Parameter force - SynchroForm

The motors can be briefly overloaded, particularly during acceleration processes. The Siemens controllers do not record any measured values exceeding 100% of the rated current. No measured values over 100% are communicated to the HRI.

When specifying limiting values, ensure that on machines with a Siemens controller, no values higher than 100% are input. HRI would not trigger a fault response at limits over100% of the rated current.



# 2.4.3 Vibration parameter

To record the vibrations, various sensors and VSE evaluation units are installed in the PRÄWEMA machines. See chapter 6.5 and 7.5.

#### Vibration value

The data recorded by the individual vibration sensors are transferred raw data, whereby each sensor outputs its measured value in mg (one thousandth of the acceleration due to gravity).

G PRÄWEMA HRI							III (8)
🖿 Files 🗠 Spectrum 🎛 HRI Overview	비 HRI-Bar	💠 Settings 🛛 Use	er Logs			Ø	🌐 en 🔻 🚯
Overview Ranges Recordings (No	workpiece re	elation)					
Filesystem:							
Name: changed at:	Order	Bandwidth	Procsteps	NC-Prog-No.	Handling	Limit Ro	eaction
MockPart1.json 3.24.25, 2:12:06							+ - 6
MockPart2.json 3.20.25, 10:34:30	Тур	Min Max	Procsteps	NC-Prog-No.	Axis-Handling		Reaction
nonejson							2
320.22, 14130	Hri	2000	3,4.7.9,10,8	50	HandlingChannel1 HandlingCh	annel2	None
Upload limiting curve:	Vibration	0mg 500mg	3,7,4,10,9	50	C1-Spindle		Reset
	Vibration	0mg 1000mg	1,2,5,6	50	C1-Spindle		Reset
							pro Seite: 50 😽
							+ - 2
Fig. 7 Example of vit	oration	parameters					

1 Max. limiting value 2 Reaction

In the example, the machine is stopped with "reset" if the limiting value is exceeded.



# **3** Software component HRI<sup>®</sup>





# 3.1 The main HRI menu

1 PRÄWZIA HRI 3		4	5 6			7)	III ( <mark>8</mark> 11)
Files Zpectrum	view 🔟	HRI-Bar 🂠 Set	ttings 🖻 User	Logs			● en - 3
Overview Ranges Recordin	gs (No wa	orkpiece relation)					9 10
Filesystem:							
Name: changed at:	Order	Bandwidth	Procsteps	NC-Prog-No.	Handling	Limit	Reaction
MockPart1json 3.24.25, 2:12:06 A 256 052 08 00 Z=29 (0.1)ison	1	2 4,	,10	50 Hand Hand	lingChannel1 lingChannel2	100mg	NOK
2.6.23, 10:47:30							ro Seite: 50 🗸
3.24.25, 2:12:06							+ - 6
Upload limiting curve:	Тур	Min Max	Procsteps	NC-Prog-No. Ax	is-Handling		Reaction
(14)	Hri	0 50	000 3.7.4.10.9	50	Handli	ngChannel1	NOK
	Tempera	ture 0°C 50	)°C 0,1,2,3,4,5,€	,7	C1		StopCycle
							+ - 6
	IĎ	Dateiname Limiting Curve		Reaktion	Update	Del	ete
						Einträge pro	o Seite: 50 🗸

Fig. 8 Main menu HRI - data loaded



Item	Name	Function	Description
1	Files	Tabs	To the <i>file system</i> menu
2	<b>Spectrum</b> (only with HRIex- pert)	Tabs	To the <i>spectrum</i> menu Frequency objects as bar charts (See chapter 4.6)
3	HRI overview	Tabs	To the menu <i>HRI bar</i> HRI diagrams and HRI table
4	HRI Bar	Tabs	To the menu <i>HRI bar</i> shows the monitored variables (HRI, force, temperature, vibration)
5	Settings	Tabs	To the menu <i>Basic settings</i> All settings for communication between HRI and controller
6	Documentation	Tabs	To the <i>documentation</i> menu Creating a logbook
7	System status	Button	To System status menu window Display of the system status (connection to the backend, controller or sensors) Red = no connection yet, White = connection
8	Side of the ma- chine	Selection field	Select left or right side of machine (only with <b>SynchroForm</b> )
9	Language	Selection field	<i>Select</i> language (en, cn, es)
10	Information	Button	To <i>Information</i> menu window Version display Frontend and Backend.
11	Login	Button	To <i>Login</i> menu window
12	gear toothing	Display field	Currently loaded gearings of the machine
13	Deletion file	Button	Delete gearings of the machine
14	Upload limit curve	Button	Only possible with the <b>HRIanalyze+</b> component See chapter 5.4.4.2

The programs in the *File system* of the machine HMI are loaded in the file system menu. The currently loaded gearing is preselected.



#### NOTE!

With a rollover over buttons or a symbol, for understanding, the text is displayed in the selected language.



# 3.1.1 Login menu window

G PRÄWEMA HRI		III 🔗
Files 🗠 Spectrum 🖽 HRI O	Login	& 🌐 en 🚺 🕄
Overview Ranges Reco		
Filesystem:	2 Email address	
Name: changed at:	3 User Pasword	Limit Reaction
MockPart1.json 3.24.25, 2:12:06		400 NOK
MockPart2.json 3.20.25, 10:34:30	4 SIGN IN	Tuumg NOK
nonejson 3.20.25, 7:47:30	5 CANCEL	Einträge pro Seite: 50 🗸
Upload limiting curve:	Typ Min Max Procsteps NC-Prog-No. Axis-Handling	Reaction

Fig. 9 Login menu window

Item	Name	Function	Description
1	Login symbol	Button	To open the login menu window
2	Username	Input field	Enter username
3	Password	Input field	Enter password
4	LOGIN	Button	Login after inputting the data
5	STOP	Button	Stop text input

#### INSTRUCTION

Proceed as follows to login to the HRI system:



- 1. Select the *Login* (1) button.
- 2. The *Login* menu window is opened.
- 3. Enter username (2) and your password (3),
- 4. Confirm *Login* (4) with button or *Cancel* (5).



# 3.1.2 Language menu window

ଡ	PRÄWEMA HRI	
File:	s 🗠 Spectrum 🎛 HRI Overview 🔟 HRI-Bar 🌩 Settings 😰 User Logs 🛷	🌐 en 🔺 🕄
<b>¢</b> ∉	Base settings	en cn
<u>*</u> -	OPCUAServeripf BridgeCredentials BridgeTopic MachineClient AdaptivHonServ Channel 127.0.0.1 Ctrl2MqttBridge:Ctrl2MqttBridge ctrl2mqttbridgv ctrl2mqtt 127.0.0.1 S7Connectiv 1	es sv
i •	NetworkCredentials ActiveProfile MinimumFreeSpaceGB ZOffsetHRI HRIOffsetIFM username:passv SynchroFc 4 BackupPath 30 0	
€ +)	HRIFactorIFM MachineNo DeleteHriLogAfterDays DeleteHriDobugLogAfterDays DeleteHriFFTLogAfterDays 1 MachineN 365 60 60	

Fig. 10 Language menu window

Item	Name	Function	Description
1	Language arrow	Button	Currently selected language
2	Language selection	Drop-down menu	Select language



#### INSTRUCTION

To select a language, select the *Language* (1) button and the drop-down menu (2) opens, scroll down and select the desired language.



# 3.1.3 Information menu window

G PRÄWEMA HRI				13	
	Information				
🖿 Files 🗠 Spectrum 🖽 HI		hataahaik Ombili		@ 🌐	en 🔻 🕄
Overview Ranges					
Filesystem:	Version Frontend 3.2.13				
Name: 2	Version Backend		ing	Limit	Reaction
	Support hrisupport@praewema.de		ndle_X		NOK
MockPart2.json 3.20.25, 10:34:30				nträge pro	Seite: 50 🗸
none.json 3.20.25, 7:47:30		CLOSE			+ - 6
	Typ Min Max Proc	steps NC-Prog-No. 3 is-Handling			Reaction

Fig. 11 Information menu window

Item	Name	Function	Description
1	Symbol information	Button	Open information menu window
2	Menu window information	Display field	Display Frontend, Backend and Support ad- dress
3	CLOSE	Button	Close information menu window



#### **INSTRUCTION**

Select the button (1) to open the *Information* menu window. Select the CLOSE (3) button to close the *Information* menu window.

In the *Information* menu window, the Backend and Frontend versions and the support address are shown.



# 3.1.4 System status menu window

G PRÄWEMA HRI					
	System-Status			2 4	
Files 🗠 Spectrum 🖽 HRI C	C1-Spindle_X: OK			@ #	en ₹ 🕕
Overview Ranges Reco	C1-Spindle_Y: OK		(	1	
Filesystem:	C1-Spindle_Z: 0K				
Name:	E1-Spindle: OK		ling	Limit	Reaction
	Control connection: OK Verbindung Backend: OK		oindle_X	100mg	NOK
MockPart2.json 3.20.25, 10:34:30		01.025		inträge pro	Seite: 50 🗸
none.json 3.20.25, 7:47:30					
	Typ Min Max Procsteps NC-Prog-No. Axis	s-Ha			Reaction

Fig. 12 System status menu window

Item	Name	Function	Description
1	Symbol system status	Button	Open system status menu window
2	Menu window system status	Display field	Status display of connections
3	CLOSE	Button	Close system status menu window



#### INSTRUCTION

Select the button (1) to open the *System status* menu window. Select the CLOSE (3) button to close the *System status* menu window.

In the *System status* menu window are displayed the connections to the VSE, controller and Backend.

Display symbol of system status red = No connection yet Display system status symbol white = HRI server connected



# 3.2 File system menu, overview of limiting values of diagnostic objects

<b>G</b> präwema hri							₩ 8
🖿 Files 🗠 Spectrum 🖽 HRI O	verview	네 HRI-Bar 🂠	Settings 🖻 U	lser Logs		Ø	🌐 en 👻 🚯
Overview Ranges Recor	dings (No	workpiece relatio	n)				
Filesystem:							
Name: changed at:	Order	Bandwidth	Procsteps	NC-Prog-No.	Handling	Limit	Reaction
MockPart1.json	15	2	3,7,4,10,9	50	C1-Spindle_X	120mg	FeedLimiter
3.24.23, 2:12:00	15.1	2	3,7,4,10,9	50	C1-Spindle_X	200mg	NOK
3.20.25, 7:47:30	<b></b>						pro Seite: 50 🗸
Upload limiting curve:	Тур	Min Max	Procsteps	NC-Prog- No.	Axis-Handling		Reaction
	Hri	0 12000	1,2,3,4,5,6,7,8	35	HandlingChannel1		None
	Temperat	ure 0°C 40°C	1,2,3,4,5,6,7,8	35	C1		StopCycle
	2	3 4	5	6	7	Einträge p	pro Seite: 50 🔕
	ID	Dateiname Limiting Curve		Reaktion	Update		9,10 11

Fig. 13 File system menu - lower area, limiting values of diagnostic object

Item	Name	Function	Description
1	HRI range	Display range	All limiting values diagnostic object
2	Туре	Display field	HRI variable for monitoring
3	Min	Display field	Limiting value that must be reached in the pro- cess step
4	Мах	Display field	Limiting value that must not be exceeded in the process step
5	Program steps	Display field	Program steps of the machining processes that are monitored
6	NC-program numbers	Display field	NC subprograms that are monitored
7	Axis handling	Display field	The monitored axes and sensors.
8	Reaction	Display field	Fault response that is triggered by exceeding or not reaching the value.
9	+	Button	Open New diagnostic object menu
10	-	Button	Delete selected diagnostic object
11	Edit	Button	Open existing Diagnostic object menu



# 3.2.1 New diagnostic object menu - input menu for limiting values

An input menu for the *Diagnostic objects* is integrated into the software for easier configuration of the limiting values and to reduce the risk of incorrect inputs.

In this input menu, individual variables can be monitored and fault responses defined.



INSTRUCTION

To open the input menu, press the *Machining* (11) button in the *file system* menu.

To add an additional diagnostic object, select the "+" (9) button.

The New diagnostic object input menu is opened.

G PRÄWEMA HRI					
	New diagnostic object				
Files 🗠 Spectrum 🖽 HRI Overview	Туре			Ø	🌐 en 🔻 🕚
Overview Ranges Recordi	Undefined				
Filesystem:	Reaction				
Name: 2- changed at:	None NC program number		dling	Limit	Reaction
MockPart1.json  3.24.25, 2:12:06	e.g.: 1,23,12,22,53		pindle_X		
MockPart2.json	Proc stops Bep.: 1.2.3,12.22.53 empty = all				
nonejson 3.20.25, 7:47:30	Axis-handling				+ - 0
Upload limiting curve:	Max		dling		Reaction
	Max				
	PAIRS				
	Status Value				StopCycle
(8)=	0	9 10			
		<b>T</b>			
		OK Cancel			

Fig. 14 New diagnostic object - input menu for limiting values

ltem	Name	Function	Description
1	Туре	List selection field	Select HRI variable for monitoring
2	Reaction	List selection field	Fault response that is triggered if the value is exceeded.
3	NC-program numbers	Input field	Various subprograms, select channel number
4	Program steps	Input field	Select program steps of the machining that should be monitored
5	Axis handling	Selection field	Select spindle or sensor which should be moni- tored
6	Мах	Input field	Enter the limiting value that must not be exceeded in the process step
7	Min	Input field	Enter min. limiting value for fault response
8	Status Value	Input field	Input status text number for display in the HMI.



9	ОК	Button	Confirmation of the inputs closure of the input menu
10	Stop	Button	Cancel the input and close the input menu


## 3.2.1.1 Types

New diagnostic object	
🖿 Files 🖌 Spectrum 🖽 HRI Overview	
The Decision of the Decision o	
Overview Ranges Recordings (N: Hri	
Filesystem:	
Name: HinAvg HinAvg HinAvg Limit Reaction	
changed at: Force	
MockPartIjson pindle_X 120mg FeedLimiter 3.24.25, 2:12:06 Vibration	
MockPart2json Proceteps	
3202, 103450  Standart	
non-sion All proc steps	-
S202, r4r30	Ľ
📄 Path to TT position 💿 Immersion distance 🕑 touch distance	
Upload limiting curve:	on
2. touch distance (between touch- and work distance)	
📄 Prehoning, at Nick in gray range 🕑 Discontinuous cut hannel 1 None	
2. work distance (between 1. work- and spark out) StopC	

Fig. 15 New diagnostic object menu - selection list of types

ltem	Types	Description				
	Undefined	No info				
	HRI	Calculated HRI value				
1	HRIAvg	Average of the calculated HRI value				
	HRISurface	Integral of the HRI curve				
	Force	Force from the various axes				
	ForceAvg	Average force from the various axes				
	Temperature	Temperatures of the various spindles				
	Vibration	Vibrations from the various sensors				

The various HRI variables that are monitored are listed in the selection list *Types*.



#### INSTRUCTION

Click the *Types* selection field and select the HRI variable to be monitored.



#### 3.2.1.2 Reactions

In the selection list, the fault responses are available for selection, which are triggered if certain values are exceeded or not reached.

These fault responses may cover various measures, such as stopping the process, triggering an alarm or displaying a warning message to indicate deviations or problems in the machining process.



Fig. 16 New diagnostic object menu - selection list of Reactions

ltem	Reaction	Description		
	None	No machine reaction		
	NOK	The part is ejected as an NOK part		
	SPC	The part is unloaded as an SPC part		
1	StopCycle	The machine stopped after the cycle.		
	Reset	EMERGENCY STOP and retraction into X-0 position		
	FeedLimiter	Feed limitation as from the infeed axis		
	Contact detection	Contact detection from tool to workpiece.		

#### Fault reaction MIN

If the average value of the machining is not reached, the HRI monitoring and the defined fault response are implemented. The **Minimal monitoring** should detect a tool breakage. If there is no or little contact between the tool and the workpiece, this is detected and the fault response is triggered.



#### NOTE!

This fault response is only possible with HRIAvg, HRISurface and ForceAvg.

Fault reaction Max



If the value entered in the process is exceeded, the HRI monitoring responds and the defined fault response is implemented. High forces, vibrations or temperatures during the machining trips the fault reaction.

#### Fault reaction surface

The HRI monitoring reacts if the area under the HRI curve is smaller than the entered value. If the honing process is slowed by a manual intervention or a feed limitation, the maximum and minimum values are lower.

The integral under the curve of the HRI remains relatively stable. In this way, changes in the machine can be detected.



### INSTRUCTION

Click on the *Reaction* selection field and select the corresponding reaction.



## 3.2.1.3 NC program numbers

G PRÄWEMA HRI					
	New diagnostic object				
Files 🗠 Spectrum 🎛 HRI Overview	Туре			Ø	🌐 en 👻 🚯
Overview Ranges Recordings (No	Undefined				
Filesystem:	Reaction				
Name: changed at:	None NC program number		dling	Limit	Reaction
MockPart1.json  3.24.25, 2:12:06	e.g.: 1,2,3,12,22,53		pindle_X		
MockPart2.json 3.20.25, 10:34:30	Proc steps Bsp: 1.2.3,12.22.53 empty = all		pindle_X	200mg	NOK
nonejson 3.20.25, 7:47:30	Axis-handling	*			ge pro serte: su 🔻
Upload limiting curve:	Max Max		dling		Reaction
	Min				
	Min Status Value				StopCycle

Fig. 17 New Diagnostic object menu - NC-program numbers

ltem	Number	Description						
	1	Footprint / KM 0 measuring						
	2-9	Additional programs (turning, drilling, ancillary processes, etc.)						
	21	oning ring measure head dresser						
	22	Measure honing ring gearing dresser						
	31	Profile head						
	32	Profile gearing						
	33	Preprofiling only with VSD						
1	34	Profiling only with VSD						
	41	Workpiece measuring, left						
	42	Workpiece measuring, right						
	50	Honing						
	51	Dress gearing with DDG						
	52	Dressing head						
	53	Dress with VSD						
	60	Calibration						

Tab. 4 NC-program numbers - for honing



Item	Chan nel	Description		
1	35	Gear Cutting / Power Skiving		
Tab. 5	NC program numbers - for skiving			

In the *NC program numbers* input field, various program number are listed, that represent various subprograms. Each number represents a specific subprogram that performs a specific processing task, such as honing, form-truing, calibration or hobbing.



## INSTRUCTION

Enter the corresponding NC program number in the input field (1) and separate with commas



## 3.2.1.4 Honing program steps

G PRÄWEMA HRI				
	New diagnostic object			
🖿 Files 🗠 Spectrum 🎛 HRI Overview	Туре		Ø	🌐 en 🔻 🖲
Overview Ranges Recordings (No	Vibration			
Filesystem:	Reection			
Name:	None	dling	Limit	Reaction
changed at:	NC program number			
MockPart1.json O 3.24.25, 2:12:06	50	pindle_X		
MockPart2.json	Procsteps			
	Standart			
none.json	All proc steps			_
5.20.23, 1:41:30	Free selection			
	Path to TT position immersion distance of touch distance			
	🕑 work distance 📄 spark out 📄 Retreat path	dling		Reaction
	2. touch distance (between touch- and work distance)			
	🦳 Prehoning, at Nick in gray range 🛃 Discontinuous cut	hannel1		
	2. work distance (between 1, work- and spark out)			StopCycle

Fig. 18 New diagnostic object menu - program steps of honing

ltem	Program step	Description
		Standard
		All program steps
		Free selection
	1	Feed path from 0 to tooth-tooth position (ZZ)
	2	Insertion aid from tooth to tooth until scraping point (high feed ~1000 mm/min)
	3	1.
	4	1.
1	5	Spark out (dwell time at end axis distance without additional feed with oscillation)
	6	Retraction path
	7	2. (optional)
	8	Pre-honing for nick in gray area (optional)
	9	Interrupted step (optional)
	10	2.
	25	VSD - steps without correction (dressing)
	26	VSD - steps without correction (dressing)

Tab. 6Honing program steps

If NC program number **50** (honing) is activated, a selection can be made between the various process steps in plain text.



During the honing, various program steps are run through. Each of these steps, such as for example: Feed path, plunge path and work path, represent a specific process within the honing process.



Fig. 19 New diagnostic object menu - program steps of hobbing

On skiving machines, each skiving stroke is considered as a separate process action. if, for example, a workpiece with 15 skiving strokes is to be processed, 15 corresponding process steps are recorded on the machine.



## NOTE!

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



### INSTRUCTION

Enter the corresponding program steps in the input field (1) and separate with commas.



## 3.2.1.5 Axis handling

G PRÄWEMA HRI				
	New diagnostic object			
🖿 Files 🗹 Spectrum 🖽 HRI Overview			Ø	🌐 en 🔻 🕄
Overview Ranges Recordings (No	HandlingChannel1			
Filesystem:	HandlingChannel2			
Name:		dling	Limit	Reaction
changed at:	C1-Spindle_X			
MockPart1.json		pindle_X	120mg	FeedLimiter
	C1-Spindle_Y	pindle_X		NOK
	C1-Spindle_Z			
	Ac	- III		
3.20.25, 7:47:30	C_L_L_E1-Spindle			+ - 2
	Max			
Upload limiting curve:	Max	lling		Reaction
	Min			
		hannel1		
	Min			StopCycle
	Status Value			

Fig. 20 New diagnostic object menu - axis handling

ltem	Name of axis / handling	Description		
	Right-hand spindle	For HRI and vibration - all active sensors		
	Left-hand spindle	For HRI and vibration - all active sensors		
	X1 axis	For force and force AVG		
	X2 axis For force	For force and force AVG		
4	Z1 axis	For force and force AVG		
1	Z2 axis	For force and force AVG		
	C1 axis	For force and force AVG and temperature		
	C2 axis	For force and force AVG and temperature		
	B axis	For force and force AVG and temperature		
	Individual vibration sensors	For vibration		

Tab. 7 Axis handling





## 3.2.1.6 Status text display in the HMI menu machine status (example

Fig. 21 Status text display in the HMI menu machine status (example)

- 1 Status text display for right-hand spindle
- 3 NOK parts drawer right
- 2 Status text display for left-hand spindle

The status value is sent to the honing HMI, and for the rejected workpieces displayed there in the HMI menu machine status. This enables the operator of the machine to determine the reason for ejecting the workpiece. The texts for the status value can be extended.

Item	Jam Value	Display text
1	18	HRI maximum exceeded
	19	HRI minimum not reached
	20	HRI maximum exceeded
	21	HRI Integral not achieved
	22	HRI order analysis
	23	HRI Reserve



### NOTE!

The display depends on the installed component of the honing HMI. The texts are displayed as from inspection 1839.





#### INSTRUCTION

Enter the corresponding status number in the *Diagnostic object* input menu.



# 3.2.2 Feed limitation menu - Current/Force and Vibration

G PRÄWEMA HRI								
🖿 Files 🗠 Spectrum 🎛 HRI Ov	verview <u>!</u>	l HRI	-Bar 🗯	Settings 🕑 User	Logs	Ø right	· e •	en 🔻 🚺
Overview Ranges Record	lings (No w	orkpie	ece relatio	on)				
Filesystem:								
Name: changed at:	Order	Ban	dwidth	Procsteps	NC-Prog-No	. Handling	Limit	Reaction
MockPart1.json 2.14.24, 9:11:48	26	2		3,7,4,10,9	50	HandlingChannel1	100 mg	NOK
Upload limiting curve:							Items per p	bage: 50 🗸
	Тур	Min	Max	Procsteps	NC-Prog-No.	Axis-Handling		Reaction
	Hri	0	5000	3.7.4.10.9	50	HandlingChannel1 HandlingChannel2	c	None
	Force	0 %	100 %	3,7,4,10,9	50	X1,X2		FeedLimiter
	Vibration	0 mg	500 mg	3.7.4.10.9	50	C1-Spindle		FeedLimiter
							-	

Fig. 22 Feed limitation menu - current/force and vibration

To make the process more stable, and to catch acceleration peaks, a feed limitation (Feed Limiter) (1) is integrated in the software. So that precise process control is possible,

The control of the machine feed can be done in the HRI component by specifying threshold values for **current/force** and vibration.

As soon as the specified threshold value is exceeded, there is the feed limitation.

First the feed is reduced in 10% steps. Exceeding 120% of the set limiting value, the Feed Limiter sets the value of the feed axis to 0%. An increase in the feed rate first starts when the measured value once again falls below the threshold value.



#### NOTE!

A limiting value for vibration monitoring is only available with the HRIexpert software component. See chapter 4.7.





Fig. 23 Example of a feed limitation - feed limiter

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

First, the feed is reduced to 90%, and if this action is inadequate, the feed is reduced to 0%. When the vibrations fall below the limiting values again, the feed is increased again.

## 3.3 Spectrum menu



#### NOTE!

The Spectrum menu is only available in the HRIexpert software component. See chapter 3.7



# 3.4 HRI Menu overview

G PRÄWEMA HRI								5	III (8)
🖿 Files 🗠 Spectrum 🖽	HRI Overview	/ 비 HRI-Bar	🜣 Settings 🛛 🖉	User Logs				🧭 right 👻	🌐 en 🍷 🚯
500									
400									
200									
	1	2	3	4	2	5	6 7	8 9	10
fimestamp	Spindle	HRI min	HRI max	HRI average	HRI surf	Part status	Extendent status	DMC	
8.10.2024, 14:05:58		433.2	437.8	435	1306.4	544	Ord[1]	1ef9f438-f8fca31b-151edb04d7ff	
8.10.2024, 14:05:43		433.7	436.5	435	435.2	544	Ord[1]	1ef9f438-f8fca31b-151edb04d7ff	
8.10.2024, 14:05:37		0.2	438.5	412	195	544	Ord[1]	1ef9f438-f8fca31b-151edb04d7ff	
8.10.2024, 14:05:29		0.2	436.3		543	544	Ord[1]	1ef9f438-f8fca31b-151edb04d7ff	
8.10.2024, 14:05:15			0.2			544	Ord[1]	1ef9f438-f8fca31b-151edb04d7ff	
8.10.2024, 14:05:08			438.9	418	2505.8	544	Ord[1]	1ef9f438-f8fca31b-151edb04d7ff	
								Entra	,

Fig. 24 HRI Menu overview (example)

- 1 HRI diagram
- 2 HRI table
- 3 Part status field

- 4 Extended status field
- 5 Select left / right side of the machine

In the menu, *HRI overview*, the machining of the last workpieces produced are shown as an HRI diagram (1) and HRI table (2). Machines in which processes can run in parallel, a distinction is made between the left and right sides of the machine (5).

The individual signals of the *Part status* (3) are bit values and can be combined with one another.

Item	Bit value Part status	Description
	0/1	Measuring is OK - limiting values were not exceeded
	2	During the processing, the limiting value was exceeded.
	4	During the machining, the average value was not reached
	8	During the machining, the surface is not reached.
2	16	Fault message via HRI (vibrations, force or temperature)
3	32	Fault message via HRIexpert (order object or limit curve)
	64	Stop after cycle end
	128	Eject workpiece (SPC)
	256 Reset - emergency retraction to X0 position	
	512	Eject workpiece (NOK)

### Significance of bit values:



#### Example:

A triggering error message "4 - During the machining is that the average value was not reached", with the error response "64 - Stop after cycle end" would be output as workpiece status "68".

In the *Extended status* (4) field, the limiting value breaches are shown as plain text, with the set limiting values and the values that exceed or undershoot the values, and the set fault response.



# 3.5 To the menu HRI bar

G PRÄWEMA HRI		III 😣
■ Files 🗠 Spectrum 🌐 HRI Overview 🔟 HRI-Bar 🏟 Settings 🗭 User Logs	🥔 left 👻	🌐 en 🎽 🚯
Overview HRI Force Temperature Vibration 1 2 3 4		
HRI Force Temperature Vibration		

Fig. 25 HRI Bar (example)

- 1 HRI button
- 2 Force button

- 3 Temperature button
- 4 Vibrations button

The status messages of the process parameters are shown in the *HRI Bar* menu. As well as the *HRI value*, *force*, *temperature* and *vibrations* are also displayed for the parameters, whether the limiting values are observed.

During the creation of an HRI monitoring object, the associated buttons (1-4) are activated. If the limiting value is less than 80% of the limiting value, the button is displayed with a white circle and a checkmark.

With limiting values of more than 80%, the button is orange, and in the event of exceeding this, it is shown in red.

If no diagnostic object has been created, the status message is colored gray (4).



#### INSTRUCTION

To display the individual HRI monitoring objects, click a button (1-4), and switch into the *HRI Bar single view* menu.



G PRÄWEMA HRI	
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4	
StopCycle StopCycle min: 0 min: 0 max: 65 max: 60	
<	

Fig. 26 HRI Bar single view (example)

1 Temperature of C2-axis

2 Temperature of B-Axis

- 3 Red line
- 4 Orange line

The HRI Bar single view menu opens.



## NOTE!

Th HRI monitoring objects from HRIAvg, HRI Surface and ForceAvg are not displayed here. The values of these HRI monitoring objects are not calculated until the end of the process.

In the example, the orange line (4) is scaled to 80%, and the red line is the limiting value. Three HRI monitoring objects are created for the temperature.

On the C1-axis, the measured value lies between 80% and 99% of the set limiting values.



## 3.6 Settings menu

In the *Basic settings* menu, all the important settings for communication between HRI and the controller machines are set.

Furthermore, various additional options can be set here.

All entries in the Settings menu are stored in the HRIData directory on the PC



## NOTE!

The basic settings are specified once during the commissioning by the PRÄWEMA service technician.

No additional settings are necessary, except in the case of faults or changes to the programming.

The changes can only be made with the authorization level administrator.



## INSTRUCTION

To the extended view, click a symbol in the tool bar (1). To close the extended view, click on a tool bar symbol again.



Fig. 27	Menu bar Basic settings closed and extended view
---------	--------------------------------------------------

Item	Name	Description
1	Menu bar	Menu bar closed, only symbols
2	Menu bar	Extended view with text
3	Basic settings	To the <i>Documentation</i> menu Basic setting of all important settings for HRI and con- troller communication
4	VSEs	To the VSE basic settings menu Display of the VSE evaluation units for the vibration sensors
5	Setup	To the <i>Setup</i> menu Search for vibration sensors, Restart of HRI backend
6	One Wire	To the <i>OneWire</i> menu



		Input field for IP address of the controller
7	Information	To the <i>Information</i> menu Display of backend and frontend versions
8	License management	To the <i>License management</i> menu Display of installed licenses
9	Help	To the <i>Help</i> menu HRI and HRIexpert training documentation
10	User management	To the <i>User management</i> menu Creation of various users
11	Login/Logout	To <i>Login</i> menu window

# 3.6.1 Basic settings menu

## 3.6.1.1 Basic settings menu - Input fields



Fig. 28 Basic settings menu - upper range

Item	Name	Function	Description
1	OPCUAServer- IpPort	Input field	IP address of the controller with the OPC UA server port (from PRÄWEMA)
2	Bridge Creden- tials	Input field	User and password for the network bridge for DVS Edge (from PRÄWEMA)
3	Bridge Topic	Input field	For DVS Edge (from PRÄWEMA)
4	Machine Client	Input field	For DVS Edge (from PRÄWEMA)
5	Adaptive Hon ServerIP	Input field	IP address of the controller with the Adap- tiveHonServer (from PRÄWEMA)
6	S7Connection IP	Input field	IP address of the S7 CPU in the Profinet (from PRÄWEMA)
7	ZOffsetHRI	Input field	Only with SynchroFine - offset on the force of the Z-axis with activated tailstock
8	HRIOffsetIFM	Input field	Offset from the vibration proportion of the HRI calculation
9	HRIFactorIFM Input field		Factor from the vibration proportion of the HRI calculation
10	MachineNo	Input field	Number of the machine
11	Channel	Input field	NC channel of the Siemens S7 Controller (from PRÄWEMA)



12	BackupPath Input field		Storage location for the HRI backup on a server		
13	Network cre- dentials	Input field	Username and password for the backup server		
14	ActiveProfile	Input field	Active profile - SynchroForm or SynchroFine (from PRÄWEMA)		
15	Minimum free space	Input field	Minimum free hard disk space (in GB)		
16	Delete HRILog Data After Days	Input field	Deletion of the Logging files after number of days on the machine		
17	DeleteH- RIDe- bugLogAfter- Days	Input field	Deletion of the Debug Logging files after num- ber of days on the machine		
18	DeleteHRIFFT- LogAfterDays		Deletion of the FFT Logging files after number of days on the machine		
19	DeleteHRI ShockLogAfter Days	Input field	Deletion of the Shock Logging files after number of days on the machine		
20	DeleteHRIAI- ertLogAfter- Days	Input field	Deletion of the Alert Logging files after number of days on the machine		
21	DeleteHRIAvg MaxLogAfter- Days		Deletion of the Avg Max files after number of days on the machine		
22	DeleteHRIRaw AfterDays	Input field	Deletion of the Raw files after number of days on the machine		





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		DeleteHriFFTLogA 60	fterDays	DeleteHriShockLog, 60	AfterDays	DeleteHriAk 0	ertLogAfterDays		
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Fig. 29 Basic settings menu - upper range

ltem	Name	Function	Description (authorization)		
1	ReadDMC Ar- rayFromS7	Checkbox	Read in data matrix code from Siemens S7 (from PRÄWEMA)		
2	Debug Checkbox		HRI recordings during standby and simulation		
3	PublishRaw DataViaMqtt Checkbox		Transmits raw data via MQTT (from PRÄWE- MA)		
4	4 Enable raw da- ta Checkbox		Record raw data		
5	ForceOrder Monitoring	Checkbox	At least one order monitoring must be created (from PRÄWEMA)		



6	Generate Leg- acyCsvs	Checkbox	Create standard CSV Log files		
7	LegacyCsv SaveAvgMax	Checkbox	For OK workpieces only the average and maxi- mum amplitudes of the vibrations are stored		
8	Generate Wave	Checkbox	Generate a compressed WAVE file from the da- ta of the vibration sensors		
9	Generate datagrams	Checkbox	Generate datagrams for analyzing the work- pieces		
10	Generate WaveUnzipped	Checkbox	Generate an uncompressed WAVE file from the data of the vibration sensors		
11	Com- pressData- grams	Checkbox	Compress datagrams		
12	DeleteAfter Backup	Checkbox	Delete the logging files on the machine if an ex- ternal backup path is set up		
13	InvertHRI CommMonitor	Checkbox	Communication monitoring inverted (by PRÄWEMA)		
14	FeedOverridel nPercent	Checkbox	Feed limitation is written in percent on the PLC (from PRÄWEMA)		
15	Experimental	Checkbox	Beta functions - Caution near production machines! (PRÄWE- MA)		
16	RollOn- ProgChange	Checkbox	Save new FFT/ShockLog files after dressing		
17	DefaultLan- guage	Input field	Standard language		
18	MenuUrl	Input field	Function of the 9 points buttons in the header		
19	Debug	Checkbox	HRI recordings during standby and simulation		
20	Control tags	Drop-down menu	Set parameters for NC-communication		
21	Saving	Button	Save last inputs		

In the controller variables (Control tags) (20), the various parameters for the NC communication are set Values for recording in the HRILog files can be entered here.



## INSTRUCTION

To open and close the *Control tags* drop-down menu, click on the (20).



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Sharaby2k:line         Handing/Yee	StandByActive	Handling		
NC         Handlingfore         APC/X NC COB_ACX/TBLESHIV_DRFUTTED.DMCH         I           INC         Handlingfore         I         I           INC         Handlingfore         I         I           INC         Handlingfore         I         I           INC         Handlingfore         I         I           INCARD         Handlingfore         I         I           INCARD         Handlingfore         IIII (IIII)         I         I           INCARD         Handlingfore         IIII (IIIII)         I         I           INC         Handlingfore         IIIII (IIIIIIIIIIIII)         I         I           INCA         Handlingfore         IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	StandBy2Active	Handling		
NACC         Matshappe		HandlingSync	/NC/_N_NC_CD5_ACX/TEILESTATUSFUTTER_DMC[2]	
bkChids:         Handlingsync         -           bKChids:         Handlingsync         -           bKChids:         Handlingsync         -           bKChids:         Handlingsync         -           CVH         Handlingsync         -           CVH         Handlingsync         Chander/drawsetter/th/Ldv11         -           CVH         Handlingsync         Chander/drawsetter/th/Ldv11         -           CVMC         Chander/drawsetter/th/Ldv11         -         -           Specificatura         Output         Chander/drawsetter/th/Ldv11         -		HandlingSync		
BKChinder2         Handlingfyree         -           BKCATMY         Handlingfyree         (PC/GRC911.D080/mder4569-C0)(A0)         -           CVM         Handlingfyree         (CAUCHO11.D080/mder4569-C0)(A0)         -           CVM         Handlingfyree         (CAUCHO11.D080/mder4569-C0)(A0)         -           CVM         Handlingfyree         (CAUCHO11.D080/mder4569-C0)(A0)         -           CVM         Handlingfyree         (CAUCHO12.D080/mder4569-C0)(A0,101)         -           CVMC         Handlingfyree         (CAUCHO12.D080/mander/A0,10,101)         -           CMADLINE         Counter         (CAUCHO12.D080/mander/A0,10,101)         122 Lef           CMALINET         Counter         (CAUCHO12.D080/Mander450/A0,10,101)         122 Lef           CMALINET         Counter         (CAUCHO12.D080/Mander450/A0,10,101)         122 Lef           GradeGatana         Counter         (CAUCHO14.D080/Mander450/A0,10,01)         -           GradeGatana         Counter         (CAUCHO14.D080/Mander450/A0,10,01)         -           GradeGatana         Counter         (CAUCHO14.D080/Mander450/A0,10,01)         -           GradeGatana         Counter         (CAUCHO14.D080/Mander450/A0,10,01)         -           GradeGatana         Counter         (CAUCHO14.	DMCIndex	HandlingSync		
Bestingtyre         Acc/01081.0000/redent/00-50(A0)		HandlingSync		
CVI         Handingsyre         -           LVId         Handingsyre         Channel/Naraveter/shi/Loll         -           LVId         Handingsyre         Channel/Naraveter/shi/Loll         -           LVId         Handingsyre         Channel/Naraveter/shi/Loll         -           LVId         Handingsyre         Channel/Naraveter/shi/Loll         -           LVID         Channel/Naraveter/shi/Loll         -           LVID         Channel/Naraveter/shi/Loll         -           DiesclorefAct         Coater         Afbereid/Naraveter/shi/Loll         11 E           GesclorefAct         Coater         Afbereid/Naraveter/shi/Loll         12 E           GesclorefAct         Coater         Afbereid/Naraveter/shi/Loll         12 E           GesclorefAct         Coater         Afbereid/Naraveter/shi/Loll         12 E           GesclorefAct         Coater         -         -           GesclorefAction         Output         Afbereid/Naraveter/shi/Loll         -           GesclorefAct         Coater         -         -         -           GesclorefAct         Output         Afbereid/Naraveter/shi/Loll         -         -           GesclorefAct         Output         Afbereid/Naraveter/shi/Loll <t< td=""><td></td><td>HandlingSync</td><td>/PLC/D8281.D88(Index+500+20)(40)</td><td></td></t<>		HandlingSync	/PLC/D8281.D88(Index+500+20)(40)	
EVet         Handinghree         Absend/Parameters/bit/200]		HandlingSync		
1414         Manual (Manuscher/Manuscher/Mal/D6)         -           1417         Handingfyrer         (Manual (Manuscher/Mal/D6)         -           1417         Gammar         APGL/0020-0001000         -           Deschortsit         Gammar         APGL/0020-0001000         -           Deschortsit         Gammar         (Channell (Manuscher/Mal/D1))         11 Le           Deschortsit         Gammar         (Channell (Manuscher/Mal/D1))         12 Le           Deschortsit         Gammar         (Channell (Manuscher/Mal/D1))         12 Le           Deschortsit         Gammar         (Channell (Manuscher/Mal/D1))         12 Le           Deschortsit         Gammar         (Channell (Manuscher/Mal/D1))         -         -           Gammarkentmin         Gammarkentmin         -         -         -         -           Gammarkentmin         Gammarkentmin         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         -         - <t< td=""><td></td><td>HandlingSync</td><td>/Channel/Parameter/r[u1,401]</td><td></td></t<>		HandlingSync	/Channel/Parameter/r[u1,401]	
INST         Handlingfyre:         A/Example/Dearsetter/hJ/15(5)		HandlingSync	/Channel/Parameter/r[u1,200]	
Pretocuti     Coster     APC/00/250.000/0000     -       Bresdounduct     Counter     A/Sherred/Parametor/(u/,1/12)     11 Lr       Todu/thict     Counter     A/Sherred/Parametor/(u/,1/12)     12 Lr       Bresdounduct     Counter     -       Bresdounduct     Counter     -       Bresdounduct     Counter     -       Bresdounduct     Counter     -       Bresdounductor     -     -       Bresdounductor     -     -       Bresdounductor     -     -       Spredetztanic     Ourput     -       Spredetztanic     Ourput     -       Spredetztanic     Ourput     -       Freedownick     Ourput     -       RequestStanucz     Ourput     -       Interseativerd     Ourput     -       Interseativerd     Ourput     -       Logtert     Ourput     -		HandlingSync	/Channel/Parameter/r[u1,50]	
Deskkart     Counter     A/Channel/Parameter/pl/(3/15)     11 E/       Took/Inb/C     Counter     A/Channel/Parameter/pl/(3/15)     123 E/       DesklowAdd     Counter     -       Bitte Counter     A/Channel/Parameter/pl/(3/57)     -       Bitte Counter     -     -       Spinded Starke     Output     -       Interseathword     Output     -       Updet     Output     -				
Tool.fabit:     Counter     A'Channel/Parameter/pi/J,011)     122 L2       Branderval     Counter     -       Branderval     Counter     -       Branderval     Output     /Channel/Parameter/pi/J,507]     -       Genderdstance     Output     -       Genderdstanuck     Output     -       Genderdstanuck     Output     -       Genderdstanuck     Output     -       Bracestance     Output     -       Inscenative     Output     -       Inscenative     Output     -       Inscenative     Output     -       Inscenative     Output     -       Loptext     Output     -	DresCountAct		/Channel/Parameter/r[u1,913]	
Distantieved         Counter         -           HR CountMonton         0xfput         /Channel/Narameton/bjl/(507)         -           Spindedstauce         0xfput         /ND/,N.NC, CDB, ACX/TELESITY/DEPUTER(0)         -           Spindedstauce         0xfput         /ND/,N.NC, CDB, ACX/TELESITY/DEPUTER(0)         -           Spindedstauce         0xfput         -         -           Spindedstauce         0xfput         -         -           Spindedstauce         0xfput         -         -           Spindedstauce         0xfput         -         -           Feedoverside         0xfput         -         -           Feedoverside         0xfput         -         -           Spindedstauce         0xfput         -         -           RequestSpinophote         0xfput         -         -           Spindedstaude         0xfput         -         -           Loptexi         0xfput         -         -			/Channel/Parameter/r[u1,911]	
III RConnstvorter 04.pt / Channel/Paraveter/b/1,967 - Spindesttause 04.pt / No./.N.NC.COB.ACX/TELESTATURE/ITTE(D) - Spindesttause 04.pt - Spindesttause 04.pt - Spindesttause 04.pt / Channel/Paraveter/b/1,966] - Reconstrain 04.pt / Channel/Paraveter/b/1,969] - Reconstrain 04.pt / Channel/Paraveter/b/1,969] - Reconstrained 04.pt / Channel/Paraveter/b/1,969] - Reconstrained 04.pt / Channel/Paraveter/b/1,969] - Reconstrained 04.pt / Channel/Paraveter/b/1,969] - Histocustinocod 04.pt /	Dresinterval			
Spindleftatus Ovrput (NO./N.NC.GOB.ACX/TELESTATUSFUTTER[1]) - Spindleftatus Ovrput - Spindleftatus Ovrput - Spindleftatus Ovrput - FreeOverside Ovrput (Channel/Parameter/n)/,506] - FreeOverside Ovrput (Channel/Parameter/n)/,506] - RequestSite/Color Ovrput (Channel/Parameter/n)/,506] - RequestSite/Color Ovrput (Channel/Parameter/n)/,506] - Hetessaffrond (Channe			/Channel/Parameter/r[u1,907]	
Sponderstandr Ourput - SpinderStanuar Ourput - SpinderStanuar Ourput - FreeCoverside Ourput //Chernel/Paraseter/sh(s)(68) - FreeCoverside Ourput //Chernel/Paraseter/sh(s)(68) - RequestStanuar Ourput //Chernel/Paraseter/sh(s)(64) - Interstativent Ourput //Chernel/Paraseter/sh(s)(64) - Interstativ	SpindleStatus		/NC/_N_NC_CD5_ACX/TEILESTATUSFUTTER[3]	
Spink/c23tarus         Output         -           Spink/c23tarus2         Output         -           Freedbarride         Datput         //Channel/Parameter/ph/S08]         -           Inscontact         Output         //Channel/Parameter/ph/S08]         -           RepectStorpSide         Output         //Channel/Parameter/ph/S08]         -           RepectStorpSide         Output         //Channel/Parameter/ph/S08]         -           Inscensit/Parameter/ph/S08         Output         //Channel/Parameter/ph/S08]         -           Inscensit/Parameter/ph/S08         Output         //Channel/Parameter/ph/S08]         -           Logitext         Output         -         -         -	SpindleStatus2			
Spindrattshutz Ourput Freedoverside Ourput //Shannel/Parameters/pl.(566) Heccostat: Ourput //Shannel/Parameters/pl.(564) BequestBooket Ourput //Shannel/Parameters/pl.(564) BequestBooket Ourput //Shannel/Parameters/pl.(564) Logted Ourput //Shannel/Parameters/pl.(564) Logted Ourput //Shannel/Parameters/pl.(564)	Spindle2Status			
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rescontaci oucput ,rchannel/Pharameter/Adv01.506] - RequestSkopCycle Ourput ,rChannel/Pharameter/Adv1.506] - RequestReamt Ourput ,rChannel/Pharameter/Adv1.506] - InsteaseMineard Ourput - Logitext Ourput -	FeedOverride		/Channel/Parameter/r[u1,908]	
RegentStöglcyte Durput //Dannel/Parameticn/bit.969 - RegenstRenet Ourput //Dannel/Parameticn/bit.964 - Helessaffrærd Ourput - Loglest Ourput -			/Channel/Parameter/r[u991,908]	
Regentitional Output /Channel/Parameter/bit/204 - Interstativent Output - Logiter: Output -	RequestStopCycle		/Channel/Parameter/r[u1,909]	
HRRESHARWOOD OUTPUT - Loylex: Output - 	RequestReset		/Channel/Parameter/r[u1,904]	
Layter. 0.4504 -	HriResultword			
	Logtext	Output		

Fig. 30Menu Control tags opened

# 3.6.2 VSE basic settings menu - vibration sensor system



Fig. 31 Close VSE basic settings menu

G präwema hri	III 😣
🖿 Files 🗠 Spectrum 🖽 HRI Overview 🔳 HRI-Bar 🂠 Settings 😢 User Logs	Ø ⊕ en ▾ 3
♦ VSE Base settings     1     VSE1     7     7     102 168 1 80	3 REMOVE VSE
1     192.100.1.00     8 ✓ ISAnresa       9     C1-Spindle_X     15       Input-Channel     Name     Handling       2     C1-Spindle_X     0	17 ^ 16 🔽 islEPE
10 C1 Spindle_Y	v
11) C1-Spindle_Z	×
12 E1-Spindle	×
	(18 - + (19



ltem	Name	Function	Description
1	VSE1	Display field	VSE no. 1
2	VSE2	Display field	VSE no. 2
3	Remove VSE	Button	Remove VSE
4	Arrow	Drop-down menu	Open / close VSE menu

5	SAVE	Button	Save input for the VSE basic settings
6	ADD VSE	Button	Add input for the VSE basic settings
7	IP	Input field	Display of IP address of VSE
8	isAnresa	Checkbox	Use of ANRESA firmware
9	C1 spindle-X	Drop-down menu	Input vibration sensor 1
10	C1-Spindle_Y	Drop-down menu	Input vibration sensor 2
11	C1-Spindle_Z	Drop-down menu	Input vibration sensor 3
12	E1-Spindle	Drop-down menu	Input vibration sensor 4
13	Input channel	Input field	Sensor input of VSE (1-4)
14	Name	Input field	Name of vibration sensor
15	Handling	Input field	Select processing side that should be monitored
16	isIEPE	Checkbox	IEPE sensor (current)
17	Arrow	Drop-down menu	Open the individual vibration sensors 1-4
18	-	Button	Deletion of a vibration sensor
19	+	Button	Addition if a vibration sensor

In the VSE basic settings menu, the individual VSE evaluation units of the manufacturer, IFM, are shown. Normally, one or two VSE evaluation units are used with the **ANRESA** firmware.

4 inputs (9-12) of the vibration sensors can be connected to each VSE evaluation unit.



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### NOTE!

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

### Example (fig. 31)

In a SynchroForm machine, a single-axis sensor VSA001 (3) for the E1-spindle and a three-axis sensor VSM103 for the C1-spindle are connected.

The single-axis sensor VSA001 is connected to the sensor input 1 (3), and setup as an IFM standard vibration sensor.

The three-axis sensor VDM103 is connected to the inputs 2-4 (4-6), and set up as an IEPE sensor (current). Each axis of the sensor requires a separate input on the VSE evaluation unit.



#### INSTRUCTION

To open and close the drop-down menu, click on the arrow.

## 3.6.2.1 Settings for handling

ltem	Handling number	Active sensor on the SynchroFine
	0 One of the two spindle sensors is active	
15 1 Sensor on the C1 spindle is ac	Sensor on the C1 spindle is active	
	2	Sensor on the C2 spindle is active

ltem	Handling number	Active sensor on the SynchroForm	
15	1	Sensor on the C1/E1 spindle is active	
15	2	Sensor on the C2/E2 spindle is active	



## INSTRUCTION

Depending on the sensor, enter the corresponding handling number in the input field (15).



# 3.6.3 Commissioning menu



#### Fig. 33 Commissioning menu - search of VSE evaluation units

Item	Name	Function	Description
1	FIND	Button	Search for the evaluation units of the VSE vibra- tion sensors
2	RESTART HRI	Button	Restart HRI backend
3	SET VSE IP ON BASIS OF MAC	Button	Set a new IP ADDRESS
4	MAC address	Input field	Enter MAC address of the VSE that should be given a new IP
5	New IP	Input field	Enter IP address that is to be assigned.
6	Net Mask	Input field	Enter subnet mask that is to be assigned.
7	Gateway	Input field	Enter gateway that is to be assigned





Fig. 34

Commissioning menu - open extended search input

Item	Name	Function	Description
8	VSE no.	Display field	VSE found

9	IP	Display field	IP address
10	Port	Display field	UDP port address
11	Subnetmask	Display field	Subnetmask
12	Gateway	Display field	Gateway
13	MAC	Display field	Media Access Control - Address
14	Host name	Display field	Host name
15	Serial	Display field	Serial number of device
16	Firmware	Display field	Software component
17	Device type	Display field	Hardware version
18	Set new IP	Input field	Enter new IP address
19	Send new IP	Button	Send new IP ADDRESS
20	FLASH ANRESA	Button	ANRESA firmware for the VSE evaluation units
21	FLASH STANDARD	Button	Standard firmware for the VSE evaluation units
22	Arrow	Drop-down menu	Open/close extended search input

In the *Commissioning* menu, a search can be made for the VSE evaluations of the vibration sensors.



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#### INSTRUCTION

To find a VSE evaluation unit, select the Search button (1).

After the search of a VSE evaluation unit, all relevant settings and information are shown in the extended search input. The IP address can be changed here.



#### INSTRUCTION

To change the IP address in the Set New IP input field (18) enter new IP address.

Furthermore, a selection can be made between the two firmware versions, **ANRESA** or **Standard**. Up to 4 sensors can be connected to the VSE evaluation units. These must be read out one after the other. With the ANRESA firmware, the channels can be read out in parallel.



#### NOTE!

The updating (flashing) of the ANRESA firmware is only possible as from hardware version 6 (16). If the installed hardware is older, the VSE evaluation unit must be exchanged to update the firmware.



#### INSTRUCTION

To select the firmware, select *the Flash* ANRESA (20) or *Flash Standard* (21) button.



If the search cannot find a VSE evaluation unit or the configuration of the IP address is not possible, the IP address can be set the aid of the MAC address.



Fig. 35 Adhesive label with MAC address on the VSE evaluation unit

The MAC address is on an adhesive label on the side of the VSE evaluation unit.

### INSTRUCTION

To make the other configuration, proceed as follows:

- Enter the MAC address on the adhesive label in the input field (3),
- Enter the new IP address in the input field (18).
- Enter the gateway (12) in the input field,
- Enter the subnet mask in the input field (11),
- Select the Set VSE IP by MAC (7) button.

To accept the changes, the HRI Backend must be restarted.



## INSTRUCTION

To restart the HRI Backend, select the button (2).



## 3.6.4 OneWire menu - temperature monitoring

Ģ	PRÄWEMA HRI				:	
🖿 File	es 🗠 Spectrum 🖽 HRI O	verview 🔟 HRI-Bar 🏟 Se	ttings 🕑 User Logs		Ø 🖯 🖨	en 🔻 i
<b>\$</b> #=	OneWire					
*	1 192.168.142.83:	50	2			
i •	Sensors		l			<b>2</b>
0 0	DeviceID	FriendlyName	Handling	Value	bearbeiten	
[→				OnewireSet	tings.DataChanged	84

Fig. 36 OneWire menu - temperature monitoring

Item	Name	Function	Description
1	Connection URL	Input field	IP address of temperature controller
2	Sensors	Input field	Enter temperature sensor and display of the measured value
3	Arrow	Drop-down menu	Open/close temperature sensor data menu
4	Saving	Button	Save sensor data

In the OneWire menu, the HRI monitoring is connected to the controller.

Temperature sensors are mounted on the tool and workpiece spindles of the machine to monitor the bearing temperature. These sensors use the OneWire bus.

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



#### INSTRUCTION

Enter the IP address of the controller in the input field Connection URL (1).

The sensors are assigned to the particular installation locations by using the serial number of the OneWire sensors.



# 3.6.5 Information menu



Fig. 37 Information menu

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◆ III → I · · · · ● ● &	<ul> <li>@angular/animations MIT</li> <li>@angular/cdk MIT</li> <li>@angular/cdk MIT</li> <li>The MIT License</li> <li>Copyright (c) 2024 Google LLC.</li> <li>Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:</li> <li>The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.</li> <li>THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.</li> </ul>	
		<b>▼</b>

Fig. 38 Information menu - extended view

Item	Name	Function	Description
1	Version Frontend	Display field	Installed frontend version
2	Version Backend	Display field	Installed backend version
3	Support	Display field	Link to PRÄWEMA HRI Support
4	SHOW 3RD PARTY LICENSES	Button	Open extended view Display licenses from third parties





5	Text field	Display field	Licenses from third parties, scroll text field read	
6	CLOSE	Button	Close extended view	

In the *Information* menu, the backend and frontend versions are shown. When faults occur, always state the program version.



### INSTRUCTION

To open the extended view, select the SHOW 3RD PARTY-LICENSES (4) button.

# 3.6.6 License management menu

Ģ	PRÄWEMA HRI			<b>a</b> d
🖿 File	s 🗠 Spectrum 🎛 HRI Overview 🔟 HRI-Ba	ar 🏟 Settings 🖉 User Logs		ø 🖨 🌐 en 🔹 🚯
÷ : * ●	5 Licence Key A1CF8-23201-C7AB5-B593D-99887-6E240 1 ADD 3 2 GENERATE REQUEST 4 GENE	Customer Test Licence PRÂWEMA REMOVE RATE TEST LIC (2 REM.)	ValidDate 9999 December	Options HRI, HRIexpert, FeedLimiter
е •				

Fig. 39 License management menu

ltem	Name	Function	Description	
1	ADD	Button	Install additional licenses	
2	GENERATE REQUEST	Button	Generate LRQ file	
3	REMOVE	Button	Delete license	
4	GENERATE TEST LIC (2 REM)	Button	Generate test license (2x possible)	
5	Lincence Key	Display field	Display installed license keys	
6	Options	Display field	Display of the licensed software component HRI / HRIexpert	

In the *License management* menu, the installed licenses are shown. The license key is generated by PRÄWEMA, and sent to the customer as a text file.



### INSTRUCTION

To install additional licenses, select the ADD (1) button.



### INSTRUCTION

To delete a license, select the REMOVE (3) button.



#### 3.6.6.1 Generate permanent / provisional license

With the information from the License Request file a permanent or provisional license can be generated. A license file is generated. This License File must be installed in the HRI to activate all functions.



## INSTRUCTION

To install additional licenses select the ADD button (fig. 39, pos. 1).

The Add a new license input window is opened.

<b>G</b> präwem	IA HRI	··· 🔊
🗖 Files 🗠 Spec	trum 🎛 HRI Overview 🔟 HRI-Bar 🌣 Settings 🗭 User Logs	🖉 🤁 🌐 en 🍸 🚯
<ul> <li>↓</li> <li>↓</li></ul>	Add a new licence You may just upload or drop a .lic file here Customer: Enter customer name Location: Enter location name Machine ID: Enter Machine ID Licence Key: Enter licence key	

#### Fig. 40 License management menu - add a new licence input window

ltem	Name	Function	Description
1	IMPORT	Button	Import LIC file
2	Customer	Input field	Enter customer name
3	Location	Input field	Enter location
4	Machine ID	Input field	Enter machine ID
5	Licenses Key	Input field	Input license key
6	SAVE	Button	Save all inputs
7	CLOSE	Button	Close input window





## INSTRUCTION

To import the LIC file, select the blue button (1).

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Fig. 41 License management menu - LIC file in the directory



#### INSTRUCTION

Select the LIC file (1) in the PC directory and import with Open button.


### 3.6.6.2 Generate permanent license

For a long-lasting license, an LRQ file must be generated.



INSTRUCTION

To create the LRQ file, select the *GENERATE REQUEST* button (fig. 39, pos. 2).

The Generate License Request input window is opened.



Fig. 42	License management men	I - Generate Licen	se Request input window
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Item	Name	Function	Description
1	Machine ID	Input field	Enter machine number
2	DOWNLOAD	Button	Save LRQ file
3	QR-Code	Display field	QR code graphic
4	Text	Display field	Text field with code
5	CLOSE	Button	Close input window





# INSTRUCTION

To create the LRQ file:

- 1. Enter the machine number in the Machine ID (1) input field
- 2. To save the generated LRQ file in the Downloads folder, select the Download (2) button



### 3.6.6.3 Generate test license

A maximum of two test licenses can be generated. The test license works until the last day of the following month.

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



### INSTRUCTION

To generate a test license, select the GENERATE TEST LIC (fig. 39, pos. 4).

The Generate TEST LIC input window is opened.



Fig. 43 License management menu - Generate Test license input window



Item	Name	Function	Description
1	Customer name	Input field	Enter customer name
2	Location	Input field	Enter location
3	Machine ID	Input field	Enter machine ID
4	Variables	Checkboxes	Select variable
5	GENARATE	Button	Create test license
6	CLOSE	Button	Close input window



# 3.6.7 Help menu



Fig. 44 Help menu

ltem	Name	Function	Description
1	Training doc- ument	Display field	Training documentation for HRI and HRIexpert
2	Navigation bar	Button	Miniature view of the individual pages for navi- gating
3	Page before	Button	Scroll one page back
4	Page no.	Button	Enter the page nos., which should be opened
5	Page back         Input field		Scroll one page back
6	6 Mag. lens Button Open search function input field		Open search function input field
7	Enlarge +	Button	Enlarge text
8	Shrink -	Button	Shrink text
9	Scroll	Button	Scroll in the document (across or vertically)

In the Help menu, the stored training documentation for HRI and HRIexpert are shown.



### INSTRUCTION

To open the input field *Text search*, click the *Lens* button (6).

The input field *Text search* is opened for the search function.



Fig. 45	Help menu - search open input field
---------	-------------------------------------

Item	Name	Function	Description
10	Search text field	Input field	Enter text for search in the document
11	Backwards	Button	Jump to the previous hit in the training docu- mentation.
12	Forwards	Button	Jump to the next hit in the training documenta- tion.



### INSTRUCTION

To close the input field *Text search* (10) click on the *Lens* button (6) again.

# 3.6.8 To the User management menu

G ı	PRÄWEMA HRI				III 🐢
📄 Files	🗠 Spectrum 🛛 🞛 HRI Overview	📕 HRI-Bar 🔅 Settings	ピ User Logs	Ø 🔒	🏶 en 🍷 🕯
¥ ≅	User mangagement Filter				
- i	ID Username	Firstname	Lastname	Mail	Roles
(1)	- 1 Admin	Admin	Admin	hrisupport@praewema.de	
•			Items per page:	5 😴 1 - 1 of 1	$\langle \rangle$
€→					
				2	3 4

Fig. 46 To the user management menu

Item	Name	Function	Description
1	User	Display field	Registered user
2	Edit	Button	Process user data
3	Delete	Button	Delete user
4	User Add (+)	Button	Add new user

In the *User management* menu, various users can be created and edited. Authorization levels were introduced to prevent unauthorized inputs.

Item	Authorization levels	Rights	
1	Operator	No authorization to change limiting values.	
	Setter	The limiting values can be changed	
	Administrator	The limiting values and settings can be changed	



### INSTRUCTION

To add a new user, select the "+" (4) button.



The Add user input window is opened.

G PRÄWEMA HRI				
		Add user		
🖿 Files	🗠 Spectrum 🖪 HRI Over	Username	Username	Ø 9 ⊕ en ▼ 8
\$	User mangagemer	Roles	2 -	
žΞ		Password	3 Password	
*	Filter	Confirm password	Confirm password	
_			4	
	ID Username	ок	CANCEL	Roles
٠	1 Admin	Admin	Admin hrisup	pport@praewema.de
0		5		
			Items per page: 6	1-1of1 < >
€÷				2 T +

#### Fig. 47 User management menu, add user input window

ltem	Name	Function	Description
1	Username	Input field	Enter username
2	Role	Selection field	Select user level
3	Password	Input field	Enter password
4	Repeat password	Input field	Repeat password
5	ОК	Button	Confirm input
6	STOP	Button	Delete input

### INSTRUCTION

To create a new user or to edit an existing user:

- 1. Enter username (1),
  - 2. Select user level (2),
  - 3. Specify password (3+4),
  - 4. Confirm all entries with the *OK* (5) button.



# 3.7 Documentation menu



#### Fig. 48 Documentation menu

Item	Name	Function	Description
1	Sequence	Display field	Stored notices with date and clock time
2	Delete	Button	Delete sequence input
3	NEW ENTRY	Button	Create new logbook entry
4	EXPORT	Button	Export course as JSON file

In the *Documentation menu*, a logbook for the machine can be created.

Notices about changes and adjustments can be entered here. So, it can be documented why HRI objects were changed and what effects this has.



### INSTRUCTION

To add a new entry, select the NEW ENTRY (3) button.



#### INSTRUCTION

To save the entry as a JSON file, select the EXPORT (4) button.

The New logbook entry input window is opened.

G PRÄWE	MA HRI					III (8)
🖿 Files 🗠 Sp	ectrum 🖽 HRI C	New log entry	1		Ø	🌐 en 🔻 🚯
History		Please input content	U			EXPORT
•	9/5/24, 6:57 AM Test with new cla					
Ó	9/5/24, 6:57 AM change limit fron Information from	EOL		SAVE		
•	9/5/24, 6:56 AM Add new order lin order 12 bw 2 lin	nit. it 100 mg reject as NOK	ŧ			
			items per Page:	1 - 3 of 3		

Fig. 49 Documentation menu - New logbook entry input window

ltem	Name	Function	Description
1	New Logbook entry	Input field	Write new entry with date and clock time
2	SAVE	Button	Save new entry in the logbook
3	STOP	Button	Stop text input



# 4 HRI<sup>®</sup> expert software component





### 4.1 What is HRIexpert?

The **HRIexpert** software component expands the range of **HRI** functions to include the frequency analysis (FFT) high-frequency data.

This function facilitates the targeted monitoring of specific orders, to effectively prevent quality failures in the workpieces produced, and detect them before the next process.

In HRIexpert, limiting values can be defined individually and in detail, and extended to orders or even limit curves.

The saving of the frequency courses creates the basis for a workpiece-related detailed analysis.

### 4.1.1 Added value with HRlexpert

The order analysis and monitoring are essential functions that require expert knowledge for parameterizing.

Extended logging functions enable a detailed recording of various machining processes. With the HRIexpert component, CSV files can be generated that are compatible with third party systems. This ensures seamless integration in various platforms.



### NOTE!

Each order corresponds to a multiple of the basic speed of the rotor.

This means that the first order corresponds to the speed of the rotor itself, the second order to the double speed, and so on.

Each order stands for a harmonic component in the vibration signal.



# 4.2 HRlexpert - visualization

# 4.3 File system menu - overview of limiting values of frequency object

G PRÄWEMA HRI									₩ 8
Files 🗠 Spectrum 🖽 HRI O	verview	비 HRI-Bar	🌣 Se	ettings ピ Us	er Logs			Ø	🌐 en 🔻 🚯
Overview Ranges Reco	rdings (No	workpiece re	elation)						
Filesystem:		a c							)
Name: changed at:	Order	Bandwidth	P	Procsteps	NC-Prog-No.	Handlir —	ıg	Limit	Reaction
MockPart1.json	15	2	3	,7,4,10,9	50	C1-Spin	dle_X	120mg	FeedLimiter
MockPart2.json 3.20.25, 10:34:30	15.1	2	3	,7,4,10,9	50	C1-Spin	dle_X	200mg	
none.json 3.20.25, 7:47:30		<u> </u>		4	<u>.</u>				
Upload limiting curve:	Тур	Min M	ax	Procsteps	NC-Prog- No.	Axis-Handl	ling		9 10 11
	Hri	0 12	2000	1,2,3,4,5,6,7,8	. 35	HandlingCh	annel1		None
	Tempera	ture 0°C 40	0°C	1,2,3,4,5,6,7,8	35	C1			StopCycle
									+ - 6
	ID	Dateiname Limiting Curv	ve		Reaktion		Update		Delete
								Einträge	

#### Fig. 50 File system menu - upper area - limiting values of frequency object

ltem	Name	Function	Description		
1	Upper range	Display range	All limiting values frequency object		
2	Order	Display field	Orders that should be monitored (feedback re- quired from the test bench)		
3	Bandwidth	Display field	Bandwidth of orders		
4	Program steps Display field		Program steps of the machining that are moni- tored		
5	NC-program numbers	Display field	NC subprograms that are monitored		
6	Handling	Display field	Select which spindle or which sensor should be monitored		
7	Limiting value	Display field	Limit value in mg which triggers the fault re- sponse when exceeded		
8	Reaction	Display field	Fault response that is triggered if the value is exceeded.		



9	+	Button	Create new frequency object		
10	-	Button	Delete selected frequency object		
11	Edit	Button	Open existing frequency object menu		



### 4.3.1 New frequency object menu - input menu for limiting values

An input menu for the *Frequency objects* is integrated into the software for easier configuration of the limiting values and to reduce the risk of incorrect inputs.

In this input menu, individual variables can be monitored and fault responses defined.



### INSTRUCTION

To open the input menu, press the *Machining* (11) button in the *file system* menu.

The New frequency object input menu is opened.

G PRÄWEMA HRI	New frequency object				III
🖿 Files 🗠 Spectrum 🖽 HRI Over	Order			Ø (	🕽 en 👻 🚯
Overview Ranges Recording	Order Bandwidth				
Filesystem: 2	Bandwidth				
Name:	NC program number		dling	Limit	Reaction
MockPart1json	Proc steps		Spindle_X	120mg	FeedLimiter
3.24.25, 2:12:06	Axis-Handling		Spindle_X	200mg	NOK
3.20.25, 10:34:30		-			
none.json 3.20.25, 7:47:30					+ - 8
	None				
Upload limiting curve:	Status Value		andling		Reaction
<mark>(8</mark> )	Staus value as number	9 10	gChannel1		None
т	e	OK Cancel			StopCycle
				1	
	Dateiname Limiting Curve	Reaktion	Update		Delete

Fig. 51 Input menu: new frequency object

Item	Name	Function	Description
1	Order	Input field	Enter which orders should be monitored.
2	Bandwidth	Input field	Enter the bandwidth of the orders.
3	NC program numbers	Input field	Various subprograms, enter channel-number, See chapter 3.2.1.3
4	Program steps	Selection field	Select program steps of the machining that are monitored, See chapter 3.2.1.4
5	Axis handling	List selection field	Select spindle or sensor which should be moni- tored, See chapter 3.2.1.5



6	Limiting value	Input field	Enter the limiting value in mg which triggers the fault response when exceeded
7	Reaction	List selection field	Fault response that is triggered if the value is exceeded.
8	Status Value	Input field	Input status text number for display in the HMI.
9	ОК	Button	close
10	Stop	Button	close



### 4.3.1.1 Responses of the machine

In the selection list, the fault responses are available for selection, which are triggered if certain values are exceeded or not reached.

These fault responses may cover various measures, such as stopping the process, triggering an alarm or displaying a warning message to indicate deviations or problems in the machining process.

G PRÄWEMA HRI					
	New frequency object				
🖿 Files 🗠 Spectrum 🖽 HRI Oven	Order			Ø	🌐 en 👻 🚯
Overview Ranges Recording	Order Bandwidth				
Filesystem:	Bandwidth				
Name: O	NC program number 35		dling	Limit	Reaction
MockPart1.json  1: 3.24.25.2:12:06	Proc steps	s	pindle_X	120mg	FeedLimiter
1!	Axis-Handling	S	pindle_X	200mg	NOK
MockPart2.json 3.20.25, 10:34:30		<b>*</b>			
none.json 3.20.25, 7:47:30	Limit				
	Reaction				
Upload limiting curve:	None		ndling		Reaction
	NOR SPC Reset FeedLimiter ContartDetertion	2	Channel1		None
Te		UK Cancel			StopCycle
					+ - 6
ID	Dateiname Limiting Curve	Reaktion	Update		Delete

Fig. 52 New frequency object menu - selection list reactions

ltem	Reaction	Description		
	None	No machine reaction		
	NOK	The part is ejected as an NOK part		
	SPC	The part is unloaded as an SPC part		
1	StopCycle	The machine stopped after the cycle.		
	Reset	EMERGENCY STOP and retraction into X-0 position		
	Feed control FeedLimiter	Feed limitation as from the infeed axis		
	Contact detection	Contact detection from tool to workpiece.		

### 4.3.1.2 Example of an order analysis

G PRÄWEMA HRI								
🖿 Files 🗠 Spectrum 🖽	HRI Over	riew 🔟 H	HRI-Bar 🔅 Se	ttings 🕜 Use	r Logs		<i>@</i> (	en 🔹 🕄
Overview Ranges	Recordin	gs (No wor	kpiece relation)					
Filesystem:								
Name:		Order	Bandwidth	Procsteps	NC-Prog-No.	Handling	Limit	Reaction
changed at: A 256 052 08 00 Z=29 (0.1).js on 2.6.23, 10:47:30		26	2	4,10	50	HandlingChannel1 HandlingChannel2	100mg	NOK
BPS.json 12.16.24, 8:00:26		(						
MockPart1.json								
Upload limiting curve:								• Seite: 50 🗸

Fig. 53 Files menu - Order analysis

In this example the 26th order (1) is monitored with a Bandwidth of two orders. Workpieces that exceed the limiting value of 100 mg are marked as NOK (2), and ejected from the production process.

This monitoring ensures a high product quality and minimizes exclusion in the assembly.



Fig. 54 Result of acoustic test stand

# 4.4 Upload limit curve

G PRÄWEMA HRI	G PRÄWEMA HRI							
🖿 Files 🗠 Spectrum 🖽 I	HRI Overview 🔟 I	HRI-Bar 🔅 Se	ttings 🛯 🖻 Use	r Logs		ø	en 🔹 🕄	
Overview Ranges	Recordings (No wo	rkpiece relation)						
Filesystem:								
Name: changed at:	Order	Bandwidth	Procsteps	NC-Prog-No.	Handling	Limit	Reaction	
A 256 052 08 00 Z=29 (0.1),js on 2.6.23, 10:47:30	26							
BPS.json 12.16.24, 8:00:26								
MockPart1.json 😑 3.21.25, 7:53:44								
Upload limiting curve:						Einträge pro	o Seite: 50 ↔ + - 2	

Fig. 55 Files menu - Upload limit curve

With the HRIanalyze+ software component, a limit curve can be created and saved as a JSON file. See chapter 5.4.4.2.

This limit curve can be read in and visualized with the HRIexpert.



### INSTRUCTION

To upload the limit curve, select the button (1) in the menu file system.

The Upload file menu window file is opened .

G PRÄWEMA HRI					1	II
🖿 Files 🗠 Spectrum 🎛 HRI Over	Ô			Upload file	<i>0</i>	en 🕋 🔅
Overview Ranges Recordir		_				
Filesystem:			Choose file	close		
Name: changed at:					Limit	Reaction
A 256 052 08 00 Z=29 (0.1)js on 2.6.23, 10:47:30			50	HandlingChannel1 HandlingChannel2		
BPS.json 12.16.24, 8:00:26						
MockPart1.json • 3.21.25, 7:53:44 Upload limiting curve:					Einträge pro	Seita: 50. 🗸

Fig. 56 Files menu - upload limit curve menu window

Item	Name	Function	Description
1	Select file	Button	Select file in the PC directory
2	Close	Button	Close menu window



### INSTRUCTION

To upload the limit curve:

- 1. Select the file (1) button in the menu window.
- 2. A browser window is opened. Select the desired file on the PC and confirm with the *Open* button.
- 3. After the upload, the loading bar changes color.



#### NOTE!

The file name of the limit curve and the file name of the workpiece, for which the limit curve should apply, must be identical, otherwise the HRI monitoring (HRIexpert) cannot assign the limit curve!



### INSTRUCTION

To check whether the limit curve has been uploaded, switch to the *Spectrum* menu. See chapter 4.6.3.



# 4.5 File system menu - Recordings

G PRÄWEMA HRI	G PRÄWEMA HRI						
🖿 Files 🗠 Spectrum 🖪		HRI-Bar 🔅 Se	ttings ピ Use	r Logs		<i>@</i> (	en - 3
Overview Ranges	Recordings (No wo	rkpiece relation)					
Filesystem: Name: changed at:	Order	Bandwidth	Procsteps	NC-Prog-No.	Handling	Limit	Reaction
A 256 052 08 00 Z=29 (0.1),js on 2.6.23, 10:47:30	26						
BPS.json 12.16.24, 8:00:26	•						
MockPart1.json							
Upload limiting curve:							o Seite: 50 🗸

Fig. 57

Files menu - Register recordings - recording function of the spectrum

 $(\mathbb{M})$ 

### **INSTRUCTION** In the *File system* menu, click register *Recordings* (1).

Register *Recordings* is opened in the Files menu.

G	PRÄWEMA HRI				:	. 8
File	s 🗠 Spectrum 🛑 🎛 HRI Overview 🔟 HRI-Bar	🔹 Settings	🖉 User Logs		<i>ø</i>	en 🔻 🗉
	Overview Ranges Recordings (No workpiece relat	iion)				
ID	Start time	Stop time		Duration	Download	Delete
37	2025-03-28T09:55:14.466Z		STOP I			
New	START		2			



Item	Name	Function	Description
1	START	Button	Start recording
2	STOP	Button	Stop recording

In register *Recordings*, a manual recording function of the vibration spectra can be started. Here the recording can also be stopped and the recording saved.





### INSTRUCTION

To start the recording, click the *START* (1) button. To stop the recording select the *STOP* (2) button.

The recording is stored as a BIN file. The recording can be opened and analyzed with the software component HRIanalyze+.



### INSTRUCTION

To monitor the recording, open the Spectrum menu.

Activating the recording function shows an additional field in the Spectrum menu.



Fig. 59 Spectrum menu - Register recordings

Item	Name	Function	Description
1	Infos Record	Display field	Info on the running recording are shown
2	FILES	Button	To the <i>Files</i> menu
3	Red point	Display flashes	Recording running

### INSTRUCTION

To stop the recording, select the STOP button in the Files menu.



### 4.6 Spectrum menu



#### Fig. 60 Spectrum menu

Item	Name	Function	Description
1	SETTINGS	Button	Open the Settings menu window (orders / fre- quencies)
2	PROCESS- DATA	Button	Open Process data menu window
3	Bar charts	Indication	Frequency objects as bar charts

In the Spectrum menu, The order objects are shown as bar charts. If the process step is not active, the bar chart (3) is light blue. If the process step is active, the bar chart is green. If the limiting values are exceeded, the bar chart (3) is red.



#### INSTRUCTION

To open the SETTINGS menu window, select the button (1).



### INSTRUCTION

To open the PROCESS DATA menu window, select the button (2).



# 4.6.1 Settings frequency / order)

The SETTINGS menu window is opened for order or frequency (1).



Fig. 61 Spectrum menu - Settings menu window - Adapt frequency or order

ltem	Name	Function	Description
1	FREQUENCY / ORDER	Button	The X-axis of the diagram is shown as a FRE- QUENCY or ORDER.
2	Y max automatic	Checkbox	Adapt value automatically
3	Y max manual	Input field	Enter fixed value
4	Line colors	Buttons	Adjust line color
5	Close	Button	Save and close the Settings menu window

In the menu window *SETTINGS*, the X-axis can be switched between the frequency and the orders in relation to the speed of the workpiece spindle.



### INSTRUCTION

Select the button (1) to change between the order or frequency settings.

### INSTRUCTION

Set the Y-axis to either a fixed value (3) or to automatically adjusted (2).



The colors of the individual lines can be individually specified.



### INSTRUCTION

To adapt the colors, select the desired *Line color* (4) button.

The Adapt line colors menu window is open.



Fig. 62 Spectrum menu - Settings menu window - Adapt line colors

ltem	Name	Function	Description
1	FREQUENCY / ORDER	Button	The X-axis of the diagram is shown as a FRE- QUENCY or ORDER.
2	Y max automatic	Checkbox	Adapt value automatically
3	Y max manual	Input field	Enter fixed value
4	Defined line colors	Buttons	Set line color
5	Close	Button	Close setting menu window
6	Color selector	Menu window	Select colors for the lines
7	Current color	Selection	Currently selected color (indicated by a white circle.
8	Color model	Button	Switch between the color models RGBA / HSLA / CMYK / HEX
9	Color model Values	Input field	Enter color values manually (numerical value)
10	Color field	Input field	Open color field menu window



11	Extended color field window	Selection field	Select color
12	Color selector	Slider	Select color
13	Transparency	Slider	Select transparency
14	ACCEPT	Button	Accept selected color
15	CANCEL	Button	Close menu window



### INSTRUCTION

Select the button (10) to open the *Extended color* field menu window. In the *Extended color* field (11) menu window, set a color and save with the *ACCEPT* (15) button.

In the color field of the color selector, various color components can be set in the color models RGBA, HSLA, CMYK or HEX.

All settings made are stored and are available the next time the page is called.



# 4.6.2 Process data

G PRÄWEMA HRI		::: <b>(</b>	୧	
🖿 Files 🗠 Spectrum 🎛 HRI Overview 🔟 HRI-Bar 🏟 Settings 🗭 User Logs	ଡ	🌐 en	-	3
Spectrum4				
Process data: Prog: 50 Program step: 4		U-Tailstock		
Display only limit curves of the current process step				
250 mg				
150 mg				
100 mg				
o mg LIL بالا برق برق برق برق برق برق برق برق وق وق وق برق SETTINGS PROCESS DATA:	8 <sup>8</sup> 1	ig fi	220	

#### Fig. 63 Spectrum menu - adapt line colors menu window

Item	Name	Function	Description
1	SubProg	Display field	Display the current NC program
2	Program step	Display field	Display the active program step.
3	Display only limit curves of the current process step	Checkbox	Only display limit curves in the current process step
4	Close	Button	Close process data menu window



### INSTRUCTION

To close the *Process data* menu window, click the button (4).

Under process data, the active NC program and the active process step are displayed. This controls the work step in which the machine processes the workpiece.

By means of a button, the limit curves are inly displayed in the current process step.



# 4.6.3 Check limit curve

After successful uploading of a limit curve (see chapter 4.4), a check can be made in the *Spectrum* menu whether or not the limit curve was taken over.



Fig. 64 Spectrum menu - checking the limit curve

The limit curve is shown in the *Spectrum* menu spectrum as a yellow limit line (1). Each active process step has been given its own limit curve.



### 4.7 Feed limitation menu - orders

G PRÄWEMA HRI								
🖿 Files 🗠 Spectrum 🎛 HRI Ov	verview <u>!</u>	HRI ال	-Bar 🔹	Settings ピ Use	r Logs	ø right	× e	en 🔻 i
Overview Ranges Record	lings (No w	orkpie	ece relatio	on)				
Filesystem:								
Name: changed at:	Order	Ban	dwidth	Procsteps	NC-Prog-No	. Handling — —	Limit	Reaction
MockPart1.json 2.14.24, 9:11:48	26	2		3,7,4,10,9	50	HandlingChannel1	100 mg	NOK
Upload limiting curve:							Items per p	• = €
	Тур	Min	Max	Procsteps	NC-Prog-No.	Axis-Handling		Reaction
	Hri	0	5000	3,7,4,10,9	50	Handling Channel 1 Handling Channel 2	<i>.</i>	None
	Force	0 %	100 %	3,7,4,10,9	50	X1,X2		FeedLimiter
	Vibration	0 mg	500 mg	3.7.4.10.9	50	C1-Spindle	1	FeedLimiter
							-	2

Fig. 65 Feed limitation menu - orders

To make the process stable, and to catch acceleration peaks, a feed limitation (Feed Limiter) was integrated in the software. So that precise process control is possible,

In the HRIexpert version, the control of the machine feed can be done by specifying threshold values for orders.

A limiting value for monitoring vibrations is programmed In the HRIexpert software component.

As soon as the specified threshold value is exceeded, there is the feed limitation.

The Feed Limiter was added to select the fault reaction (1).

If 100% of the set limiting values is exceeded, the feed is reduced by 10% steps until the vibrations stabilize. If the vibrations fall below the 100% limit, the feed is increased step by step.

In the event of exceeding the limiting value by 120%, the feed is reduced to 0%. If the vibrations fall below 100% of the limiting value, the feed is increased to 100% again in steps of 10%.





Fig. 66 Feed limitation menu - example in HRIanalyze+

The spindle "Vibration C1 spindle" (for the first 20 orders, value in mg) and FeedOverride (feed limitation) are shown in this example.

If the limiting value of 120 mg is exceeded, the feed limitation becomes active and reduces the feed of the X-axis.



# 5 HRI<sup>®</sup> analyze+ software component





# 5.1 What is HRIanalyze+?

The **HRIanalyze+** software component was developed to analyze the recorded HRI data. The program automatically detects the following file formats from the software components HRI and HRIexpert:

- HRILog
- HRIDebugLog
- HRIFFTLog
- HRIShockLog

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

For a better overview, certain parameters are preselected.

Furthermore, the following file-formats can be read in:

- XML files from Siemens Servo Trace,
- CSV files from the drive oscilloscope from Bosch Rexroth

From these read-in data, an FFT diagram can then be calculated.

# 5.2 HRIanalyze+ - visualization

### INSTRUCTION

Proceed as follows to start the HRIanalyze+ software.

1. Open the *HRIanalyze*+ file in the PC directory *HRIAnalyze*+2.1.2. The main HRIanalyze+ menu is opened.

### 5.3 Main menu HRI analyze+



```
Fig. 67 Main menu HRIanalyze+
```

Item	Name	Function	Description
1	Import	Button	Open the Import file menu window
2	Add files	Button	Open the Add files menu window
3	Unloading of files	Button	Delete files
4	Language selection	Button	Open Language selection menu window
5	Request support	Button	Open the Request support menu window
6	Settings	Button	Open the Settings menu window
7	Account	Button	Open the Current licenses menu window.



8	Exit	Button	End HRIanalyze+ program
9	v.2.1.2	Display field	Current program version
10	Export	Button	Export current view of a diagram
11	Back	Button	One work step back
12	Display table	Button	Display values as table
13	Line diagram	Button	Display values as line diagrams
14	FFT	Button	Display values as FFT diagrams
15	Display Camp- bell diagrams	Button	Display values as Campbell diagrams



### 5.3.1 Import a file

🕆 HRIan	alyze+			- 0	×
	U2.12		■ ⊭	FFT	<b>4</b> 1
Î					
S					
?		Import Files ( 0 )			
\$		2			
-					
⊗		left			
		OK Cancel			





Fig. 69 Import menu window - data directory in the PC



Item	Name	Function	Description
1	Import	Button	Open the Import file menu window
2	Directory	Button	Select directory in the PC, and open file
3	ОК	Button	Confirm the selected file and close the menu window.
4	Stop	Button	Stop the file import stop and close the menu window
5	File	File name	Select file in the PC directory
6	Open	Button	Confirm the selected file

### INSTRUCTION

To import a file:



- 1. Select the *Import* button (1).
- 2. Select the *Directory* button (2).
- 3. Select the corresponding *File* (5) in the PC directory, and confirm with *Open* button (6),
- 4. Press the *OK* button (3). The menu window closes.

The following file types that were generated with HRI and HRIexpert can be loaded:

- HRILog
- HRIDebugLog
- HRIFFTLog
- HRIShockLog

HRIanalyze+ automatically detects the file type. Furthermore, the measurements from the spectrum display can be loaded.

Set data paths for Produc	tion data and config files		
Production data (big)	C: \hridata \production		
2 Config Data	C:\hridata\config		
Logs	C:\hridata\log		

Fig. 70 Storage path in PC directory



### NOTE!

When installing the HRI, a storage path for the HRI data is sought. Later, this setting can no longer be changed!


## Production data (1)

The HRI files concerning the Production are stored in the *Production data* folder in the PC directory as HRILog, HRIDebugLog, HRIFFTLog, or HRIShockLog files.

## Config Data (2)

The settings part programs and limit curves are stored under Config Data.



NOTE!

We recommend backing up this folder with the IndraWorks project:

## Logs (3)

The logging files are stored in the *Logs* folder for error analysis.

The files are stored in the following folder:

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

The file name is built as follows:

Filetype\_NCProgSubNr\_Componentname\_Date\_Index hrilog\_50\_Component\_name\_20210114\_1

If monitoring objects are added or changed, a new file with an ascending index is created.

NC program numbers - see section 3.2.1.3.

# 5.3.2 Language selection

- HRlan	alyze+					- 0	×
	PRÄWEMA v2.1.2			•	k	FFT	ŧ
•							
Î							
<b>©</b> -	-1						
?							
\$			Language selection				
*		Diseas is	English				
8		Please IC	OK Cancel				
			3 4				

#### Fig. 71 Language selection menu window

ltem	Name	Function	Description
1	Language selection	Button	Open Language selection menu window
2	Language selection	Drop-down menu	select a language
3	ОК	Button	Confirm the selected language and close the menu window.
4	Stop	Button	Stop the language selection and close the menu window.

## INSTRUCTION



To select a language

- 1. Select the *Language selection* (1) button.
- 2. Open the drop-down menu (2), and select the corresponding language,
- 3. Press the OK (3) button. The menu window closes.



# 5.3.3 Current licenses

🕆 HRlar	alyze+			_						 	o x
	>	PRÄWEMA v2.1.2	9 e	5						8 🗠 FFT	AF.
12											
-		6	Aktuelle	Lizenzen							
			Id	ValidDate	Key	Permissions	Customer	Identifier	IsTestLicence		
S		0	36	Montag, 1. Januar 0001					False		
?		4	0000147	Montag, 1. Januar 0001	578F8-88700-81AB2-24C05-3AD7D-20093		PRÄWEMA		False		
-		l	11072003	Montag, 1. Januar 0001	578F8-887A8-C5588-D75DA-13E86-6F203		PRÂWEMA		False		
*		-									
<b>*</b>	-(	1)									
	Filter										

Fig. 72 Current licenses menu window

Item	Name	Function	Description			
1	Account	Button	Open the Current licenses menu window.			
2	Current licenses	Indication	Display data for licenses			



## INSTRUCTION

To display the current licenses:

- 1. Select the *Account* (1) button.
- 2. The Current licenses menu is open.

## 5.3.4 Export a screenshot







Fig. 74 Export a screenshot into the PC directory



Item	Name	Function	Description
1	Export	Button	Export current data
2	Diagram	Indication	Graphic representation of the parameters
3	Scroll bar	Scroll bar	Shift the chronological area
4	File name	Input field	Enter file name in the PC directory
5	File type	Selection list	Select format for saving
6	Saving	Button	Save file and close menu window.

The export of a screenshot is done in the current view, and is possible in the following formats:

- PNG
- JPG
- BMP
- PDF

## INSTRUCTION

For the e of a screenshot:



- 1. Select the *Export* (1) button.
- 2. Enter the desired *File names* (4) and select the *File type* (5) in the open PC directory.
- 3. Confirm the input with the *Save* (6) button. The directory window closes.

## 5.4 Analyze HRI files

## 5.4.1 Analysis of HRIlog files

The files are stored in the following folder: (C/D):\hridata\production\(left\right)HRILog

The file name is built as follows:

Filetype\_NCProgSubNr\_Componentname\_Date\_Index hrilog\_50\_Component\_name\_20210114\_1

If monitoring objects are added or changed, a new file with an ascending index is created.

HRIanalyze +	PRÄWEMA C		3	3	3	3	3	3	3	3	3	3	3	3
•	Time stamp	Spindle	Temp6_min	Temp8_avg	Temp8_max	TempC_min	TempC_avg	lempC_max	(Vib_min	(Vb_avg	(VIb_max)	Forcell_min	ForceB_avg	Force8_ma (
4-	16.05.2024 00:27:19.234	2	27.3	27.6	28.2	25.6	28.1	35	72	441.4	788.3	0	4.4	2
$\checkmark$	16.05.2024 00:28:01.481	1	28.2	29,4	30	30.7	32	35	70.2	471.5	573.8	0	5.5	2
©	16.05.2024 00:53:21.239	2	35.6	35.9	36.1	35	35.5	33.8	68.9	435.2	831	٥	3.1	1
~	16.05.2024 00:54:00.681	1	35.6	35.8	35.8	35	37.9	38.3	75.1	467.2	573.9	0	4.9	1
1	16.05.2024 01:13:03.028	1	26.6	36.8	37.1	40.7	40.8	41	89.9	-471.9	591.4	٥	5.6	2
÷	16.05.2024 01:13:44.370	2	36.6	36.6	36.8	35	33.8	36.1	61.5	440.4	545.6	0	2.9	1
× .	16.05.2024 01:14:24.309	1	36.6	36.6	36.6	35	40.8	41.6	102	471.9	575.1	0	4.3	2
1	16.05.2024 01:15:03.807	2	36.6	36.6	36.8	35	37.2	37.5	85.9	438.6	696.6	0	3.1	
-	16.05.2024 01:15:44.078	1	36.6	36.8	36.8	35	40.9	41.6	71.8	472.6	600.8	0	5.8	2
8	16.05.2024 01:17:32.238	2	37.1	37.1	37.1	35	36.9	37.5	91.7	429.1	556.6	0	3.7	1
	16.05.2024 01:18:11.592	1	37.1	37.1	37.1	35	40	40.1	90.9	470.5	574.7	0	4.1	1
Filter	16.05.2024 01:18:52.037	2	37.1	37.2	37.3	35	37.6	38.3	78.4	427.6	595.1	0	2.6	
	16.05.2024 01:19:31.554	1	37.1	37.3	37.3	35	40.3	40.9	69.7	472.6	573.1	0	5.7	2
	16.05.2024 01:20:11.567	2	37.3	37.3	37.3	35	38.5	39.2	57.8	427.5	789.9	0	3.5	1
	16:05:2024 01:20:50.970	1	37.3	37.3	37.3	35	40.7	41.4	85.2	473.5	500.4	0	6.1	2
	16.05.2024 01:21:30.569	2	36.6	37.3	37.5	35	39.4	39.6	60.1	430.1	564.7	0	3.6	2
	16.05.2024 01:22:10.123	1	36.6	37,4	37.5	35	41.2	41.9	113.6	481.4	575.8	0	5.5	
	16.05.2024 01:22:49.887	2	37.5	37.5	37.5	35	40	40.3	90.4	431.2	631.6	0	3	1
	16.05.2024 01:23:30.600	1	37.5	37.6	37.8	35	41.5	42.3	76	473.8	579.1	٥	5.6	2
	16.05.2024 01:24:09.917	2	37.5	37.8	37.8	35	39.6	40.5	75.7	428	619.6	0	3.1	1
	16.05.2024 01:24:49.887	1	37.8	37.8	37.8	35	42.3	42.6	75.2	474.5	577.3	0	6	2
	16.05.2024 01:25:29.087	2	37.8	37.8	38	35	40.6	40.9	63.4	434	643.4	0	3.5	1
	16.05.2024 01:26:08.711	1	37.8	37.8	38	35	42	43	124.2	483.6	584.7	٥	6	2
	16.05.2024 01:26:49.462	2	37.8	38	38	35	40.8	41.2	87,8	429.7	829.7	0	3.7	1
	16.05.2024 01:27:28.715	1	37.8	37.9	38	35	41.9	42.8	75.5	485.2	578.3	0	5.6	2
	*													18

Fig. 75 Imported HRILog file - table view

Item	Name	Description
1	Time stamp	Date and clock time
2	HRI	HRI value
3	Columns	All other parameters of sensors (temperature, current/force, vibra- tions, axes)
4	Lines	Values for each machined workpiece.

The imported file is shown as a table. Each line (4) in the table stands for a machined workpiece. Each column (3) of the table represents the values for a measured parameter or sensor.

HRI creates a file for each day, for each workpiece that is processed on the machine. All relevant information is stored as a **HRILog** file. For order objects, a shown as bar is created for each sensor.

Some columns are not shown in the HRIanalyze+. These columns are columns with text information. These HRILog files must then be opened with a text editor or a table program.



Workpieces that, for example, were read in though a DMC, this information is stored in the HRI, HRIFFTLog and HRIShockLog.

This enables workpieces to be traced from the honing process to the installation.

Fundamentally, the workpiece counter is stored in all log files.

If the machine works in simulation or standby mode, or the processing of a workpiece was stopped, the workpiece counter does not count it. This can lead to double part numbers and DMC. The simulation and standby is not recorded as from Backend version. 3.1.X.



#### NOTE!

If the processing is stopped by an EMERGENCY STOP (reset), there is a current peak, and so a high HRI value. Such workpieces must be considered separately via HRIDebugLog files.

-	bitte.														a x
	>	PRÄWEMA 12.12	5											•	нт 👘
-	1	Time stamp	Spindle	Temp8_min	Temp8_avg	Temp8_max	TempC_min	TempC_avg	TempC_max	Vib_min	Vib_avg	Vib_max	ForceB_min	ForceB_at_1	Force8_ma
Î		16052024 00:27:19.234	2	27.3	27.6	28.2	25.6	28.1	35	72	441.4	768.3	0	2	
		16.05.2024 00:28:01.481		28-2	29.4		30.7			70.2		573.8		5.5	
3		16:05:2024 00:53:21:239		35.6	359	36.1	35	35.5	35.8	68.9	435:2	831	0	3.1	
2		16.052024 00:54:00.681													
		16.05.2024 01:13:03.028													
*		16.052024 01:13:44.370		36.6	366	36.8	35	35.8	36.1	61.5	440.4	545.6		2.9	
		16.05.2024 01:14:24.309	1	26.6	26.6	26.6	25	40.9	41.6	102	471.0	\$75.1	o	4.2	
-		16.052024 01:15:03.807	2	36.6	366	36.8	35	372	37.5	85.9	438.6	696.6	0	3.1	
		16.052024 01:15:44.078	1	36.6	368	36.8	35	40.9	41.6	71.8	472.6	600.8	0	5.8	
8		16.052024 01:17:32.238		37.1	37.1	37.1		36.9	37.5	91.7	429.1	686.6			
		16.05.2024 01:10.11.592		37.1	074	37.1	39	-40	40.1	90.9	470.5	574.7		4.1	
	Filter	16.05.2024 01:18:52.037										595.1			
		16.052024 01:19:31.554		37.1	373	37.3		40.3	40.9	69.7	472.6	573.1		5.7	
		16.05.2024 01:20:11.567		37.3	373	37.3	35	38.5	39.2	57.8	427.5	789.9		3.5	
		10.05/2024 01:20:50.970		51.5	5/3	57.5	۵۵	40.7	41.4	80.2	475.0	580.4	U	0.1	
		16.052024 01:21:30.569	2	36.6	37.3	37.5	55	39.4	39.6	60.1	430.1	664.7	0	3.6	
		16.05.2024 01:22:10.123	1	36.6	37.4	37.5	35	41.2	41.9	113.6	481.4	575.8	0	5.5	
		16.05.2024 01:22:49.887	2	37.5	37.5	37.5	35	40	40.3	90.4	431.2	631.6	0	3	1
		15.05.2024 01:23:30:500	1	37.5	37.6	37.8	35	41.5	42.3	76	473.8	579.1	0	5.6	2
		16.05.2034 01:24:09.917	2	37.5	37.8	37.8	35	39.8	40.5	75.7	428	619.6	0	3.1	1
		16.05.2024 01:24:49.887	1	37.8	37.8	37.8	35	42.3	42.6	75.2	474.5	577.3	ø	6	2
		16.05.2024 01:25:29:087	2	37.8	37.8	38	35	40.5	40.9	63.4	434	643.4	0	3.5	1
		16.05.2024 01:20:08:711	1	37.6	17.8	34	35	42	43	124.2	483.6	584.7	٥	6	2
		16.05.2024 01:26:49.462	2	37.8	38	38	35	40.8	41.2	87.8	429.7	829.7	0	3.7	1
		16.05.2024 01:27:28.715	1	37.8	17.9	38	85	41.9	42.8	75.5	485.2	578.3	٥	5.6	2
		+							-						18

Fig. 76 Imported file - selected table cells

Item	Name	Function	Description			
1	Table Indication		Select table cells for calculation			
2	Line diagram Button		Display values as line diagrams			

## INSTRUCTION

To the representation of the table as a line diagram:

- 1. Select the desired table cells with the Shift key.
- 2. The Display line diagram (2) button.

#### NOTE!

We recommend always to just select some workpieces, and let them be displayed in the line diagram. The calculation of the minimal, average and maximum values requires a lot of processing power and can take a very long time for many workpieces,





The line diagram is created from the selected data in the table.

Fig. 77 View of the data as a line diagram - example

Item	Name	Function	Description			
1	Y axis	Indication	Representation of the parameter values such as in the table			
2	X axis Indication		Representation of the time axis			
3	Parameter	Checkboxes	Select parameters (columns from the table)			
4	Line diagram	Indication	Display line diagram of the values			

On the right-hand side of the line diagram, the displayed parameters can be selected or the selection can be canceled.

Information about the curve values and be shown by moving the mouse over the diagram.



#### INSTRUCTION

To select parameters in the line diagram, click the corresponding checkbox (3).

In the example, a preselection is made for the parameters HRImax, HRIavg, Partcount Dress and Lifetime Wheel.

A separate Y-axis is calculated for each column. Therefore, there can be prolonged waiting times for many order and diagnostic objects, when the diagram is calculated.

With the right mouse button, a dialog field can be opened and the information shown or hidden.





Fig. 78 Dialog field in the line diagram - line 1



Fig 70	Dialog	field in	the line	diagram	- line 2	
FIQ. 79	Dialog	neiu in	uie iiie	ulayiam	- iiiie z	

ltem	Name	Function	Description
1	Y axis	Drop-down menu	Input window, show min./max. of the Y-axis.
2	Show/hide	Drop-down menu	Input window for item show 6, 7, 8 and 9
3	Markings	Drop-down menu	
4	ScaleAllData	Button	Scaling of the Y-axis to the highest value
5	Мах	Input field	Enter the maximum value of the Y-axis 6
6	Min	Input field	Enter the minimum value of the Y-axis 5



7	Legend Show/hide	Button	Parameters, right side show or hide
8	Y-axes Show/hide	Button	Show or hide all Y-axes
9	Mouse pointer information	Button	Show or hide mouse pointer information
10	Display DMC	Button	Display DMC, if present



# 5.4.2 Set and delete filter

* HRia	alyze+													- 0	X (
-	<	Machine     Devices	V2.1.2	5									•	M RET	4
		Sensors     Working store	Time stamp	Spindle	Temp8_min	Temp8_avg	Temp8_max	TempC_min	TempC_avg	TempC_max	Vib_min	Vib_avg	Vib_max	ForceB_min	Fort
$\checkmark$	/		28/04/2022 07:37:24.934	1	19.8	19.8	19.9	21.9	24.1	25.9	20	606	767.8	0	
			28/04/2022 07:43:30.900	1	19.8	19.9	20.1	24.4	25.7	26.8	20	611.3	952.5	0.2	
		02	28/04/2022 07:47:14.921	1	19.8	19.8	19.8	26.4	27.5	28.1	20	601.7	876.1	0	
2			28/04/2022 07:51:00.129	1	19.8	19.9	20.1	27.6	28.5	29.1	20	595.6	940.2	0	
\$		D 5	28/04/2022 07:54:45.840	1	20.1	5 DC	5 DC	78.4	29.3	29.6	Z0	597.4	956.3	0.3	
\$			28/04/2022 07:59:02.822	1	(5)	Add cust	om filter		28.9	29.6	20	642.2	1001.6	0	
	2	0.8	28/04/2022 09:03:35:757	1		Aud cust	om inter		0	26.8	20	644.6	993.8	0	
	9	9	28/04/2022 09:24:19:450	1	19.8	Name				27	20	647.6	1117.8	0	
		0 11	28/04/2022 09:27:36:352	1	(6)-	Column			28.5	29.1	221.7	640.5	976.2	0	
$\otimes$		0 12	28/04/2022 09:30:54.075	1	19.8	wachine			29.6	30	210.1	635.2	993.2	0	
		14	28/04/2022 09:34:11.343	1	(7)-				30.4	30.6	205.5	636.3	1007.7	0	
	ilter	□ 15 □ 15	28/04/2022 09:37:28.981	1	(9.9	Value			30.7	30.9	207.7	638.5	1023.9	0	
		0 17	28/04/2022 09:40:46.136	1	19.9	The entered format is	not contect		(9)	31.3	202.8	540.4	1015.8	0	
		□ 18 □ 18	28/04/2022 09:44:03.460	1	8	Value 2			31.5	31.5	203	646.2	1029.2	0	
		□ 19 □ 20	28/04/2022 09:47:20.672	1	U				31.6	3 1.7	198.2	642.6	1053.7	0	
		🗆 21	28/04/2022 09:50:37.934	1	19.9			OK Cane	31.8	32	195.4	646.9	1048.2	0.1	
			28/04/2022 09:53:55.363	1	19.9				32	32.1	193.4	646.5	1069.5	0	
		24	2022 09:57:12.599	1	19.8	19.9	20	32	32.1	32.4	190.9	643	1030.7	0	
		25	4/2022 10:00:30.251	1	19.9	20	20.1	(10) (11	32.4	32.5	185.6	642.9	1193.9	0	
		Custom	28/04/2022 10:03:47.977	1	19.9	19.9	20	32.4	32.5	32.7	185.5	643.2	1111.7	0	
			28/04/2022 10:07:04.403	1	19.9	20	20.1	32.6	32.7	32.8	189.8	647.4	1104.4	0	
			28/04/2022 10:10:21.920	1	19.8	19.9	20.1	32.6	32.8	32.9	188.8	643.9	1059.4	0	
			28/04/2022 10:13:39.389	1	19.8	19.9	20.1	32.8	32.8	33	187.7	648.9	1057.5	0	
			28/04/2022 10:16:56.274	1	19.8	19.9	20	32.9	33	33.2	184.5	648.4	1095.2	0	
			28/04/2022 10:20:13.677	1	19.8	19.9	20.1	33.1	33.1	33.3	188.2	650.2	1089.1	0	
			16 III							1					14

Fig. 80 Filter function - add filter menu window

	Machine Devices	PRÄWEMA v212	*										Le 197	
	Sensors	Time stamp	Spindle	Temp8_min	Temp8_avg	Temp8_max	TempC_min	TempC_avg	TempC_max	Vib_min	Vib_avg	Vib_max	Parce8_min	F
	Working steps	28/04/2022 07:37:24.934	1	19.8	19.8	19.9	21.9	24.1	25.9	20	606	767.8	0	
	□ 2	28/04/2022 07:43:30.900	1	19.8	19.9	20.1	24.4	25.7	26.5	20	611.3	952.5	0.2	
	03	28/04/2022 07:47:14.921	1	19.8	19.8	19.8	26.4	27.5	28.1	20	601.7	876.1	0	
	□ 4	28/04/2022 07:51:00.129	1	19.8	19.9	20.1	27.6	28.5	29.1	20	595.6	940.2	0	
	0.5	28/04/2022 07:54:45:840	1	20.1	20.2	20.3	28.4	29.3	29.5	20	597.4	956.3	0.3	
1	□ 6 □ 7	28/04/2022 07:59:02:822	1	19.8	10.0	20	282	28.9	29.5	20	642.2	1001.6	0	
0	38	28/04/2022 09:03:35.757	1	19.9				24.9	26.8	20	644.5	993.8	0	
C	9	29/04/2022 09:24:19:450	1	19.8	Select the filts	custom filter ers to be deleted an	d confirm with OK.	25.2	27	20	647.6	1117.8	0	
	10	28/04/2022 09:27:36:352	1	(A)	Example 1			28.5	29.1	221.7	640.5	976.2	0	
	1	28/04/2022 09:30:54.075	1	12	Example 2			29.6	30	210.1	635.2	993.2	0	
	12	28/04/2032 09:54:11.343	1	19.9				30.4	30.5	205.5	636.3	1007.7	0	
	4	28/04/2032 09:37:28:981	1	19.9				30.7	30.9	207.7	638.5	1023.9	0	
	5	28/04/2022 09:40:46.136	1	19.9				31.2	31.3	202.8	640.4	1015.8	0	
	16	28/04/2022 09:64:03.460	1	19.9			31.3	31.5	203	645.2	1029.2	0		
	17	28/04/2022 09:47:20.672	1	19.9			OK Canci	el 31.6	31.7	198.2	642.6	1053.7	0	
	18	28/04/2022 09:50:37.934	1	19.9				31.8	32	195.4	645.9	1048.2	0.1	
	20	28/04/2022 09:53:55.363	1	19.9	20	20.1	31.9	32	32.1	193.4	646.5	1069.5	0	
C	21	28/04/2022 09:57:12:599	1	19.8	19.9	20	(10) 32	32.1	32.4	190.9	643	1030.7	0	
C	22	28/04/2022 10:00:30.251	1	19.9	20	20.1	323	32,4	32.5	185.6	642.9	1192.9	0	
C	23	28/04/2022 10:03:47.977	1	19.9	19.9	20	32.4	32.5	32.7	105.5	643.2	1111.7	0	
	1 24	28/04/2032 10:07:04:403	1	19.9	20	20.1	32.6	12.7	32.8	189.8	647.4	1104.4	0	
	□ 25 □ 25	26/04/2022 10:10:21.920	1	19.8	59.9	20.1	32.6	32.8	32.9	188.8	643.9	1059.4	0	
	Custom	28/04/2032 10:13:39.389	1	19.8	19.9	20.1	32.8	32.8	33	187.7	648.9	1037.5	0	
1	Example 1	28/04/2022 10:16:56:274	1	19.8	19.9	20	32.9	33	33.2	154.6	648.4	1095.2	0	
	Example 2	28/04/2022 10:20:13:677	1	19.6	10.0	20.1	13.1	33.1	33.1	168.2	650.2	1099.1	0	

Fig. 81 Filter function - delete filter menu window

Item	Name	Function	Description
1	Arrow	Drop-down menu	Open and close Filter menu
2	Filter	Checkboxes	Select or deselect desired filter
3	-	Button	Open Delete user-defined filter menu window
4	+	Button	Open Add user-defined filter menu window
5	Name	Input field	Enter filter name



6	Column	Drop-down menu	Which variable should be filtered
7	Operator	Drop-down menu	Should be filtered with which operator
8	Value	Input field	Enter value
9	Arrow	Drop-down menu	Open and close drop-down menu
10	ок	Button	Confirm all inputs and close menu window
11	Stop	Button	Stop all inputs and close menu window
12	User-defined filter	Checkbox	Select user-defined filter to delete

After the import of a file, user-defined filters can be specified.

A filter can be set to better analyze the HRIFFTLog and the HRIShockLog files,

As well as filters on sensors and work steps, user-defined filters are also possible.

Specific frequency ranges can also be filtered. With the display, only these frequency ranges can be displayed in the lines or Campbell diagram

## INSTRUCTION

To add a user-defined filter:

- 1. Click on the Arrow (1) in the Filter drop-down menu,
- 2. Select the + (4) button. The Add filter menu window is open,
- 3. Enter a name for the filter in the Name (5) input field,
- 4. Select a designation in the Column (6) drop-down menu,
- 5. Select a symbol in the Operator (7) drop-down menu,
- 6. Enter a value in the Value (8) input field,
- 7. With the OK (10) button confirm all inputs and close the input window.







Fig. 82 Add user-defined filter - drop-down menu column

Item	Column	Description	
	Machine	Machine number	
	Control system	Name of vibration sensor	
	Sensor	Number of the inputs of the vibration sensor	
	Step	Number of process step	
	Material	Designation of the gearing / of the workpiece	
	Resolution	Sampling rate of the vibration sensors	
	Speed	Workpiece spindle speed	
6	Part	Part counter	
	Max.	Maximum amplitude in mg	
	Max. Amplitude freq.	Frequency with which the maximum amplitude was measured	
	DMC	Serial number of workpiece	
	Impact	Maximum level of the vibration sensor	
	RMS	RMS value of the maximum level	
	Spindle	Filter by spindle number	



Frequency range

Filter by a specific frequency range



Fig. 83 Add filter - operator drop-down menu

Item	Operator	Description	
	<	Larger	
	>	Smaller	
	==	Equal to (exact correspondence)	
7	С	Contains	
	< =	Greater than or equal to	
	> =	Less than or equal to	
	><	Values between	



## 5.4.3 Analysis of HRIDebugLog files

HRI creates a debug file for each part.

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



#### SynchroFine

SynchroFine machines record the positions of the linear axes X and Z are charted, and the position of the W-axis is recorded.



## ,

**SynchroForm** SynchroForm machines record the positions of the linear axes X, Y and Z.

The files are stored in the following folder:

## (C/D):\hridata\production\(left\right)HRIDebugLog

The file name is built as follows:

Filetype\_Date\_Time\_NC-subprogram hri\_data\_debug\_2020-09-21T11-30-36\_50\_470

The components can be clearly assigned on the basis of the total number of parts.







#### SynchroFine

This example shows the honing of a workpiece.

The blue line is the position of the X-axis (1). During work step 9 (interrupted cut), the X-axis is briefly retracted.



The force component (2) and the vibration component (3) on the HRI are reduced considerably during the stroke section.

After the tool comes into contact with the workpiece again, the forces are lower than before the interrupted step.



## 5.4.4 Analysis of HRIFFTLog files

The vibration spectra are stored in the HRIFFTLog files.

A complete spectrum is stored from each sensor every 120 ms. Each line in the table contains a frequency spectrum for a workpiece.

The spectra can be visualized with HRIanalyze+ as a line diagram or as a Campbell diagram.

The files are stored in the following folder:

#### (C/D):\hridata\production\(left\right)HRIFFTLog

The file name is built as follows:

Channel\_Date\_Hour\_Componentname\_Sensorname\_Processstep\_FFT 34\_2020090208\_component\_name\_B\_honinghead\_26\_FFT

To divide the quantity of data, every two hours a new FFT and shock file is generated. The quantity of data for one day can exceed one gigabyte in the case if a processing machine with 4 sensors.

This quantity of data must be completely loaded to analyze the vibrations. Therefore, the data is divided.

On the left-hand side of the overview, filters for the files HRIFFTLog and HRIShockLog are specified. See chapter 5.4.2.

The name of the sensors is shown in the text.

## NOTE!

We recommend always to just select some workpieces, and let them be displayed in the line diagram. The calculation of the minimal, average and maximum values requires a lot of processing power and can take a very long time for many workpieces,



#### 5.4.4.1 Campbell diagram

If a Campbell diagram is to be created, a menu window is opened.



Fig. 85 Menu window query Campbell diagram

## INSTRUCTION

To represent the X-axis in the diagram:

- 1. Select either the Orders (1) buttons or
- 2. Select the *Frequency* (2) button.



Fig. 86 Campbell diagram - display of the orders (example)

Item	Name	Function	Description
1	Filter	Drop-down menu	Open and close Filter menu
2	X axis	Indication	Representation of the orders (or frequencies)
3	Y axis	Indication	Representation of time in ms
4	Color scale	Indication	Adaptation of the color scale
5	Draw anew	Button	Reset zoom



## NOTE!

When creating a Campbell diagram ensure that only one sensor is selected in the filter (1). Otherwise the creation is canceled with an error message.

In the Campbell diagrams menu, the meshing frequency and rotation frequency can be shown in the dialog menu.

+ Tooth action
Insert number of teeth.
5500 2
SelectColor
3
4
6 5 Cancel OK

Fig. 87 Campbell diagram - display of the orders

Item	Name	Function	Description
1	Number of teeth program- mable	Input field	Enter the number of teeth
2	Speed	Input field	Enter speed
3	Color field	Selection field	Select color
4	Color selector	Slider	Select color
5	ОК	Button	Confirm the inputs and close the menu window.
6	Stop	Button	Stop the input and close the menu window.



With the right mouse button, a pop-up-menu can be opened, and targeted markings added, and the color of the marking set.



Fig. 88 [	Dialog field in th	e Campbell	l diagram - s	et marking
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Item	Name	Function	Description
1	Add marking	Button	Add a marking
2	Mark rotation fre- quency	Button	Add a rotation frequency
3	Meshing frequency	Button	Add a meshing frequency
4	Markings	Drop-down menu	Open color window
5	Color field	Selection field	Select color
6	Color selector	Slider	Select color
7	ОК	Button	Confirm the inputs and close the menu window.
8	Stop	Button	Stop the input and close the menu win- dow.

# (M)

## INSTRUCTION

To show the pop-up menu Markings:

- 1. Click in the graphic with the right mouse button.
- 2. Set the desired color in the Select color menu and confirm with OK.





Fig. 89 Dialog field in the Campbell diagram - with line diagram

ltem	Name Function Description		Description	
1	Line diagram	Indication	Line diagram is displayed	
2	Marking	Indication	Set marking for a specific frequency.	
3	Draw anew	Button	Reset zoom	
4	Synchronization	Button	Synchronization between diagrams	
5	Color field	Selection field	Select color	
6	Color selector	Slider	Select color	
7	Frequency/ Order	Input field	Enter frequency or order	
8	OK         Button         Confirm the inputs and window.		Confirm the inputs and close the menu window.	
9	Stop	Button	Stop the input and close the menu win- dow.	

Another line diagram (1) appears under the Campbell diagram.

In this, the chronological course of a specific frequency or order is shown. Apart from that, the individual work steps appear. This enables a differentiation of the workpieces. Furthermore, one sees how long a workpiece was processed.



## INSTRUCTION

To adapt the line diagram under the Campbell diagram:



- 1. Shift the marking (2) on the desired frequency or order in the Campbell diagram or
- 2. Open the pop-up menu with a double click on the frequency or order input.
- 3. Enter the *Frequency* or *Order* (7) directly here,
- 4. Adapt the color (5+6) if necessary,
- 5. Use the *OK button* (8) to confirm the input and close the pop-up menu.



## 5.4.4.2 Limit curve

With a menu window, a limit curve can be created in the FFT line diagram.



Fig. 90	FFT line diagram - create limit curve
Fig. 90	FFT line diagram - create limit cur

ltem	Name	Function	Description
1	Create limit curve	Button	Open Create limite curve menu window
2	Create a limit curve from the	Drop-down menu	Create limit curve of min. average or maximum
3	Offset	Input field	Specify offset
4	Overwrite the minimum ampli- tude	Input field	Specify the minimum limit for the limit curve
5	Color field	Selection field	Select color
6	Color selector	Slider	Select color
7	ОК	Button	Confirm the inputs and close the menu window.
8	Stop         Button         Stop the input and close the men dow.		Stop the input and close the menu win- dow.

## INSTRUCTION

To show the dialog field Create limit curve:

- 1. Click in the graphic with the right mouse button,
- 2. *Create the limit curve* in the menu window, select the spectrum from which the limit curve is created,
- 3. Enter the value for the offset (3),
- 4. Enter the minimum limit (4) for the limit curve,
- 5. Set the desired line color (5+6) and confirm all entries with OK (7).



Fig. 91 Example of limit curve

In the example, the limit curve (1) was created with the following settings:

- Create limit curve of: Max
- Offset: 100
- Overwrite the minimum amplitude: 50
- Line color: Red



#### INSTRUCTION

For the fine adjustment of the limit curve, select the drop-down menu *Adjusting limit curve* (2).





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Item	Name	Function	Description
1	Limit curve	Indication	Chow the course of the limit curve
2	Settings of the limit curve	Drop-down menu	Open and close the limit curve settings menu
3	Single point	Option field	Edit limit curve as single point
4	As curve	Option field	Edit limit curve as curve
5	As block	Option field	Edit limit curve as block
6	Delete	Button	Delete limit curve
7	Diskette symbol	Button	Open the Save limit curve dialog window

After the fine adjustment of the limit curve, the limit curve can be saved in the *Limit curve settings* drop-down menu.



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## INSTRUCTION

Select the button (7) to save the limit curve.

The Save limit curve menu window is opened.



Fig. 93 Menu window save the limit curve

Item	Name	Function	Description
1	File name	Input menu	Assign the file name for the limit curve. This must agree with the name of the gearing!
2	Select VSE	Drop-down menu	Select VSE



3	Program steps	Option field	Select program steps
4	Reaction	Drop-down menu	Select fault reaction
5	ок	Button	Confirm all inputs. A JSON file is saved. Close the menu window.
6	Stop	Button	Stop all inputs and close menu window

#### INSTRUCTION

In the save menu window, Save the limit curve as follows:

- 1. Enter file name (1),
- 2. Select the desired VSE in the drop-down menu (2),
- 3. Select the program steps (3),
- 4. Select the reaction in the drop-down menu (4),
- 5. With the OK button, confirm all inputs and close the menu window.



#### NOTE!

The file name (1) of the limit curve and the file name of the workpiece, for which the limit curve should apply, must be identical, otherwise the HRI monitoring (HRIexpert) cannot assign the limit curve!

## NOTE!

The stored settings of the limit curve cannot be changed later on the machine!

The limit curve stored as a JSON file can be uploaded in the limit curve menu with HRIexpert, see chapter 4.4.

After successfully uploading a limit curve, a check can be made in the *Spectrum* menu whether the limit curve was taken over, see section 4.6.3.



## 5.4.5 Analysis of HRIShockLog files

The fourth type of log files are the HRIShockLog files. With these files, a breakage of a tool can be detected.

## The files are stored in the following folder: (C/D):\hridata\production\(left\right)HRIShockLog

The file name is built as follows:

Channel\_Date\_Hour\_Componentname\_Sensorname\_Processstep\_Shock 50\_2020090208\_Componentname\_B\_HoningHead\_2\_Shock



Fig. 94 Imported HRIShockLogFile - line diagram

The example of an HRIShockLog file shows a SynchroFine with two workpiece spindles. In each case of the processing, there is only one workpiece spindle in the grip. For filter setting and deleting HRIShockLog files see section 5.4.2.



## 5.5 Analyzing other sources

With the software version HRIanalyze+, measuring files from other programs can also be opened.

Currently, measurements from the following sources can be opened:

- Siemens Trace
- Bosch Rexroth drive oscilloscope



NOTE! Change the measurements fro

Change the measurements from the Bosch Rexroth drive oscilloscope into a CSV format before reading them in.

## 5.5.1 Analyzing Siemens Trace

After opening the Siemens Trace measuring file, the measured signal are displayed.



**NOTE!** Only applies to machines with Siemens controllers (here SynchroForm).

## 5.5.1.1 Line diagram

T HRIan	nalyze+									- ð x
-	>	V2.1.2	~							
		Filename	Signal	Key	Name	Description	Interval	MinV	MaseV	
Î		Z2_Testfahrt_F500.xml	ft	62	/Nck//SD/nckServcDataCtrlDev64 [u1, 2]	Regeldifferenz Z1	0.002	-0.00430283203125	0.00052626953125	
-		Z2_Testfahrt_F500.xml	12	\$11	/Nck/ISD/nckServoDataCtriDev64 [u1, 5]	Regeldifferenz Z2	0.002	-0.078539533691405	0.034625969238281	
G		Z2_Testfahrt_F500.xml	ß	512	/Nck/ISD/nckServoDataActPos2ndEnc64 [u1, 2]	Lageistwert Z1	0.002	0	1	
7		Z2_Testiahrt_F500.xml	64	513	/Nck/ISD/nckServoDataActPos2ndEnc64 [u1, 5]	Lageistwert Z2	0.002	0	-1	
	1)—	Z2_Testfahrt_F500.xml	5	\$14	/Ndt/ISD/nckServoDataDrvLoad64 [u1, 2]	Auslastung Z1	0.002	0	1	
	1	Z2_Testlahrt_F500.xml	15	\$15	/Ndx/ISD/nckServoDataDrvLoad64 [u1, 5]	Auslastung Z2	0.002	-27.350616455078125	71.86355590820312	
1744		Z2_Testfahrt_F500.xml	17	516	/Nck/ISD/nckServcDataActCurr64 [u1, 2]	Momentenbildender Stromistwert Z1	0.002	-5.47237091064453	-4.939976501464846	
-		Z2_Test/ahrt_F500.xml	18	517	/Nck/ISD/nckServcDataActCurr64 [u1, 5]	Momentenbildender Stromistwert Z2	0.002	-8.830464172363282	18.737178039550784	
8	Filter									

Fig. 95 Table view of Siemens Trace

## INSTRUCTION

To represent the Siemens Trace measured values as line diagrams:

- 1. Import Siemens Trace measuring file,
- 2. Select the desired table cells (1) with the Shift key,
- 3. The Display line diagram (2) button.





Fig. 96 Example of line diagram - Siemens Trace -

With the right mouse button, a dialog field can be opened in the line diagram, and the individual signals can be shown and hidden (1).

Item	Name	Function	Description	
1	Y axis	Drop-down menu	Input window, show min./max. of the Y-axis.	
2	Show/hide	Drop-down menu	Show and hide i	
3	ScaleAllData	Button	Scale the curve to the maximum value	
4	Min	Input field	Min.	
5	Мах	Input field	Max.	



#### 5.5.1.2 FFT diagram

From the signals of the Siemens Trace, spectra can also be calculated.

Before beginning the calculation, the period of time must be limited in the *FFT settings* menu window. The amplitudes of the vibrations and the frequencies change during the process. With the time limitation, specific anomalies can be targeted for investigation.

Fig. 97 FFT settings - Siemens Trace

ltem	Name	Function	Description
1	Table	Indication	Select table cells
2	FFT	Button	Display values as FFT diagrams
3	Start time in ms	Input field	Enter start time
4	Block length	Input field	Enter block length
5	Calculated end time (ms)	Display field	End of FFT calculation
6	FrameSize Display field		Number of values for FFT calculation
7	Interval	Display field	Time interval of recording in ms
8	SampleRate	Display field	Sample rate of the recording in Hz
9	ок	Button	Confirm the input entries and close the menu window.
10	Stop	Button	Stop the input and close the menu window.



## INSTRUCTION

To represent the Siemens Trace measuring file as an FFT diagram:

- 1. Select the desired table cells (1) with the Shift key,
- 2. Select the FFT (2) button.
  - The FFT settings menu window is open,
     Enter Start time and Block length into the input fields (3+4),
  - 4. Use the *OK* button (9) to confirm the input and close the menu window.



## NOTE!

The block length (4) must be an exponent of 2.



Fig. 98 Example FFT- line diagram - Siemens Trace

In this example, the travel to Z+ would be considered, with following settings: Start time: 16,000 ms Block length: 4096



## 5.5.2 Analyze Rexroth INDRA Works

When measuring in a SynchroFine, the honing ring is stopped just before the end of the machining.

At the position of the X-axis, it can be seen how the process gets out of control and leads to breakage (1) of the honing ring.



Fig. 99 Example: line diagram - REXROTH INDRA Works - tool breakage

#### **HRI in SynchroFine machines.** 6

#### 6.1 SynchroFine process parameters

In SynchroFine machines, the following parameters are determined for the calculation of the HRI value:

- Temperatures of the B-axis and C-axis
- Current / force from the B-axis, C-axis, X-axis and Z-axis
- Values from the Vibration sensors of the B-axis, C-axis and U-axis



Fig. 100 Axes of a SynchroFine machine

В	Tool spindle, honing	X1
		X2
C1	Workpiece spindle, right	
C2	Workpiece spindle, left	Z1
		Z2
U	Dolly cross slide	Z3
		Z4
W3	Turret loader, right	
	<b>T</b> (1 1 1 ()	

W4 Turret loader, left Workpiece spindle cross slide, right Workpiece spindle cross slide, left

- Workpiece spindle saddle slide, right
- Workpiece spindle saddle slide, left
- Turret loader saddle slide, right
- 4 Turret loader saddle slide, left



## 6.2 Machine description



Fig. 101 Module overview, external honing machine SynchroFine (example)

- 1 Main switch
- 2 Control cabinet
- 3 Workpiece spindle C1
- 4 Tool spindle C2
- 5 Test station, left
- 6 Tool spindle honing head
- 7 Test station, right
- 8 Loading gantry
- 9 Conveyor belt

- 10 SPC parts drawer right
- 11 NOK parts drawer right
- 12 SPC parts drawer left
- 13 NOK parts drawer left
- 14 Turret loader, right
- 15 Control panel (HMI + HRI)
- 16 Pneumohydraulic / dolly
- 17 Turret loader, left

The **SynchroFine high performance gearing external honing machine** can be designed as a single spindle or as a double spindle machine (types HS-A-W or HSD-A-W).

The machine is a self-loading machine which picks up the workpiece with the clamping system, aligns it electronically, checks the tolerance range, and moves the workpiece into the machining station. The machine works using the hobbing method.

The machine is designed for machining wheels and shafts, and set up for automatic operation.



The X and Z axes are driven by an electric linear motor, and all the other CNC axes are equipped with wear-free, highly dynamic AC servomotors adapted to the requirements. All linear axes are monitored using a length measurement system.

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.

To increase the total rigidity of the machine system the tool pivot W is pneumatically clamped. The individual drives of the position-controlled axes are equipped with suitable highly dynamic motors and controllers.

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.

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 electronic control unit is divided according to power supply and control sectors and housed in two separate switch cabinets. The control cabinet is connected on the machine's rear side to the machine frame via the consoles.

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

All movable machine guides and a large number of the adjustable guides are lubricated at settable intervals by a central lubricating unit. The usual monitoring devices and limit switches are available. The axis drives of the working axes are generally designed as continuously adjustable servomotors with incremental travel measurement, either as encoder or linear scale.

The machine has a comprehensive operator-guided fault diagnosis program to monitor the operational sequence in setup and automatic modes. This is displayed and can be observed on an operator console mounted next to the safety door of the machine. Interfaces to central computers are possible.

The safety cabin is equipped with door safeguards to exclude risks to the operating personnel to a major extent, even in the event of inattentiveness. The direct working area is enclosed separately and mechanically locked.

When machining long workpieces it is possible to use a dolly (16) It stabilizes the workpiece and permits oscillation of the Z axis without becoming loose from the workpiece.



## 6.3 Machining process

The honing process is based on a relative movement, subject to the axis angle of intersection between a spur-toothed or helical-toothed workpiece and a helical-toothed tool in the contact area.



Fig. 102 Model of the honing technology - SynchroFine

1 Workpiece 2 Honing ring tool

The machine has the conventional monitoring installations and limit switches. The rotary speed of the tool and the workpiece are in the same ratio as their numbers of teeth.

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.

There is an extensive temperature stabilization system installed in the honing oil processing system. A balanced temperature of the tool, the workpiece on the chucking device and the flushing oil is an important precondition for safe machine operation.

The ideal working temperature is between 22°C and 26°C.
#### 6.3.1 Hone tools



Fig. 103 Honing head with honing tool - SynchroFine

1 Honing head

2 Honing tool - Honing ring

The impact-sensitive honing tool (ceramic ring), the honing ring (2), is clamped in the honing head (1) by a hydraulic expansion chuck. During the honing process, the tool is flushed with honing oil via the flushing nozzles in order to remove the fine honing particles. Thus a continual honing result is guaranteed.

The honing head (1) can be swiveled by up to 90° and thus individually to the workpiece.



Fig. 104 Dressing tools - SynchroFine

- 1 Head dresser Diamond Dressing Ring (DDR)
- 2 Gearing dresser Diamond Dressing Gear (DDG)
- 3 Gearing dresser Vario Speed Dresser (VSD)

There are two dressing tools in the turret loader for correcting tool wear on the honing ring. See chapter 6.3.

These tools are collected by the chucking device 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 determines the dressing frequency.



This interval for a dressing procedure is stored in the automatic program, and is followed until the honing ring diameter has increased by approximately 5 mm (wear limit). 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.

# 6.4 Axes layout

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Fig. 105 CNC and positioning axes - SynchroFine

В	Tool spindle, honing	X1	Workpiece spindle cross slide, right
		X2	Workpiece spindle cross slide, left
C1	Workpiece spindle, right	X5	Loading gantry cross slide
C2	Workpiece spindle, left		
		Y5	Loading gantry load axis
U	Dolly cross slide	74	
		Ζ1	workpiece spinale saddle slide, right
W	Tool spindle swivel axle	Z2	Workpiece spindle saddle slide, left
 	Turret leader right	Z3	Turret loader saddle slide, right
vv3	runet loader, right	74	Turnet les den es delle alide, left
W4	Turret loader, left	Ζ4	i urret loader saddle slide, left



### 6.5 Overview of vibration sensors



Fig. 106 Overview of vibration sensors on a SynchroFine external honing machine

- 1 Workpiece spindle sensor, left (C1-axis; XYZ-direction)
- 2 Workpiece spindle sensor, right (C2-axis; XYZ-direction)
- 3 Sensor on the honing head (B-axis; XYZ-direction)
- 4 Dolly sensor (U axis, X direction)

The recording of machine vibrations is integrated in the external honing machine sensors of the manufacturer IFM.



#### NOTE!

Heed the manufacturer's documentation



Fig. 107 VSE evaluation unit in the control cabinet

The appropriate evaluation units (1) are located in the control cabinet.





# 6.5.1 Vibration sensors on the workpiece spindles

Fig. 108 Vibration sensors on the workpiece spindles - SynchroFine

1 Workpiece spindle C1/C2 2 Vibration sensor VSM103

Three-axis vibration sensors **VSM103** (2) made by IFM are installed as standard on the workpiece spindles (C-axis) (1).

#### 6.5.2 Vibration sensor on the honing head



Fig. 109 Vibration sensor on the honing head - SynchroFine

1 Honing head 2 Vibration sensor VSM103

A three-axis vibration sensor **VSM103** (2) made by IFM is installed as standard on the honing head (B-axis) (1).

# 6.5.3 Vibration sensor on the dolly



Fig. 110 Vibration sensor on the dolly - SynchroFine

1 U-axis dolly 2 Vibration sensor VSA001

A single-axis vibration sensor **VSA001** (2) made by IFM is installed on the dolly (U-axis) (1) as standard.



	<b>PRÄWEM</b>	A SynchroFine 205				Rexroth	Complete
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#### Starting the HRI software - SynchroFine 6.6

Fig. 111 HMI menu operator in the SynchroFine

- Display of processing sequence HMI
- HMI interface HRI Expert 2 Display of process status
- 3 4
- Button for the HRI Spectrum menu

In the up-to-date HoningHMI software version (as from version 6.6.2.1033, of 25.01.2019), there is a change to the HRI software in the HMI Operator menu.

The current HRI value is displayed as a bar chart (2). The value is scaled to 110% of the maximum HRI value.

If the set value is exceeded, the color changes from blue to red.

#### INSTRUCTION

Proceed as follows to change to the HRI software:

- 5. In the HMI Operator menu of the machine, select the HRI-Expert (1) button,
- 6. The main HRI menu is opened, see section 3.1.
- 7. Select the Login button,
- Enter your email and password 8.
  - in the open Login menu window, see Section 3.1.1,
- 9. Acknowledge with the Login button.



1

#### NOTE!

This function is currently only active for SynchroFine.





#### INSTRUCTION

Select the button (4) to display the HRI menu Spectrum.

### 6.7 Starting the HRI software in older SynchroFine machines



Fig. 112 HMI Operator menu in older SynchroFine machines

1 HMI interface HRI Expert

In older SynchroFine machines, the HRI-software is started in the HMI maintenance menu.

#### INSTRUCTION

Proceed as follows to change to the HRI software:

1. Select the HRI-Expert (1) button in the HMI *Maintenance* menu of the machine,



- 2. The main HRI menu is opened, see section 3.1.
- 3. Select the *Login* button,
- 4. Enter your email and password
  - in the open Login menu window, see Section 3.1.1,
- 5. Acknowledge with the *Login* button.

# 6.8 Known SynchroFine phenomena

### 6.8.1 Problematic frequencies

If the machine displays peaks in the frequency ranges, this indicates a problem in the machine.

Main frequency	Resonance frequen- cy	Description
Approx. 200 - 350 Hz		As resonance frequency of the cross slide, de- pending on the machine type
	240 Hz	On 204 HS without additional weights
	350 Hz	On 204 HS with additional weights
	240 - 300 Hz (nom. 280 Hz)	On 205 HS or 305 HS
Approx. 1.040 Hz		Resonance frequency of the spindle (housing)
Approx. 1.050 - 1.850 Hz		Resonance frequency of the clamping system incl. dolly
Approx. 3,000 - 4,000 Hz		Dolly

Tab. 8 Problematic frequencies - SynchroFine

### 6.8.2 Problematic products

If the machine displays high values in specific orders, this indicates a problem in the machine.

Order DE	Description
1. Order	Concentricity / imbalance (difficult to detect)
2. / 3. Order	Wobbling and/or incorrect position of the dolly
3. / 4. Order	Indication of worn guides of the X- or Z-axis

Tab. 9 Problematic products - SynchroFine

All order statements are based on the rotation frequency of the C-spindle.

### 6.8.3 Bearing arrangements of spindles

Honing head 205	Bearing arrangement			
Outer ring	26,36			
Inner ring	28,61			
Roller	22,64			

Tab. 10Bearing arrangements honing head 205 - SynchroFine

Honing head 305	Bearing arrangement		
Outer ring	30,65		
Inner ring	32,43		
Roller	15,73		

Tab. 11Bearing arrangements honing head 305 - SynchroFine

C-spindle ZX05-039-00K	Bearing front	Bearing rear
Outer ring	9,9	8,73
Inner ring	12,2	11,27
Roller	7,47	6,66

Tab. 12 Bearing arrangements C spindle ZN05-039-00K - SynchroFine

C-spindle ZX05-053-00K	Bearing front	Bearing rear
Outer ring	11,93	9,42
Inner ring	13,07	10,58
Roller	19,13	15,64

 Tab. 13
 Bearing arrangements C spindle ZN05-053-00K - SynchroFine

U-axis dolly	Bearing front	Bearing rear
Outer ring	8,08	8,0
Inner ring	8,92	11,98
Roller	17,7	3,95

Tab. 14Bearing arrangements U-axis dolly - SynchroFine

# 6.8.4 Causes of current peaks

Axis	Cause
B-axis honing head	Higher currents in the B-axis are usually generated by outsize workpieces or by workpieces with hard- ening distortion. One-sided machining of the component generates current peaks during honing.
C axis workpiece spindle	Small break-outs in the honing stone or imprecise positioning
X-axis feed axis	Chips in tooth root
Z-axis oscillating axis	A burr on the flank of the tooth generates a current pulse in the Z-axis. If the pneumatic pressure of the dolly is too high, the Z-axis is constantly under higher load. A broken spring on the spatter guard flap leads to higher loading of the Z-axis.

Tab. 15Causes of current peaks - SynchroFine



# 7 HRI in SynchroForm machines.

#### 7.1 SynchroForm process parameters

On SynchroForm skiving machines the following parameters are determined for the calculation of the HRI value:

- **Temperatures** of the C-axis and E-axis
- **Current / force** from the C-axis and E-axis (X-axis, Y-axis (skiving) and Z-axis)
- Values from the Vibration sensors of the C-axis (tri-axis sensor) and the E-axis



Fig. 113 Axes of a SynchroForm double spindle skiving machine

B1 Sv	vivel axis tool spindle 1	X1	Workpiece spindle cross slide 1
B2 Sv	vivel axis tool spindle 2	X2	Workpiece spindle cross slide 2
C1	Workpiece spindle 1, left	Y1	Infeed axis, tool spindle 1
C2	Workpiece spindle 2, right	Y2	Infeed axis, tool spindle 2
E1	Tool spindle 1 left (skiving)	Z1	Workpiece spindle vertical axis 1
E2	Tool spindle 2, right (skiving)	Z2	Workpiece spindle vertical axis 2

Particularly during acceleration processes, the motors can be briefly overloaded. It is important that the Siemens controls do not record any measured values exceeding 100% of the rated current. No measured values over 100% are communicated to the HRI.



#### NOTE!

When setting limiting values ensure that on machines with a Siemens controller, no values higher than 100% are input. The HRI would not trigger a fault response to limiting values over 100% of the

The HRI would not trigger a fault response to limiting values over 100% of the rated current.

#### 7.2 Machine description



Fig. 114 Module overview of SynchroForm internal honing / skiving machine (example)

- 1 Main switch
- 2 Control cabinet
- 3 Shuttle with shuttle carriage
- 4 Tool spindle E2 (Power skiving module, right)
- 5 Workpiece spindle C2

- 6 Tool turret, right
- 7 Control panel (HMI + HRI)
- 8 Tool turret, left
- 9 Workpiece spindle C1
- 10 Tool spindle E1 (Power skiving module, left)

The **SynchroForm CNC gearing processing machine** can be designed as a single spindle or double spindle machine.

Various machining processes, such as skiving (soft machining) and interior honing (hard machining) can be **performed on the machine**.

The modular construction of the SynchroForm machine provides an optimal platform to complement further modules, key technologies, such as skiving, interior honing or pointing um additional modules.

In the example, the loading and unloading the machine is done with a shuttle (3). This is located centrally behind the machine.



The vertical power skiving modules (4+10) on the left and the right is used to cut the gearing on the workpieces. For deburring the workpieces, there is a tool turret with a deburring steel and roller deburring tool installed alongside each power skiving module. The workpiece spindles C1+C2 (5+9) are mounted vertically on the compound slide, and equipped with a highly dynamic drive. The workpiece spindles are equipped with an appropriate adapter flange in order to hold the chucking device.

The workpiece spindles are electronically coupled with the tool spindles. The gear ratios can be freely selected on the operator console.

#### Skiving of the gearing:

The shuttle (3), together with the shuttle carriage, is located centrally behind the machine.

The customer places the raw parts on the raw part rack on the Shuttle carriage.

The Shuttle carriage moves the raw part forward into the machining area.

The particular workpiece spindle C1+C2 (5+9) takes over the raw part, clamps it externally and moves to a positioning device. There, the gearing is centered on an initiator.

Then the gearing on the tool spindles is machined E1+E2 (10+4).

The workpiece is then deburred on the turrets (8+6).

After the processing, the relevant workpiece spindle takes the finished part back to the pick-up position, to the shuttle carriage, and transfers the finished part to the finished part rack.

The shuttle carriage moves out of the machine to the rear. There, the finished part is unloaded by the customer.

#### Internal honing of the internal gearing

In this place, a tool change in the tool spindles E1+E2 is necessary!

Before starting the internal honing, the newly used unprofiled grinding tool (honing wheel) must be dressed. To do this, the shuttle carriage (3) with the dressing tools travels forwards on the racks into the machining area of the machine.

The respective workpiece spindle picks up the dressing tool from the rack on the shuttle carriage and moves with it to the tool spindle E1+E2. The grinding tool is dressed for the first time. A toothing is worked into the grinding tool. After dressing, the dressing tool is returned to the rack on the shuttle carriage by the corresponding workpiece spindle.

The workpiece spindle C1+C2 (5+9) receives the hardened workpiece, clamps it externally 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 testing station. Here the oversize of the raw part is checked on the rollchecker.

Internal honing of the internal gear on the tool spindles E1+E2 is carried out.

After the processing, the relevant workpiece spindle takes the finished part back to the pick-up position, to the shuttle carriage, and transfers the finished part to the finished part rack.

The shuttle carriage moves with the finished part out of the machine to the rear. The finished part is unloaded by the customer.

#### 7.3 Power skiving modules - tools

PRÄWEMA



Fig. 115 Tool spindle E1/E2 - skiving modules - SynchroForm (example)

- 1 Tool spindle E1/E2
- 2 Tool holder
- 3 Servomotor

- 4 Milling tool skiving wheel
- 5 Internal honing tool honing wheel

The skiving machine is equipped with two adjustable vertical tool spindles E1 and E2 (1) for the skiving and interior honing of the gearing.

The tool spindles each have a swivel axis (B1/B2) and a linear axis (Y1/Y2).

To machine various workpieces, the tools (4+5) need to be changed.



### 7.4 Axes layout



Fig. 116 Axes of the SynchroForm double spindle skiving machine - SynchroForm

- B1 Swivel axis tool spindle 1 B2 Swivel axis tool spindle 2
- C1 Workpiece spindle 1, left
- C2 Workpiece spindle 2, right
- E1 Tool spindle 1 left (skiving)
- E2 Tool spindle 2, right (skiving)

- X1 Workpiece spindle cross slide 1
- X2 Workpiece spindle cross slide 2
- Y1 Infeed axis, tool spindle 1
- Y2 Infeed axis, tool spindle 2
- Z1 Workpiece spindle vertical axis 1
- Z2 Workpiece spindle vertical axis 2

### 7.5 Overview of sensors



Fig. 117 Overview of vibration sensors skiving machine - SynchroForm

- 1 Workpiece spindle sensor, left (C1-axis; XYZ-direction)
- 2 Workpiece spindle sensor, right (C2-axis; XYZ-direction)
- 3 Tool spindle sensor, left (E1-axis, X direction)
- 4 Tool spindle sensor, right (E2 axis, X direction)

To record machine vibrations, sensors and evaluation units made by IFM are integrated into the skiving machine.



**NOTE!** Heed the manufacturer's documentation!



### 7.5.1 Vibration sensors on the tool spindles



Fig. 118 Three-axis vibration sensor on the tool spindles - SynchroForm

1 Tool spindle E1/E2 2 Three-axis vibration sensor

Fig. 119 A single-axis vibration sensor on the tool spindles - SynchroForm

1 Tool spindle E1/E2

2 Single-axis vibration sensor

Three-axis vibration sensors or single-axis vibration sensors can be installed on the tool spindles (1) (E-axis).





### 7.5.2 Vibration sensors on the workpiece spindles



1 Workpiece spindle C1/C2 2 Vibration sensor VSM103

Three-axis vibration sensors VSM103 (2) made by IFM are installed as standard on the workpiece spindles (C-axis) (1).



### 7.5.3 Temperature sensors on the workpiece spindles



Fig. 121 Temperature sensors on the workpiece spindles - SynchroForm

- 1 Workpiece spindle C1/C2
- 2 Connection to the spindle
- 3 Connection cable
- 4 Temperature sensor

Temperature sensors (4) are installed as standard on the workpiece spindles (C-axis) (1) of the SynchroForm machines.



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## 7.6 Starting the HRI software - SynchroForm

Fig. 122 Display HMI/HRI menu with SynchroForm machines with vertical display

1 HMI menu

2 HRI main menu

SynchroForm machines with a vertical display are permanently shown in the lower half of the HRI menu.

### 7.7 Known SynchroForm phenomena

#### 7.7.1 Bearing arrangements of spindles

E-spindles ZZ05-078-00K + ZZ05-079-00K	Bearing front	Bearing rear
Outer ring	10,92	8,26
Inner ring	13,07	10,73
Roller	4,99	3,64

Tab. 16 Bearing arrangements E-spindles ZZ05-078-00K + ZZ05-079-00K - SynchroForm

Spindle ZX05-0180-0K + ZF05-098-00K	Bearing front	Bearing rear
Outer ring	9,79	9,23
Inner ring	12,2	11,76
Roller	4,09	3,93

Tab. 17 Bearing arrangements E-spindles ZZ05-0180-0K + ZZ05-098-00K - SynchroForm

Spindle ZX05-182-00K + ZX05-201-00K + ZX05-204-00K	Bearing front	Bearing rear
Outer ring	9,74	8,72
Inner ring	12,26	11,27
Roller	7,77	3,73

Tab. 18 Bearing arrangements E-spindles ZX05-182-00K+ZX05-201-00K+ZX05-204-00K - SynchroForm

Spindle ZX05-103-00K	Bearing front	Bearing rear
Outer ring	9,31	7,85
Inner ring	11,69	10,15
Roller	4,2	3,72

Tab. 19 Bearing arrangements spindle ZN05-103-00K - SynchroForm

Spindle ZX05-103-50K	Bearing front	Bearing rear
Outer ring	9,87	7,41
Inner ring	12,12	9,58
Roller	4,67	3,72

Tab. 20Bearing arrangements spindle ZN05-103-50K - SynchroForm

Spindle ZX05-130-00K	Bearing front	Bearing rear
Outer ring	14,80	13,79
Inner ring	17,20	16,21
Roller	6,52	6,07
Bearing cage	0,46	0,46

Tab. 21 Bearing arrangements spindle ZN05-130-00K - SynchroForm



# 8 Conclusion

#### Dear Readers,

We thank you for the confidence which you have shown us by purchasing the license for the HRI software, and we hope that we are having a positive effect working processes.