SIEMENS


# Condition Monitoring Systems

## SIPLUS CMS1200

### SM 1281 Condition Monitoring

Operating instructions

Edition 09/2016

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SIEMENS

# SM 1281 Condition Monitoring

Operating Instructions




09/2016

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# Legal information

## Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

**⚠ DANGER**

indicates that death or severe personal injury **will** result if proper precautions are not taken.

**⚠ WARNING**

indicates that death or severe personal injury **may** result if proper precautions are not taken.

**⚠ CAUTION**

indicates that minor personal injury can result if proper precautions are not taken.

**NOTICE**

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

## Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

## Proper use of Siemens products

Note the following:

**⚠ WARNING**

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

## Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

## Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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# Preface

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## Purpose of this documentation

These operating instructions contain all the information required for installing, commissioning, and operating the SM 1281 Condition Monitoring. The manual also provides basic knowledge about vibration analysis and vibration diagnostics.

These operating instructions are intended for qualified personnel in the following target groups:

- Commissioning engineers
- Operating and service personnel
- I&C personnel (optional)
- Network administrator (optional)

## Basic knowledge required

These operating instructions assume knowledge of automation engineering and condition monitoring.

## Validity of the documentation

This documentation is valid for all components of the SIPLUS CMS1200 SM 1281 Condition Monitoring specified in these operating instructions and describes the current delivery state.

## Trademarks

SIMATIC® and SIPLUS® are registered trademarks of Siemens AG.

## Naming conventions

In this documentation, the terms "SM 1281, "device" and "module" are also used in place of the product designation "SIPLUS CMS1200 SM 1281 Condition Monitoring".

## History

| Edition | Remarks |
|---|---|
| 11/2015 | First edition |
| 06/2016 | Update for SM 1281 modules with firmware version V1.1 |
| 09/2016 | Update for SM 1281 modules with firmware version V2.0 |

# Documentation guide

# 2

## Introduction

The documentation of the SIMATIC products has a modular structure and covers diverse topics relating to your automation system.

The complete documentation for the S7-1200system consists of the system manual, function manuals, and manuals for the individual devices.

The STEP 7 information system (online help) also supports you in configuring and programming your automation system.

## Overview of documentation

The table below lists additional documentation required for using the SM 1281.

Table 2- 1 Documentation for the SM 1281

| Subject | Documentation | Most important contents |
|---|---|---|
| System description | System Manual S7-1200 Automation System (https://support.industry.siemens.com/cs/document/36932465/simatic-s7-s7-1200-programmable-controller?dti=0&dl=en&lc=de-WW) | • Application planning<br>• Assembly<br>• Connection<br>• Commissioning |
| Designing interference-free controllers | Function Manual Designing interference-free controllers (https://support.industry.siemens.com/cs/document/59193566/simatic-s7-1500-et-200mp-et-200sp-et-200al-designing-interference-free-controllers?dti=0&dl=en&pnid=13613&lc=de-WW) | • Basics<br>• Electromagnetic compatibility<br>• Lightning protection |

The latest manuals for SIMATIC products are available for download free of charge from the Internet (http://w3.siemens.com/mcms/industrial-automation-systems-simatic/en/manual-overview/Pages/Default.aspx).

# Safety instructions 3

## 3.1 Safety instructions

| ⚠ CAUTION |
| --- |
| Observe the safety instructions on the inside front cover of this documentation. |

SM 1281 devices correspond to the approvals printed on the rating plate. If you have questions about whether it is permissible to install the device in the planned environment, please contact your service representative.

| NOTICE |
| --- |
| Alterations to the devices are not permitted.<br>Failure to observe this requirement shall constitute a revocation of the CE approval and manufacturer's warranty. |

### Intended use

| NOTICE |
| --- |
| • The SM 1281 is a condition monitoring system for preventive monitoring of machines and plants.<br>• The SM 1281 is not a machine protection solution. The status displays output by SM 1281 in the form of LEDs, digital outputs, Ethernet telegrams, e-mails, and web pages must not be used for control purposes (e.g. for shutting down the machine). |

## Connection of sensors

**⚠ WARNING**

**Voltage hazards**

**May cause death or serious injury**

The inputs of the SM1281 feature functional electrical isolation up to 500 V.

Only those sensors may be used that ensure safe electrical isolation up to the maximum level of the potentials configured for the plant.

It is imperative that you observe the insulation values of the sensors used and take additional measures, if required, to ensure safe electrical isolation.

## Repairs

Repairs to the device may only be performed by authorized specialists.

**⚠ WARNING**

**No user-serviceable parts.**

**May cause death or serious injury**

Unauthorized opening or improperly performed repairs can cause considerable damage to property and/or danger to users.

For repairs, send the device to the Return Center in Fürth.

## Safety extra-low voltage

**⚠ CAUTION**

**Safe electrical isolation**

For the 24 V DC power supply, use only power supply units with safe electrical isolation in accordance with IEC 60364-4-41 or HD 384.04.41 (VDE 0100, Part 410), for example, in accordance with the PELV standard.

The supply voltage must be within the specified voltage range. Otherwise, function failures on the device cannot be excluded.

Applies to non-isolated system design:

Connect the terminal for GND 24 V from the 24 V power supply output to equipotential bonding for uniform reference potential. Select a connection point that is as central as possible.

**Note**

**Safety extra-low voltage**

Contact with live components can result in a mild electric shock.

- Disconnect from the power supply before starting work.
- Ensure that no wires or strands protrude from the terminals that can be touched.

# 3.2 IT security

## Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions only form one element of such a concept.

Customer is responsible to prevent unauthorized access to its plants, systems, machines and networks. Systems, machines and components should only be connected to the enterprise network or the internet if and to the extent necessary and with appropriate security measures (e.g. use of firewalls and network segmentation) in place.

Additionally, Siemens' guidance on appropriate security measures should be taken into account. For more information about industrial security, please visit (http://www.siemens.com/industrialsecurity).

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends to apply product updates as soon as available and to always use the latest product versions. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under (http://www.siemens.com/industrialsecurity).

## Protective measures for the SM 1281 system

| NOTICE |
| --- |
| Make sure that only authorized persons are granted access – both physically and in terms of data technology – to the SM 1281 system.<br>• Change the preset password of the SM 1281 ("0000") to an individual password.<br>• Keep your password safe.<br>• Data transfer, including passwords, between a client PC and the SM 1281 via a network is carried out unsecured, i.e. without encryption.<br>For secured (remote) access to the SM 1281, you must therefore use a router, for example, which establishes a secure connection with encryption and authentication. |

# Fundamentals of vibration monitoring and diagnostics

# 4

## 4.1 Introduction to vibration monitoring

To ensure that a machine is effectively protected during operation, you need to monitor the machine using specific measured variables. The most important measured variables are those that best describe the state of the machine. Mechanical vibration is of special significance in this regard.

There is a great variety of vibration types, measured variables and characteristics when describing mechanical vibration.

# 4.2 Mechanical vibration

## 4.2.1 Meaning and information content of vibration

### Term

Mechanical vibration is vibration that can be sensed and measured on the surface of objects. When dealing with machine monitoring, this especially includes the surfaces of machines, components and foundations.

Mechanical vibration is sometimes referred to as "structure-borne sound," because it is only propagated in solid structures. Audible "air-borne sound," by contrast, moves through gaseous media, such as air.

### Cause of mechanical vibration

Mechanical vibration always occurs when mass moves. Such mass may be rotating or oscillating parts of machines. It can also include gasses or fluids that collide with solid objects, however.

### Significance of vibration

Mechanical vibration has an especially high information content. In terms of machine monitoring, this information is highly significant in several respects as:

- Indicator of the machine condition
- Indication of dynamic stresses on the machine, machine base, adjacent machine components
- Indication of safety of operation, service life, and economic efficiency of machines
- Basics of machine diagnostics and vibration damping

### Meaning of vibration diagnostics

Various symptoms on running machines allow inferences to be made about the machine condition, such as an impending damage to the machine.

Fault symptoms indicating a condition include:

- Changes in air-borne noise
- Displacement of machine components
- Rising bearing temperatures
- Changed mechanical vibration characteristics

## 4.2.2 Causes of mechanical vibration

### Origins of vibration

Vibration largely originates from the centrifugal forces on rotating machine parts.

This may be caused by:

- Unbalance
- Misalignment of machine drive trains
- Bearing damage
- Gear defect
- Magnetic, hydraulic and / or other functional alternating forces

### Transmission and severity of the vibration

Vibration of the rotor and rotor shaft is excited by dynamic forces. This vibration is then transmitted, for example, via rolling element bearings. Transmission follows this path: from moving to non-moving machine parts, from there to the machine base.

Parameters by which the severity of the transmitted vibrations can be measured include the following:

- Rigidity and damping:
  – of the machine design
  – of the bearing design
  – of the machine base
- Condition of rolling element bearing lubricant
- Decoupling the machine base
- Ratio of machine mass to machine base mass

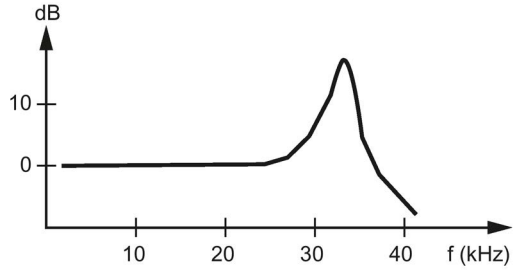
# 4.3 Measuring vibration

## 4.3.1 Acceleration sensor

### Piezoelectric sensors

Piezoelectric acceleration sensors are used for the frequencies and frequency bands to be covered for vibration monitoring with SM 1281. These sensor generate an analog voltage signal that can be further processed in response to dynamic compressive and tensile forces. Static acceleration forces, such acceleration due to gravity, are not picked up by these sensors. An industrial standard for piezoelectric sensors is IEPE (Integrated Electronics Piezo-Electric).

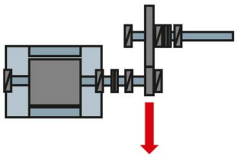
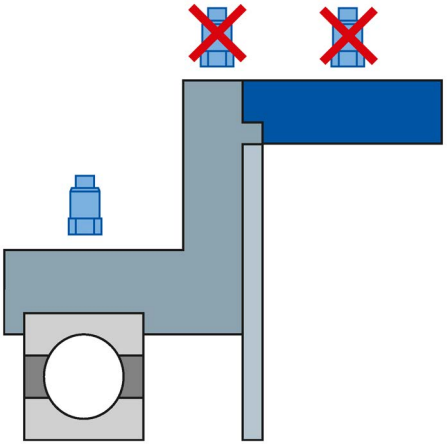
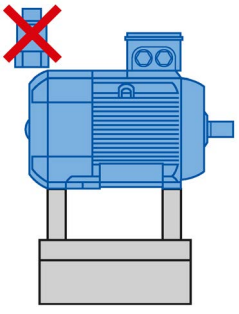
The following figure shows an example of a frequency sensor with the typical frequency response.

| Acceleration sensor | Typical frequency response (resonance at 34 to 36 kHz) |
|---|---|
|  |   |

## 4.3.2 Choice of measuring point

### Choosing the measuring point

The following gives information on how to choose the measuring point, i.e. where the acceleration sensor is to be placed.

| | |
|---|---|
| For an optimum measurement result, the measurement axis of the sensor should be oriented in the direction of the load if possible. |  <br>Example: Direction of load of gear wheel |
| The measurement path between the machine bearing and the measuring point should be as short and direct as possible<br>• The longer the signal path, the weaker vibration signals become.<br>• Material transitions damp and/or reflect the signal to be measured. |  |
| Freely vibrating or elastically deformable parts of the enclosure or cladding (e.g. fan cover) are not suitable as measuring points. |  <br>Fan cover as measuring point |

## 4.3.3 Mounting on the object to be measured

### Mounting acceleration sensors

The way the sensor is mounted will greatly influence the measurement accuracy.

A high quality of signal can only be achieved with smooth and clean mounting surfaces. Coats of paint on mounting surfaces also impair the result.

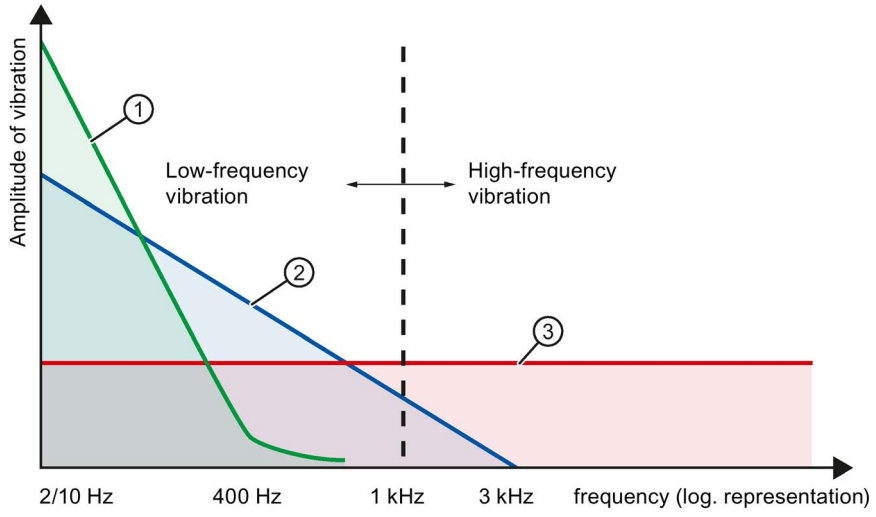
Here are some common types of fixing or mounting acceleration sensors:

| Fastening methods | | Suitability / special aspects | Frequency band |
|---|---|---|---|
|  | Direct screw fastening with threaded bolts | For flat, smooth surface | Upper frequency limit 10 kHz to 20 kHz |
|  | Screw fastening via adapter | For non-flat and/or coated surfaces | Upper frequency limit 10 kHz to 20 kHz |
|  | Adhesive bond, e.g. with superglue or epoxy resin | Depending on the temperature properties of the adhesive used | Upper frequency limit 10 kHz to 18 kHz |
|  | Fastening with permanent magnets | For fast and flexible mounting<br>Suitability depends on adhesive force, falls of at higher frequencies | Upper frequency limit typically approx. 5 kHz to 15 kHz |

## 4.3.4 Measured variable , frequencies, and energy

### Interrelationship between measured variables, frequencies, and energy

The following diagram shows how the amplitudes of the three vibration variables (displacement, velocity, and acceleration) develop as frequency rises. The diagram provides information about the frequencies up to which measurement and evaluation of a certain vibration variable can provide meaningful data.




| Item | Vibration variable | Causes of vibration and measurement limits |
|---|---|---|
| ① | Vibration displacement (µm) | Shaft vibration 1 Hz to 0.4 kHz |
| ② | Vibration velocity (mm/s) | Enclosure vibration 2 Hz / 10 Hz to 1 kHz |
| ③ | Vibration acceleration ($m/s^2$) | Gearbox, structure-borne noise 2 Hz / 10 Hz to 20 kHz |

# 4.4 Method of fault detection and diagnostics

## 4.4.1 Overview of diagnostic methods

### Method for condition monitoring

In machine monitoring, there are different ways of monitoring and diagnosing the machine condition. Only those methods are listed below that are implemented in SM 1281.

### Characteristic value formation by vibration measurement in the time range

The condition of a machine is monitored by acquiring characteristic values with which the general vibration condition of the machine can be assessed. The trends of these variables indicate whether the condition is becoming worse, i.e. incipient damage.

- vRMS: Interval rms value of the vibration velocity for monitoring the general vibration condition
- aRMS: Interval rms value of the vibration acceleration for roller bearing monitoring

### Vibration diagnostics by frequency analysis

In themselves, characteristic value measurements are not enough for precise defect location. For this purpose, the vibration pattern of the machine must be analyzed more precisely. Most types of damage are recognizable in the spectrum by the occurrence of typical damage frequencies or typical patterns of damage frequencies. The following spectra can be calculated for SM 1281 and used as a basis for vibration diagnosis and vibration monitoring:

- Vibration velocity spectrum
- Vibration acceleration spectrum
- Envelope spectrum

## 4.4.2 Types of defect and diagnostics

### Diagnostics methods

The following table shows the most frequent types of errors, which are detected via the diagnostic procedure.

| Fault type | Vibration measurement in the time range (characteristic value procedure) | Frequency analysis spectrum | | |
|---|---|---|---|---|
| | | Vibration velocity | Vibration acceleration | Envelope curve |
| Unbalance | RMS | Single rotation frequency $f_n$ | - | - |
| Misalignment, coupling defect | RMS | Single rotation frequency $f_n$<br>Double rotation frequency $f_n$ | - | - |
| Mounting defect | RMS | Single rotation frequency $f_n$<br>Double rotation frequency $f_n$<br>Triple rotation frequency $f_n$ | - | - |
| Blade passing frequency | RMS | $f_{SP} \leq 1$ kHz | $f_{SP} > 1$ kHz | - |
| Meshing defect | - | $f_Z \leq 1$ kHz | $f_Z > 1$ kHz | - |
| Belt defect | RMS | $f_R \leq 1$ kHz | $f_R > 1$ kHz | - |
| Resonance | RMS | Resonance frequency = rotation frequency $f_n$ | - | - |
| Electrical stator faults | RMS | Double line frequency $f_{line}$ | - | - |
| Electrical rotor faults | RMS | $f_{bar} \leq 1$ kHz | $f_{bar} > 1$ kHz | - |
| | RMS | Double line frequency $f_{line}$<br>Modulation with slip frequency $f_{slip}$ | -- | - |

# 4.5 Vibration diagnostics by characteristic value formation in the time range

## 4.5.1 Overview

### Applications of vibration measurement in the time range

Wide-band vibration measurement in the time range provides information about the overall condition of a machine and the effectiveness of measures taken to suppress vibration.

The development of the machine condition can be checked by comparing up-to-date measurements with previous vibration levels or by comparing with published guidance values or manufacturers' data. With this trend analysis, worsening conditions can be detected in good time and appropriate measures planned and implemented.

**Note**

Detailed fault diagnostics is not possible or only possible to a limited degree for wide-band vibration measurement based on characteristic values.

### Characteristics of vibration measurements in the time range

- The measurement methods and assessment of wide-band vibration measurements are defined and standardized in national and international guidelines and standards.
- The values of rms vibration velocity are measured and calculated over a defined frequency band.
- The range includes the frequencies 2 Hz or 10 Hz to 1000 Hz.
  Depending on the speed, the measuring range starts either at 2 Hz (speeds from 120 to 600 rpm) or at 10 Hz (speeds greater than or equal to 600 rpm) according to the DIN ISO 10816 standard.

## 4.5.2 Standards and guidelines

### Standards and guidelines

The following standards and guidelines are applicable to machine monitoring using wide-band characteristics:

| | | |
|---|---|---|
| **Standards** | EN 60034-14 | Vibration measurement, acceptance measurements at the factory |
| | ISO 10816-1 | Mechanical vibration - Evaluation of machine vibration by measurements on non-rotating parts -<br>Part 1: General instructions |
| | ISO 10816-3 | Mechanical vibration - Evaluation of machine vibration by measurements on non-rotating parts -<br>Part 3: Industrial machines with nominal power above 15 kW and nominal speeds between 120 rpm and 15000 rpm when measured in situ |
| **Guidelines** | VDI 3832 | Rolling element bearing condition, various procedures |

## 4.5.3 Monitoring measured variable trends

### Trend monitoring

The following diagram shows a typical trend curve obtained by measurement or calculation of characteristic values. Signs of an incipient fault are usually detectible long before failure, e.g. because the vibration value increases.

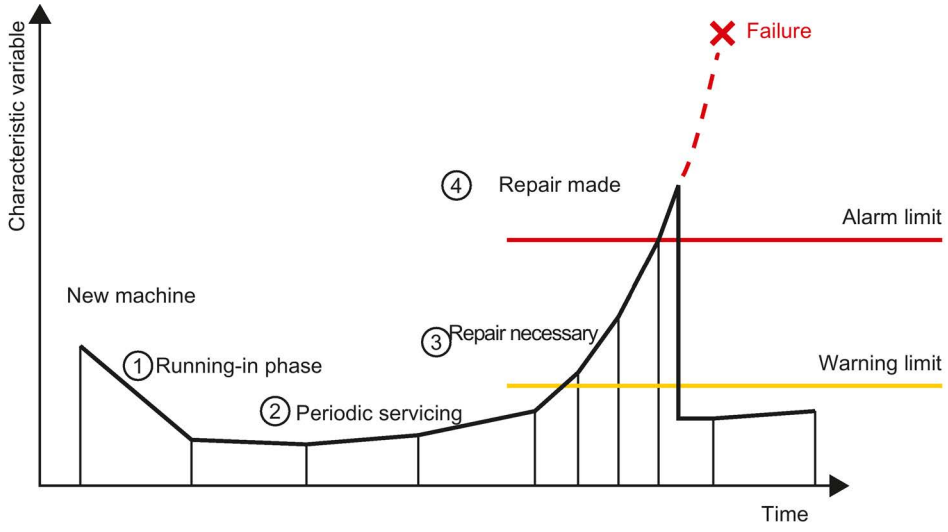



Figure 4-1 Characteristic value trend

| | |
|---|---|
| ① | The characteristic values are initially somewhat higher during the start-up phase of a new machine. The characteristics variables then decline to the values that represent the fault-free condition of the machine. |
| ② | The maintenance strategy may be periodic servicing, for example. By regular condition monitoring, developing damage can be detected as it occurs. |
| ③ | The characteristic value has exceeded a warning limit. Repair is necessary. However, the machine can still be used. Further measurements show a steep increase in the characteristic values. It is possible to extrapolate from the trend when major damage resulting in failure would occur. |
| ④ | The defined alarm limit is exceeded. The machine is now repaired. Measurements of the characteristic values again indicate the fault-free condition of the machine. |

## 4.5.4 Evaluation of the machine condition via the vibration severity (RMS)

### 4.5.4.1 Description of the diagnostic method (RMS)

#### Characteristics SM 1281

| Characteristic value | Frequency band | Monitorable |
|---|---|---|
| vRMS<br>Root mean square - speed | Configurable from 0.1 Hz to 2 kHz [1] | Speed-dependent damage |
| aRMS<br>Root mean square - acceleration | Configurable from 0.1 Hz to 10 kHz | Bearing-dependent damage |

[1] In the vibration frequency band 2 Hz / 10 Hz to 1 kHz, the interval rms value of the vibration velocity is the most meaningful analysis value. Typical excitation of machine vibrations at the frequency of rotation is in this frequency band.

#### Calculating / determining the RMS

The interval rms value of the vibration velocity is a wide-band vibration value. It is calculated as the arithmetic mean of all vibration events within a defined frequency band (e.g. 10 Hz to 1 kHz for the rms vibration velocity).

### 4.5.4.2 Application example machine analysis: Unbalance (RMS)

## Application example

Machine vibration is frequently caused by misalignment, unbalance or frames mounted under stress.

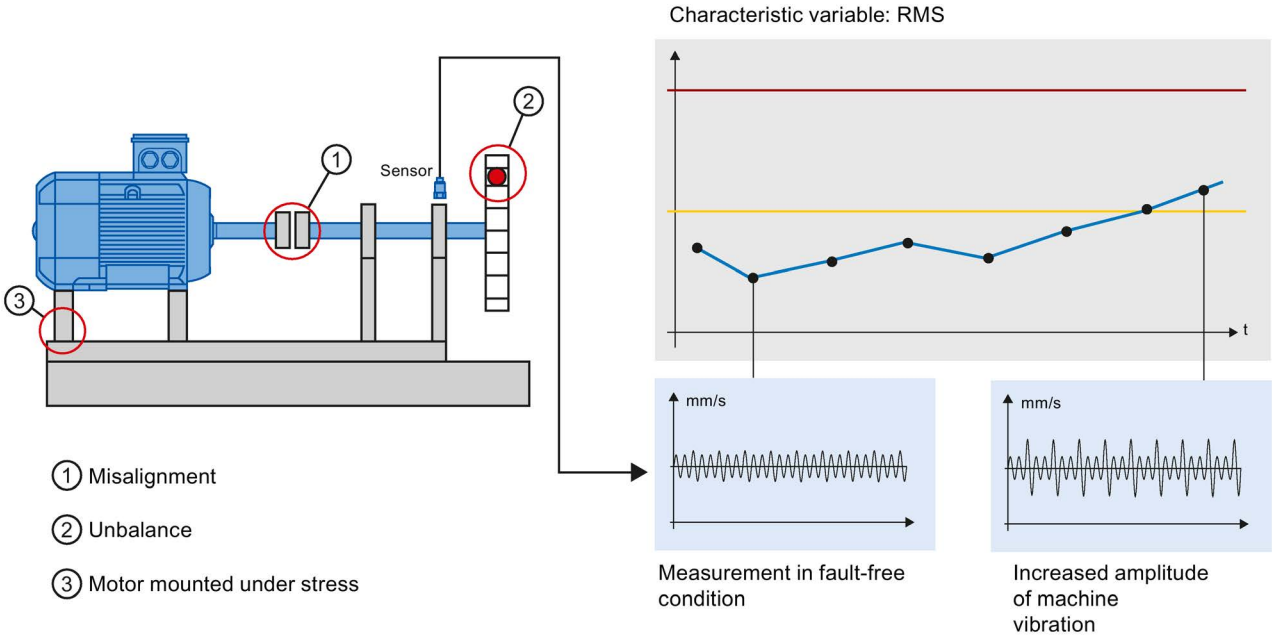



Figure 4-2 Example of RMS

# 4.6 Vibration diagnostics by frequency analysis

## 4.6.1 Overview

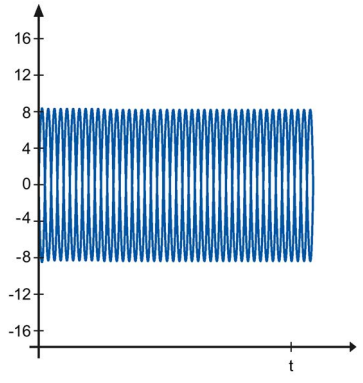
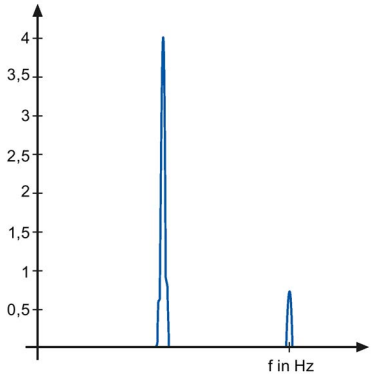
The vibration diagnostics in the time range reaches its limits when it comes to examining the causes of wear more precisely. Frequency analysis is used as the diagnostic method for more detailed examination of vibrations.

It is the basis for diagnostic vibration measurement:

1. Analyze vibration signals
2. Locate the cause
3. Define remedial action

### Frequency analysis

The principle of frequency analysis is to convert a signal from the time band into the frequency band by means of spectral analysis. One common mathematical method is the Fast Fourier Transform.

| Time signal | Frequency spectrum |
|---|---|
|  |  |

## 4.6.2 Vibration velocity spectrum

### 4.6.2.1 Description of the diagnostic method

#### Characteristics SM 1281

| Spectrum | Frequency band | Resolution | Monitorable |
|---|---|---|---|
| Vibration velocity | 2 Hz to 1 kHz | 0.204 Hz | Any combination of speed-dependent and speed-independent monitoring functions. |

Depending on the current velocity or the monitoring to be conducted, the SM 1281 automatically uses the appropriate frequency range.

#### Vibration velocity spectrum

The following figures shows the frequency band of the spectrum for the vibration velocity 2 Hz to 1 kHz and several examples of errors with their characteristic frequencies, which can be detected and revealed in this spectrum.

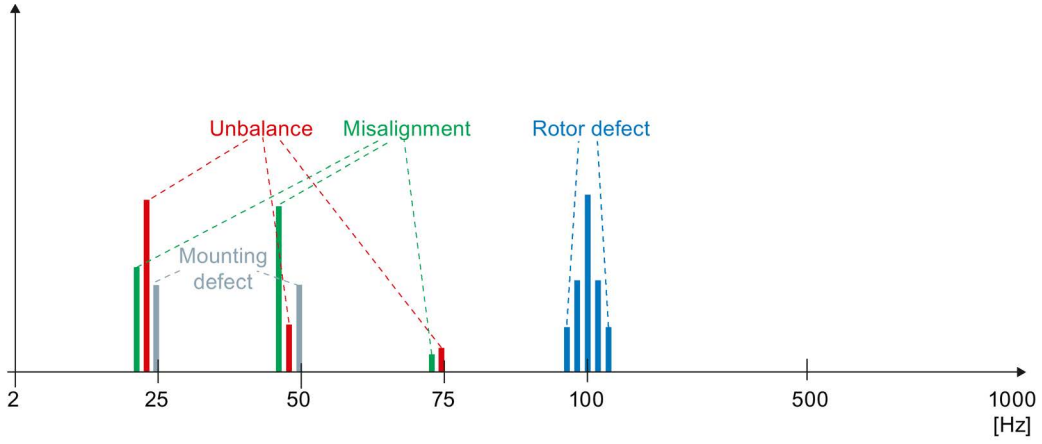



Figure 4-3 Overall spectrum of vibration velocity

### 4.6.2.2 Application example: Unbalance

## Example of unbalance

In the case of unbalance, the amplitude of the rotational frequency is very pronounced in both the horizontal and vertical directions of measurement.

The spectrum is calculated from the raw data.

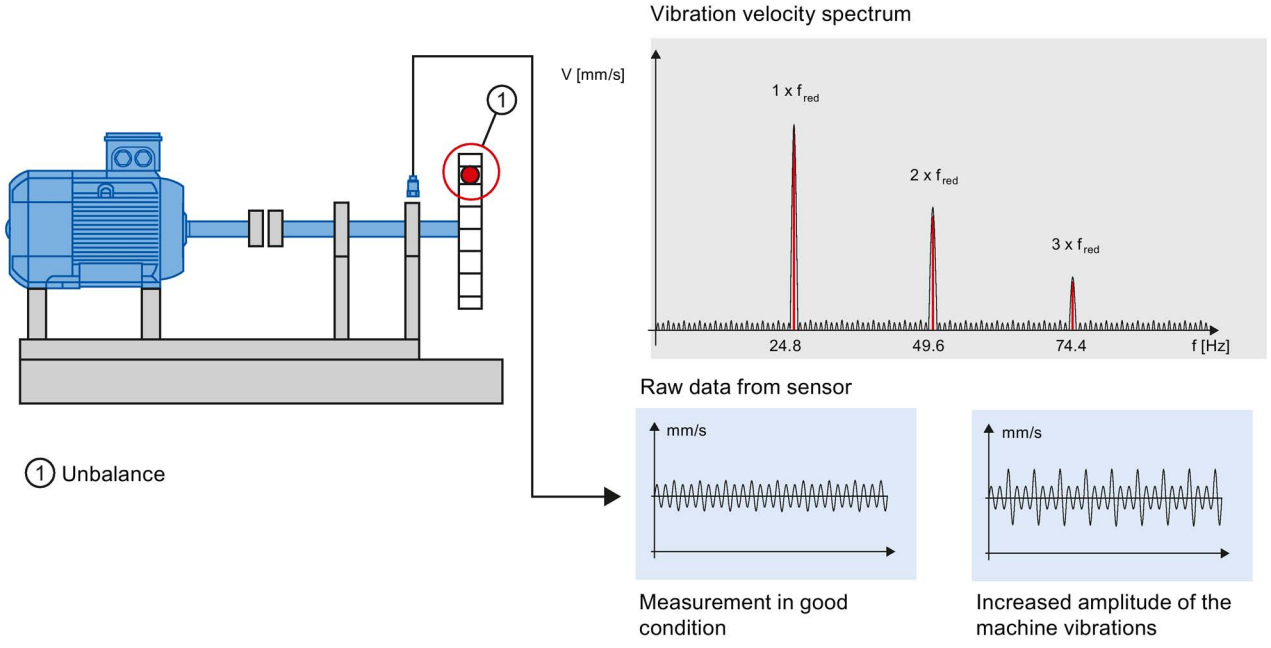



Figure 4-4 Example of a spectrum of vibration velocity (unbalance)

## 4.6.3 Vibration acceleration spectrum

### 4.6.3.1 Description of the diagnostic method

#### Characteristics SM 1281

| Spectrum | Frequency band | Resolution | Monitorable |
|---|---|---|---|
| Vibration acceleration | 2 Hz to 10 kHz | 2.86 Hz | Any combination of speed-dependent and speed-independent monitoring functions. |

#### Vibration acceleration spectrum

The following figures shows the frequency band of the spectrum for the vibration acceleration 2 Hz to 10 kHz and several examples of errors with their characteristic frequencies, which can be detected and revealed in this spectrum.

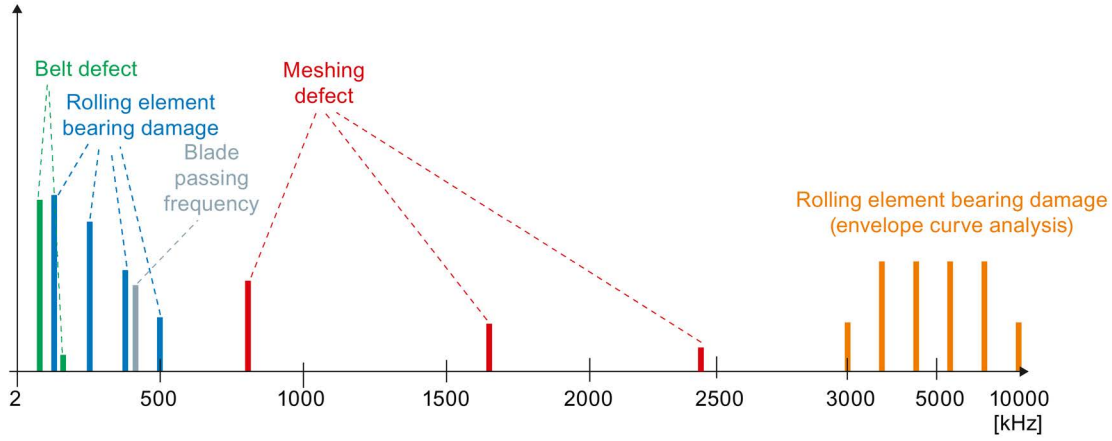



Figure 4-5 Overall spectrum of vibration acceleration

### 4.6.3.2 Application example (rotor field fault)

## Example rotor field fault

The causes of a defective rotor can be, for example, a broken or loose bar. The spectrum is calculated from the raw data.

Such faults can be detected, for example, by:

- Bar frequency with sidebands of twice the line frequency (see figure)
- Twice the line frequency with sidebands of the slip frequency (not shown here)

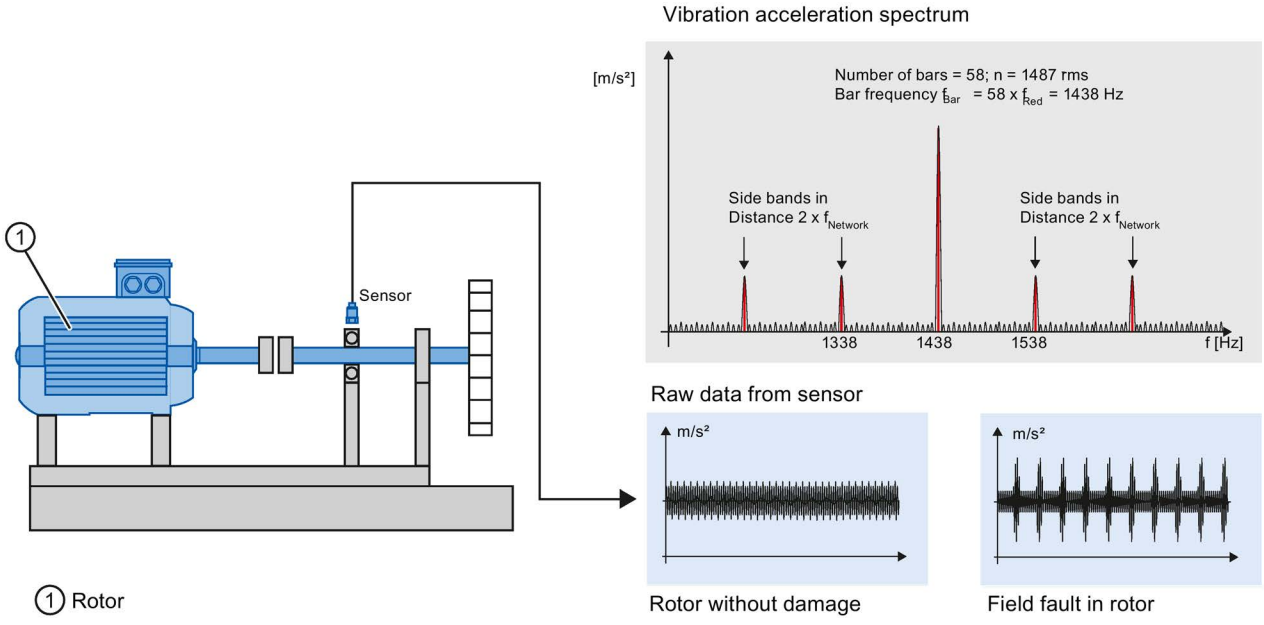



Figure 4-6 Example: Spectrum of the vibration acceleration (rotor field fault)

## 4.6.4 Envelope spectrum

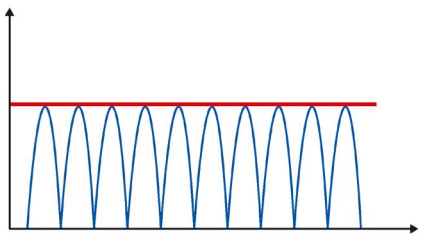
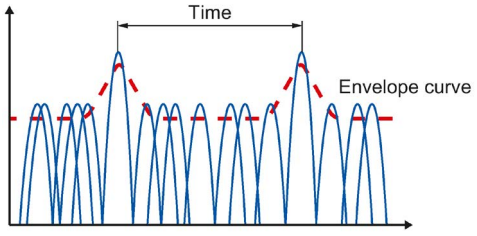
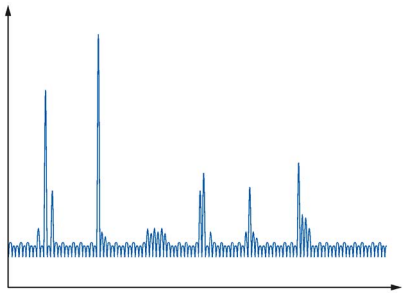
### 4.6.4.1 Description of the diagnostic method (envelope curve)

#### Characteristics SM 1281

| Spectrum | Frequency band | Resolution | Monitorable |
|---|---|---|---|
| Envelope curve analysis | 2 Hz to 1 kHz | 0.2 Hz | Bearing damage frequencies and other speed-dependent monitoring functions |

Depending on the current speed or the monitoring to be conducted, the SM 1281 automatically uses the most appropriate frequency range.

#### Method for envelope curve analysis

| | |
|---|---|
| Filtered time signal of the vibration acceleration for analyzing rolling element bearing damage. For constant amplitude, the envelope for this time signal is an almost horizontal straight line. |  |
| When a defect is rolled over, however, pulses occur periodically that overlay the machine vibrations, i.e. the horizontal straight line described above as the envelope curve is interrupted periodically or overlaid by these pulses.<br>The resulting envelope curve only contains information about defects. The smallest defects are therefore visible, regardless of the much more energy-rich machine vibrations that do not modulate the vibration signal in the frequency bands under consideration.<br>The envelope curve forms in the middle of the rectified carrier signal. |  |
| The defect frequencies become apparent when the time signal is converted to a frequency signal. |  |

### 4.6.4.2 Application example bearing analysis: Rolling element bearing damage (envelope curve)

#### Example rolling element bearing damage

Damage frequently develops in the raceway of the outer race. Such damage can normally be detected using envelope curve analysis several months before a critical condition develops. The following example shows the envelope curve spectrum of the vibration acceleration. The spectrum is calculated from the raw data.

Damage frequency of the outer race in this example: 125 Hz

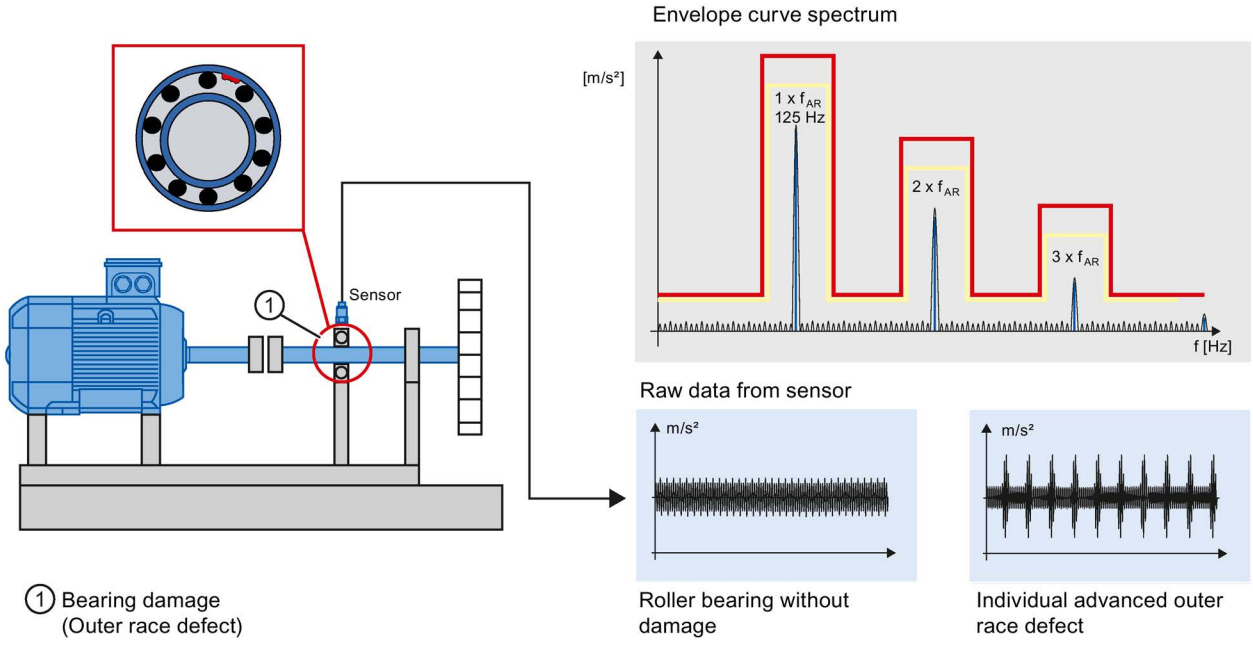



Figure 4-7 Example of envelope curve analysis

## 4.6.5 Method of operation for spectrum monitoring

Combining different monitoring methods (speed-dependent / speed-independent) on one spectrum results in a single limit band for warning and alarm. The amplitude values of the spectrum are tested continuously against the limit band.

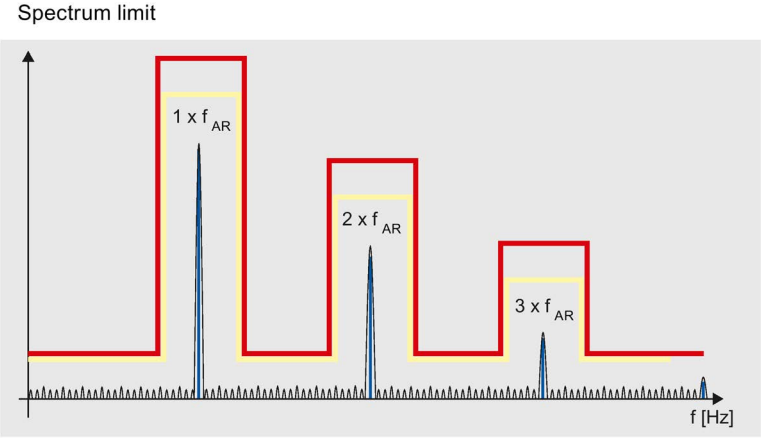



Figure 4-8 Spectrum limit band, speed-dependent

With speed-independent monitoring, add-on units (e.g. fans on machines) can be included in the calculations.

# System overview

# 5

## 5.1 Features

The SM 1281 is a module for use in combination with the SIMATIC S7-1200 automation system.

Using the SM 1281, you can continuously monitor the states of components subject to wear, e.g. motors, bearings, and critical machine components.

The SM 1281 can be used together with an S7-1200 CPU (FW 4.1 or higher) as a stand-alone monitoring system.

### Other features

- 4 VIB sensor channels for vibration signal monitoring
- 1 digital input for speed measurement
- Direct integration in existing SIMATIC S7-1200 automation systems
- Problem-free integration into new and existing machines
- High sampling rates
- Synchronous data recording
- Vibration analysis within the SM 1281. The result of the analysis is transferred to the S7-1200 CPU via the backplane bus for further processing
- Processing of the results from the vibration analysis in the control program of the user
- Configuration of functions of the SM 1281 directly from the TIA Portal

### Requirements on software components

The firmware of the SM1281 and the library blocks are matched to each other. Make sure that you use the matched system components listed in the table below.

Table 5- 1 System components for use of the SM 1281

| Module | Firmware version of the module | Firmware version of the CMS | Required library in the TIA Portal | Configuration software |
|---|---|---|---|---|
| SM 1281 | V1.x | V1.x | LSM 1281 V1.x | STEP 7 (TIA Portal) V13, SP1, Update 9 and higher and HSP 0131 (≥ V1.0) |
| SM 1281 | V2.x | V2.x | LSM 1281 V2.x | STEP 7 (TIA Portal) V13, SP1 and higher and HSP 0131 (≥ V2.0) |

# 5.2 Configuration (integration into networks)

## Configuration

The following figure shows an example configuration with the SM 1281 together with a SIMATIC S7-1200 automation system.

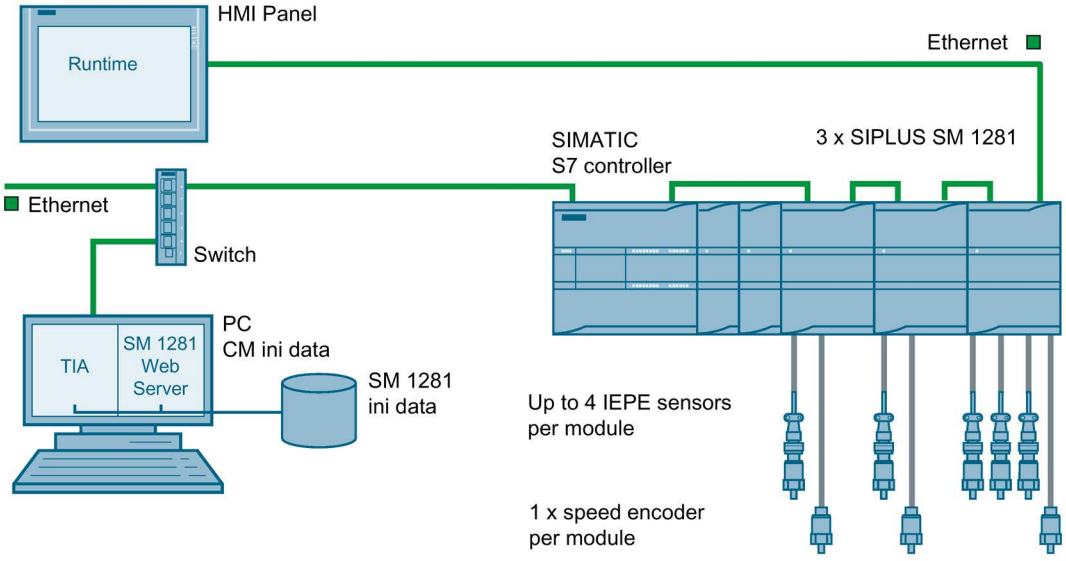
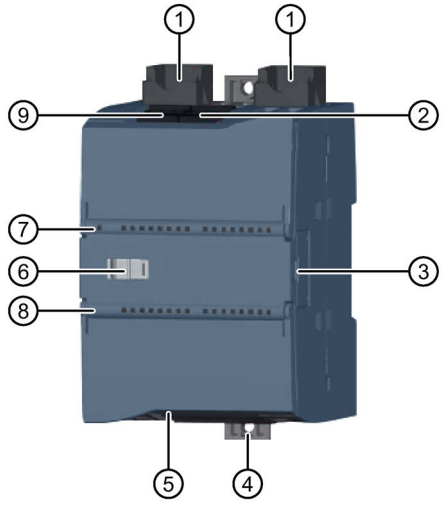



Figure 5-1 Configuration

# 5.3 SM 1281 structure

## SM 1281 structure

Table 5- 2 SM 1281 structure

| Structure | | |
|---|---|---|
|  | ① | Ethernet connections |
| | ② | Connection for speed sensor |
| | ③ | Backplane connection "downstream" |
| | ④ | Mounting slide |
| | ⑤ | Connections for four IEPE vibration sensors |
| | ⑥ | Sliding lug for backplane bus connection "upstream" |
| | ⑦ | LEDs<br>• DIAG (red/green): S7 diagnostics display<br>• MON (green): monitoring active; shows that the device is in the "RUN: Monitoring" mode. |
| | ⑧ | 4 x IEPE ERROR (red): shows the error status of the respective IEPE measurement channel. |
| | ⑨ | 24 V DC power supply connection (internal fuse T500 mA) |

# 5.4 Ordering data

Table 5- 3 Ordering data

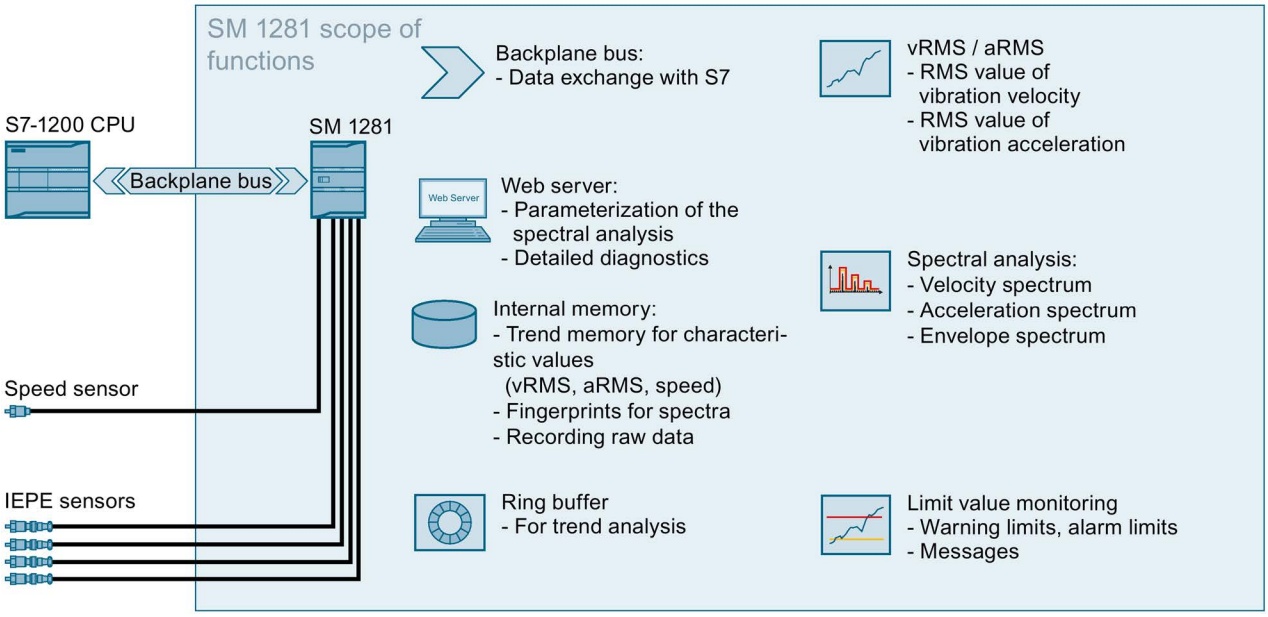
| Product | Article number |
|---|---|
| SIPLUS CMS1200 SM 1281 Condition Monitoring | 6AT8007-1AA10-0AA0 |
| SM 1281 shield clamp set, comprised of two shield clamps and five terminal clamps for the EMC connection of signal lines and encoder lines to the SM 1281 | 6AT8007-1AA20-0AA0 |
| SIPLUS CMS2000 connecting cable for connecting VIB sensors to MIL plugs; length 3 m | 6AT8002-4AC03 |
| SIPLUS CMS2000 connecting cable for connecting VIB sensors to MIL plugs; length 10 m | 6AT8002-4AC10 |
| SIPLUS CMS2000 VIB sensor (vibration sensor IEPE) | 6AT8002-4AB00 |

# Functions

# 6

## 6.1 Overview

The following display shows a functional overview of the SM 1281 and the exchange of data between the controller and SM 1281.

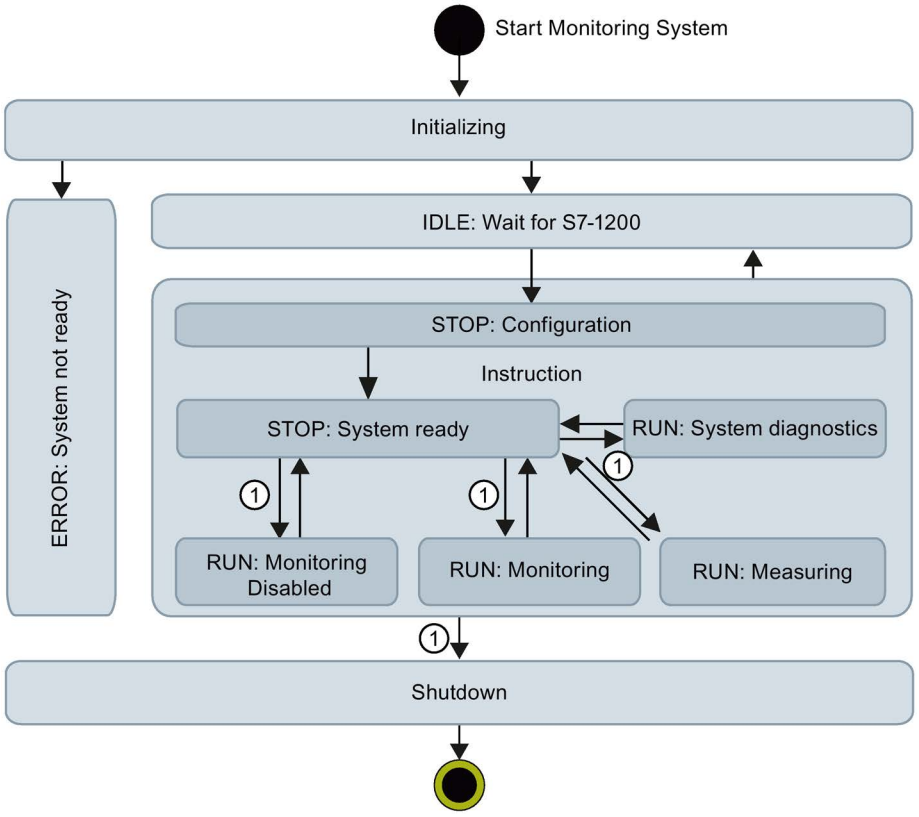



Information on the individual functions can be found in the following sections.

## 6.2 Operating modes

The SIPLUS SM 1281 Condition Monitoring System can assume different operating modes during operation.

In the following, you can see what modes the system can assume and when a change in status is initiated by a user request (①).




### Initializing

After switching on, the device is in "Startup" mode. The startup takes approximately one minute and can take up to three minutes. Non-recurrent initial settings are made in this state. Steps are subsequently performed that prepare the device for operation. If an error occurs at this point, the system will switch to the operating mode "ERROR: System not ready".

### IDLE: Wait for S7-1200

In this mode, the module waits for communication with the S7 backplane bus to be successfully established. During this mode, the SM 1281 web interface is not reachable, with the exception of the "Home" (Page 137) page. The fault is displayed on the "Home" (Page 137) page via the operating mode.

### STOP: Configuration

The configuration starts. The module waits for "STOP: System ready".

### STOP: System ready

When all initialization and preparation steps have been successfully completed, the "STOP: System ready" state is assumed. The device is now ready for operation, but not yet in an active operating mode. That is, no acquisition or monitoring of process measured variables is performed. In the "STOP: System ready" state you can perform the following actions:

- Erase, back-up and restore data
- Restart the device
- Reset the device to default settings
- Administrative tasks

**Note**

You have to actively control the changeover from STOP to an active operating mode and back by means of an explicit request via the web site or via the S7 program.

### RUN: System diagnostics

This operating mode is used for the commissioning of the vibration acceleration sensors (Page 85). All of the parameterized vibration channels are measured. For all of the parameterized vibration channels, the respective direct current portion (also: DC offset, operating point) of the connected IEPE sensor is determined and transferred to the S7 controller. No further processing or monitoring of the vibration data takes place.

This operating state can only be activated by the S7 controller. The results are available in the global data block "SM1281_Status" (Page 109) as a `sensor offset` parameter.

With knowledge of the sensor offset, the maximum measurable vibration acceleration of a vibration channel can be determined. The SM 1281 has a voltage measurement range at the IEPE inputs from 6.2 V to 15.0 V. If the operating point of a connected IEPE sensor is around 12 V, for example, wanted signals up to ±3 V can be measured before a measuring range limit is reached. When a sensor with a typical sensor sensitivity of 100 mV/g is used, the module can measure vibration accelerations up to ±30 g.

### Switch to an active operating state ①

You can control the transition from the operating mode "STOP: System ready" to an active operating mode ("RUN: Monitoring" or "RUN: Measuring") via buttons on the websites (see Chapter Changing the operating mode (Page 134)) or via the S7 (see Select operating mode/CPU restart (Page 120)).

### RUN: Measuring

In the mode "RUN: Measuring", the SM 1281 functions purely as a measuring device. The measured variables of the configured channels are recorded and displayed and transferred to the S7. The process data are recorded, but no monitoring is performed. Measuring mode is used for test purposes and supports commissioning procedures.

In measurement mode, the vRMS and aRMS characteristic values are determined and updated.

The user can also create fingerprints and record raw data in measuring mode.

### RUN: Monitoring

In the mode "RUN: Monitoring", the device is in the actual monitoring mode, i.e. all the monitoring tasks parameterized by the user will be processed. The device acquires the measured values of the configured channels, evaluates them, records process data and triggers responses in the case of limit violations.

### RUN: Monitoring inhibited

In the operating mode "RUN: Monitoring deactivated", all of the values continue to be recorded or calculated and are displayed accordingly on the Actual values (Page 139) page on the SM 1281 websites and in the S7. Monitoring no longer takes place, however (the actual values have a corresponding blue background on the SM 1281 websites). Pending messages for limit transgressions remain active, even if the measured or calculated values no longer exceed the limit. If thresholds are violated in "RUN: Monitoring inhibited" mode, no messages will be generated.

If the "RUN: Monitoring inhibited" mode is exited and there is no switchover to "STOP" or "RUN: Measuring" mode, monitoring is resumed and threshold violations will result in messages again (i.e. they will come and go in accordance with the monitored variables and their thresholds).

"RUN: "Monitoring inhibited" allows temporary interruption of the monitoring function in SM 1281. It can be used to exclude transitory states (e.g. start-up or coast-down of a machine) of the monitored object from monitoring by SM 1281. This feature can be used to avoid unwanted messages from SM 1281 due to transitory states of the monitored object.

**Example:** When a machine is started up alongside the monitored equipment, the measured vibration signal is affected. To prevent unwanted messages, the unit can be switched to RUN: Monitoring inhibited" mode during the start-up procedure.

### Shutdown

Changeover to the "Shutdown" operating mode and therefore shutdown of the device is performed if:

- "Restart SM 1281" is called via the web interface (see Section General (Page 173))
- the "Reset to factory settings" function is called (see Section Cleanup (Page 179))

The device remains in "Shutdown" operating mode for approx. 2 seconds, allowing all active operations to be completed.

This is always followed by a warm restart of the system.

### ERROR: System not ready

This is the error status of the monitoring system. In this state, the system itself does not operate. You can control the module to a limited extent, however, via the SM 1281 web interface. With the exception of a restart, a change of operating modes is not possible. Access via FTP and WebDAV is possible. For causes and remedies, see Section ERROR: System not ready (Page 199).

## 6.3 Measuring mode

Measurement mode is for test purposes and to support commissioning, in particular, to define the limits to be monitored.

In measurement mode, measured variables chosen by the user are measured, calculated and displayed as trend curves on selected channels. The measured variables are not measured during measurement mode.

Spectra can be saved as fingerprints and record of the current machine condition regarding vibration.

For subsequent analysis and evaluation, current raw data can also be stored by the user (see Section Recording raw data (Page 60).

See "RUN: Measuring" in Section Operating modes (Page 46) and Changing the operating mode (Page 134).

# 6.4 Monitoring mode

In monitoring mode, all measured variables to be monitored are constantly measured, calculated and monitored for parameterized limits. If limit values are exceeded, relevant messages are output and the parameterized responses are executed.

The control program can access the messages via an FB.

The measured variables are recorded in a trend curve.

See "RUN: Monitoring" in Section Operating modes (Page 46) and Changing the operating mode (Page 134).

## Frequency bands and speed ranges

The SM 1281 supports the following frequency bands and speed ranges for the monitoring procedures and the spectra:

Table 6- 1 Monitoring method

| Monitoring method | Frequency band | |
|---|---|---|
| | High-pass filter<br>`(HighpassFilter_...)` | Low-pass filter<br>`(LowpassFilter_...)` |
| aRMS | 0.1 Hz / 2 Hz / 10 Hz / 100 Hz / 1 kHz / 2 kHz (adjustable) | 2 Hz / 10 Hz / 100 Hz / 1 kHz / 2 kHz / 5 kHz / 10 kHz (adjustable) |
| vRMS[1] | 0.1 Hz / 2 Hz / 10 Hz / 100 Hz (adjustable) | 2 Hz / 10 Hz / 100 Hz / 1 kHz / 2 kHz (adjustable) |

[1] The standard values from ISO 10816 for vRMS:
- from 2 Hz to 1 kHz for revolutions from 120 to 600 1/min
- from 10 Hz to 1 kHz for revolutions > 600 1/min

Table 6- 2 Spectra

| Spectra | Frequency band | Speed range |
|---|---|---|
| Velocity | 2 Hz to 1 kHz | 120...16000 rpm |
| Acceleration | 10 Hz...10 kHz | |
| Envelope curve | 0.5 Hz...1 kHz | |

## 6.4.1 Vibration/bearing monitoring (characteristic RMS values)

### RMS monitoring

The SM 1281 permits the calculation of the characteristic values vRMS and aRMS:

- The vRMS is calculated based on the interval rms value of the vibration velocity.
- The aRMS is calculated based on the interval rms value of the vibration acceleration.

For each vibration channel, warning and alarm limits and hysteresis can be set for vRMS and aRMS.

### Cycle-based hysteresis

Three values calculated consecutively must violate the specified thresholds before a monitoring response is triggered. Similarly, three consecutive limit undershoots must occur (including the absolute value hysteresis), before the warning or alarm is canceled again.

## 6.4.2 Frequency-selective monitoring (spectrum vibration velocity/acceleration)

### Monitoring of spectra (velocity, acceleration)

The following methods can be combined to monitor the acceleration spectrum and the velocity spectrum. The sequence corresponds to the priority (descending order):

- Speed-independent peak monitoring of individual frequencies. For positioning in the spectrum, a factor is stated that is multiplied by the single rotational frequency.
  For the monitored frequency, a frequency tolerance band for monitoring can be set. It states the band around a certain frequency in the spectrum that will be monitored for limits.
- Speed-independent peak monitoring of absolute frequency bands (e.g. 100 to 500 Hz)
- Mask frequency band for monitoring the entire spectrum, on those frequencies that are not subject to peak monitoring.

Warning and alarm limits can be entered for the stated methods.

Three consecutive limit violations must occur before a warning or alarm is triggered. Similarly, three consecutive limit undershoots must occur (including the absolute value hysteresis), before the warning or alarm is canceled again.

## 6.4.3 Monitoring of envelope spectrum (roller bearing analysis)

### Monitoring of envelope spectrum

In roller bearing analysis, the spectrum of the envelope curve is monitored via the vibration acceleration. The following methods can be combined:

- Speed-dependent peak monitoring of individual fault frequencies with settable frequency tolerance for monitoring.

  The fault frequencies are determined from the bearing data entered.

- Mask frequency band for monitoring the entire spectrum, on those frequencies that are not subject to speed-dependent peak monitoring.

Where different methods overlap, the priority rule is:

- Speed-dependent monitoring functions interrupt the mask frequency band.

Warning and alarm limits can be entered for both methods.

The limit bands comprise warning and alarm limits for four types of damage:

- Outer race defect
- Inner race defect
- Ball damage
- Cage damage

These limits can be specified for up to five orders of magnitude (multiples of the respective fault frequencies).

Moreover, speed-dependent monitoring functions can be configured for any frequencies irrespective of the fault frequencies.

### Operating principle of the roller bearing analysis

The four bearing components, outer race, inner race, ball, and cage, have different fault frequencies which are determined by the bearing geometry and speed. The fault frequency of each bearing component multiplied by the specified order gives the frequency to be monitored in the envelope spectrum in each case.

The frequency band considered for limit comparison around the determined frequencies can be set (typically ±0.3 Hz).

Three consecutive limit violations must occur before a warning or alarm is triggered. Similarly, three consecutive limit undershoots must occur (including the absolute value hysteresis), before the warning or alarm is canceled again.

## 6.4.4 Hysteresis

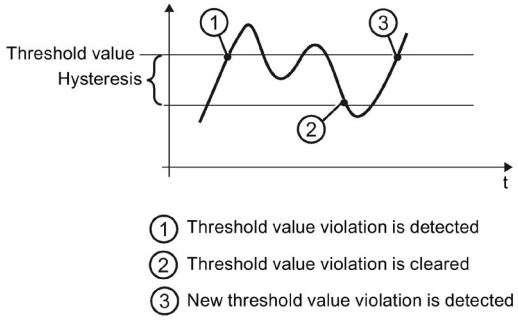
### Hysteresis

Hysteresis is used to reduce the number of alarms generated, especially when measured values fluctuate around parameterized limits.

For monitoring spectra, a hysteresis can be specified for each limit band.

With spectra, the hysteresis can be stated as an absolute value or as a percentage, that is, relative to the limit.

The hysteresis is always specified as an absolute value for vRMS and aRMS.

| Working principle of hysteresis | Description |
|---|---|
|  | This hysteresis is a single-sided absolute value hysteresis that is only considered when the monitored value falls below the limit.<br>The monitored value and the limit are directly compared to detect a violation ①.<br>If a limit violation occurs, and the monitored value falls below the limit again, the value must fall below the limit minus the hysteresis before the limit violation can be canceled ②. |

### Cyclic hysteresis

When monitoring vRMS, aRMS, and spectra, three consecutive limit violations must have occurred before a warning or an alarm is triggered. Similarly, three consecutive limit undershoots must occur (including the absolute value hysteresis), before the warning or alarm is canceled again.

# 6.5 Speed measurement

The SM 1281 has two options for speed measurement:

- Via the S7-1200 `(SpeedSource = 1)`

  The SIMATIC controller specifies the set speed via the backplane bus (`Speed`).
- Via the digital input of the SM 1281 `(SpeedSource = 2)`

## Measurement via DI

0 to 16000 pulses/minute can be recorded via the digital input. You can set the number of pulses that your speed measurement can generate per revolution in the S7 at the `PulsesPerRevolution` parameter.

For one pulse per revolution, a maximum measurable speed of 16000 revolutions per minutes is the result. 1 to 100 pulses per revolution are possible. The more pulses per revolution, the lower the maximum measurable speed, but the more accurate the speed measurement.

At speeds <100 rpm, use a speed sensor with more than 1 pulse/revolution to achieve more accurate measurement results.

Minimum pulse duration:

- If an encoder provides positive speed pulses, they are reliably recorded beyond a length of 50 µs.
- If an encoder provides negative speed pulses, they are reliably recorded beyond a length of 600 µs.

## Failure of the speed sensor

The following errors may occur during speed measurement:

- Cable break
- Short circuit of the sensor cable
- Sensor adjusted/installed incorrectly
- Sensor faulty

If an error occurs while measuring the speed, the last valid speed will be still be displayed up to one minute as the valid speed on the SM 1281 websites and in the S7. The actual speed may differ from the displayed speed during this time!

# 6.6 Message system

The message system of the SM 1281 logs events which occur in the system, device, or process. The following messages are displayed:

- Process messages: alarms, warnings
- System events: alarms, warnings, information

No alarms or warnings are pending in normal operation of the SM 1281.

## Process messages

Process messages are triggered if limit values of IEPE channels are exceeded.

Example:

| Date | Time | Type | Text | Action |
|---|---|---|---|---|
| 2012-01-01 | 08:04:02 | Alarm | VIB1 Bearing DE: vRMS alarm level violated (4.51 > 3.50 mm/s). Speed: 1001.9 rpm. | In |
| 2012-01-01 | 08:04:02 | Warning | VIB1 Bearing DE: vRMS warning level violated (4.51 > 2.50 mm/s). Speed: 1001.9 rpm. | In |
| 2012-01-01 | 08:04:02 | Warning | VIB1 Bearing DE: aRMS warning level violated (1.07 > 0.80 mm/s). Speed: 1001.9 rpm. | In |

## System messages

System messages are triggered by internal conditions or by faults in the system/device.

Example:

| Date | Time | Type | Text | Action |
|---|---|---|---|---|
| 2012-01-01 | 08:03:49 | Info | Operating mode RUN-Monitoring (user command). | In |

## Message status

Messages can have the following states:

| Message status | Description |
|---|---|
| Coming (active) | Example: A warning limit has been exceeded. |
| Going (inactive) | Example: A previously overshot warning limit has been undershot again.<br>A message can also be set to the "going" status automatically by the system, e.g. when entering STOP mode. |

## Viewing active messages

You can view messages that are currently pending on the "Pending messages" (Page 149) web page.

## Viewing the message log

The process and system messages are stored in a message log and displayed on the "Message log" (Page 150) page.

The message log can hold approximately 50,000 entries. If more messages occur, the oldest data will automatically be overwritten.

The message log is also retained if the voltage is switched Off/On.

# 6.7 Status and actual displays

You can obtain information about the current state of the device/system/process as follows:

### LEDs

The LEDs on the SM 1281 provide information about the current operating mode of the device and about the parts of the plant being monitored.

For information on the meaning of the LED displays, see section LED status display (Page 193).

### S7 diagnostics alarms

The S7 controller displays important events or faults of the S7 system in the diagnostic buffer.

Information on this can be found in Chapter S7 diagnostics alarms (Page 194).

### SM 1281 web pages

On the "Home page (Page 137)" and on the page "Pending messages (Page 149)", you will find up-to-date status information about the system and the process. You can view the current measured values of the system on the page "Actual values (Page 139)". The current operating state of the device is displayed in the header area of each Web site.

### Status values

Important status information is also provided in the S7 in the DB SM1281_Status (Page 109).

# 6.8 Recording data

## 6.8.1 Recording data: Trends

### Trend charts

Valid measurements of vRMS, aRMS, speed and monitored amplitude values of the spectra are automatically saved in the RUN state as trend curves. Minimum, maximum, and average values are recorded for every measured variable.

The trend values are stored with time resolutions that are permanently stored in the system. For each time resolution, the data are stored in a circular buffer, that is, the oldest data are overwritten when the maximum size of the circular buffer has been reached.

More recent data are available to the user with a high time resolution; older data, with a lower time resolution.

**Note**

Trend data is only displayed for the selected time period if the duration in the RUN states is greater than the resolution of the selected time period.

The time periods are available for visualization with the following resolutions:

| Maximum period | Resolution |
|---|---|
| Last day | 1 minute |
| Last week | 10 minutes |
| Last month | 30 minutes |
| Last 6 months | 3 hours |
| Last 10 years | 24 hours |

Optionally, monitored amplitude values in the frequency spectra can also be save as trend curves (see section "Velocity spectra bands").

The recording scheme is as described above, but the recording density in the individual ring buffers can be automatically reduced with regard to the storage capacity of the device.

## 6.8.2 Recording data: Fingerprints

This function enables you to record the condition of a machine. For this purpose, the calculated spectra of an IEPE channel can be stored as "Fingerprint". Up to 100 fingerprints can be stored in the device.

### Composition of a fingerprint

The stored fingerprint contains time-synchronous data. It is made up of the following data:

- Frequency spectrum
- Associated speed
- Further frequency spectra on the same IEPE channel; i.e. if available, all three frequency spectra that were calculated simultaneously - vibration velocity, vibration acceleration, and envelope of the IEPE channel - are stored
- RMS characteristic values calculated at the same time on the same IEPE channel (if present)

## 6.8.3 Recording raw data

The SM 1281 can save raw data in the form of WAV files. The raw data contains high-resolution recordings of the vibration inputs of the device and the speed. The recorded raw data contains the data of the last seconds before the initiating event. The duration of the recording can be set. You can use the raw data for further analyses, e.g. with SIPLUS CMS X-Tools.

- In principle, all of the configured vibration channels are recorded.
- The duration of raw data recording can be parameterized in the range 1 to 90 seconds for vibration channels. The setting applies for all of the configured channels.

  You can parameterize the recording on the web page "General" (Page 173).

**Note**

If an encoder is connected to the digital input of the SM 1281, then the falling edge of the speed signal is displayed with an approximate 420 µs delay in the raw data recording.

## Triggering raw data recording

Raw data recording can be triggered by three events:

- **A limit value violation:**

  It can be determined for each channel or for each analysis method of a vibration channel whether a limit violation will result in the recording of raw data.
  In this way, up to three raw data recordings are possible for each limit value and IEPE channel during a RUN phase. This serves to protect the internal flash memory, so that raw data recording is not performed continuously in the case of limit value violations that constantly come and go.

- **User command:**

  On the web page "Actual values (Page 139)", you can start raw data recording directly using a button. All vibration channels, including speed, being acquired are recorded.

  **Note**

  **Error message**

  If, after a switch of the operating mode from "STOP: System ready" to "RUN: Monitoring", you attempt too quickly to start raw data recording, the following error message appears: No or not enough raw data available to be recorded. Error code: 151".

- **Request via the S7 user program**

Recording starts after raw data recording has been triggered and ends after the parameterized duration.

The filename of the generated raw data file is automatically generated by the system and contains:

- Date and time
- Device name
- Recorded vibration channels

Raw data records are logged in the message log.

## Downloading of raw data files

You can download the recorded raw data files in one of the following ways:

- via the web page Save and restore (Page 176)
- via WebDAV (see Chapter Data transfer over WebDAV (Page 64))
- via FTP (see Chapter Data exchange via FTP (Page 67))

# 6.9 Self-monitoring of the system

The SM 1281 has functions for self-monitoring that ensure a high level of reliability of the system in continuous operation.

## Self-test

The SM 1281 performs a self-test during start-up. If an error occurs, the device will enter the Operating mode: "ERROR: System not ready" (Page 199).

## Watchdog

The SM 1281 has a watchdog function that prevents the system from being in an undefined operating mode.

**Note**

In the event of an error, the system goes into a safe state, in which no measurements or monitoring tasks are carried out.

The Ethernet switch functionality is retained.

## Measured value acquisition

To ensure that only meaningful and valid measured values are included in the evaluation, the following functions are implemented:

- Signal quality: Evaluation of the recorded vibration signals by the SM 1281.
  A system message is output if the signal quality is inadequate.
- Speed quality: If unstable or too high/too low speed repeatedly prevents vibration analysis, a system message is output.

If data acquisition is disturbed, monitoring is no longer performed on the affected channel.

## 6.10 Time keeping

The data and time are provided and managed automatically by the S7-1200 CPU.

The operating system of the SM 1281 contains its own time keeping, which is constantly synchronized by the S7. This time keeping is used for various functions, e.g. message system, trend recording.

You can make the time settings in the TIA Portal, see System Manual S7-1200 automation technology (https://support.industry.siemens.com/cs/document/36932465/simatic-s7-s7-1200-programmable-controller?dti=0&dl=en&lc=de-WW).

# 6.11 Data transfer over WebDAV

## Functions

### Exchanging data

Via WebDAV, files can be transferred to the device or downloaded from the device. Typical applications include:

- Download/delete the recorded raw data files (WAV files)
- Firmware updates
- Upload parameter settings or historic data to restore a backed-up stated.

It is not possible to download parameter settings and historical data via WebDAV. This is done using the functions on page Save and restore (Page 176).

## Information on using WebDAV

**Note**

- Only import files that have been exported from an SM 1281 device or which are permitted for SM 1281. These files may only be copied into the WebDAV directories provided for this purpose.
- Do not use WebDAV to change file names. This can cause error messages in the system.
- Only use WebDAV for importing/exporting the files intended for WebDAV: configuration data, recording data, firmware update.
- The system only imports data which you have loaded onto the SM 1281 via WebDAV after a restart.
- A WebDAV access to an SM 1281 via a domain PC is not possible.

## Adding WebDAV as drives

Proceed as follows under Windows:

1. Open Windows Explorer.
2. Under "Tools," click "Map Network Drive...".
   The "Map Network Drive" window will open.
   - Select a free drive letter in the "Drive:" selection box.
   - Select the path that should be connected as a network drive in the "Folder:" selection box. Use a path from the table below.

## Paths

Via WebDAV, you can access the following directories on the SM 1281:

Table 6- 3 Access via WebDAV

| Contents | Path | Description |
|---|---|---|
| Parameters | \\<IP-Adresse>\config | All the parameter databases for the device are located here. |
| Historical data | \\<IP-Adresse>\history | The databases for historical data and messages are located here. |
| Directory for firmware update files | \\<IP-Adresse>\update | Firmware update files are copied to this location. |
| Directory for raw data | \\<IP-Adresse>\rawdata | Here, you will find the recorded raw data files |

Access to an higher-level directory is not possible. Use access via FTP for this purpose.

## Authentication

Importing of files to the device via WebDAV is secured by an additional authentication.

Table 6- 4 Authentication

| | |
|---|---|
| User name | The user name is the standard login name "admin" |
| Password | The valid password is the one that was most recently set in the device administration on the " General" (Page 173) web page.<br>If the password was not changed here, the default password "0000" (four times "zero") applies. |

### Error message "Network error"

If the authentication is rejected with the error message "Network error", then check whether the PC is in an Active Directory (AD) of a domain. A WebDAV access to an SM 1281 via a domain PC is not possible.

## Constraints

**Note**

Note that you may only load files on the device in **STOP operating mode**.

You can also download raw data files in RUN mode.

| NOTICE |
| --- |
| **Data exchange errors due to incorrect time setting**<br>WebDAV accesses always contain a file comparison. Therefore ensure the correct time setting on the device and on the PC used for accessing. Otherwise this can lead to undesirable effects on exchanging data. Older versions of files can be erroneously regarded as the current version. So the wrong files may be saved or read. |

# 6.12 Data exchange via FTP

Instead of the WebDAV access (Page 64), you can alternatively access the SM 1281 via FTP (File Transfer Protocol).

## Establishing a connection, and authentication

There are two methods for establishing a connection via FTP in the Windows Explorer:

**"ftp://admin@<IP address><Path>"**

Example: "ftp://admin@192.168.1.200/config"
Then a dialog appears for entering the password.

**"ftp://admin:<Password>@<IP address><Path>"**

Example: "ftp://admin:0000@192.168.1.200/config"
The password is already included here and permits immediate access to the device.

**Note**

Note that you may only load files on the device in **STOP operating mode**.

You can also download raw data files in RUN mode.

## Paths

Via FTP, you can access the following directories on the SM 1281:

Table 6- 5 Access via FTP

| Content | Path | Description |
|---|---|---|
| Parameter | /config | All the parameter databases for the device are located here. |
| Historical data | /history | The databases for historical data and messages are located here. |
| Directory for firmware update files | /update | Firmware update files are copied to this location. |
| Directory for raw data | /rawdata | Here, you will find the recorded raw data files |

# Application planning

# 7

## 7.1 Shipping

| NOTICE |
| --- |
| **Damage to the device**<br>The device can be damaged by inappropriate shipping.<br>Transport the device, therefore, only in the original packaging. This will give it the necessary protection against shock and impact. |

## 7.2 Storage

It is absolutely essential that the SM 1281 is stored in compliance with the storage conditions as described in Chapter Technical data (Page 201). In the event of ingress of dirt or liquid into the equipment, formation of condensation, damage or any other failures to comply with the prescribed storage conditions, the equipment must not be commissioned until the correct remedial procedure has been discussed with Siemens AG.

## 7.3 Scope of delivery

- SM 1281

### Unpacking and checking the delivery

1. Unpack the device.
2. Make sure that the package is complete.
3. Check the device for transport damage by visual inspection.

Accessories for SM 1281 are not included in the scope of supply. You can order (Page 44) the accessories separately.

| NOTICE |
| --- |
| **Damage to the system**<br>Damaged parts can result in damage to the system. Do not use any parts that show evidence of damage! |

## 7.4 Installation location

The product is designed for use in an industrial environment.

The device is only suitable for indoor use.

---

**Note**

**Installation in control cabinet/device connection box**

The SM 1281 is intended for installation in a control cabinet or a device connection box.

- In these cases, the LEDs on the front of the device will remain visible and usable only during commissioning. Please take this into consideration for subsequent operation of the device.
- It is important to note that installation in a control cabinet or a device connection box is essential for compliance with the UL regulations.
- The control cabinet / device connection box must satisfy the regulations regarding fire-protection housing.
- Ensure that all cables and leads that protrude externally are equipped with adequate strain relief.

---

Also note the installation guidelines in the System Manual S7-1200 automation technology (https://support.industry.siemens.com/cs/document/36932465/simatic-s7-s7-1200-programmable-controller?dti=0&dl=en&lc=de-WW).

### Electromagnetic compatibility (EMC)

| NOTICE |
| --- |
| **Damage to the device**<br>Inadequately dimensioned overvoltage protection can result in severe damage to the device.<br>Therefore ensure that the overvoltage protection is adequate (see Chapter Technical data (Page 201)).<br>To do this, use the shield clamp set (see Order data (Page 44)) or take comparable actions. |

## Selection of the installation site / mounting position

The device can be mounted in a standard mounting rail.

- Permitted mounting positions: horizontal or vertical
- Permissible ambient temperature:
  - Horizontal installation: -20 °C to 55 °C
  - Vertical installation: -20 °C to 45 °C

Maintain the minimum clearances from walls and other devices:

Sides 0 mm, top 40 mm, bottom 25 mm for ventilation

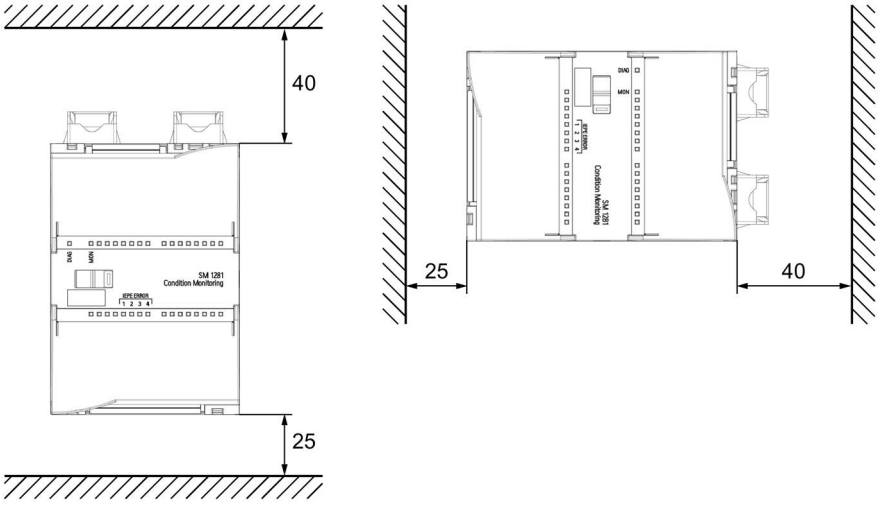



Figure 7-1 Minimum clearances with horizontal and vertical installation

Note the following device dimensions in this regard:

Table 7- 1 Device dimensions

| Dimensions | |
|---|---|
| Width | 70 mm |
| Height | 112 mm |
| Depth | 75 mm |

| NOTICE |
|---|
| **Damage due to overheating**<br>You must comply with all the instructions regarding the installation location and mounting position. Otherwise the device may malfunction or incur permanent damage as a result of overheating. |

# Mounting

# 8

## 8.1 Mounting the SM 1281

The SM 1281 can be mounted on a 35 mm standard mounting rail according to DIN EN 60715.

Permitted mounting positions: horizontal and vertical

### Procedure

Instructions and guidelines for the installation and removal of modules can be found in the System Manual S7-1200 automation system (https://support.industry.siemens.com/cs/document/36932465/simatic-s7-s7-1200-programmable-controller?dti=0&dl=en&lc=de-WW).

**Note**

For better handling, maintain a distance of 50 to 60 mm between the SM 1281 and the cable duct.

# 8.2 Mounting the shield clamps

## SM 1281 shield clamp set

The shield clamp set is used for the EMC-compliant connection of signal and encoder cables to the SM 1281.

The set contains 2 shield clamps, five terminal clamps, and one copy of the Compact Hardware Installation Instructions. It can be ordered as accessory (6AT8007-1AA20-0AA0).

- Shield clamp top: Grounding of the cable shield for the speed sensor
- Shield clamp bottom: Grounding of the cable shields for the IEPE sensors

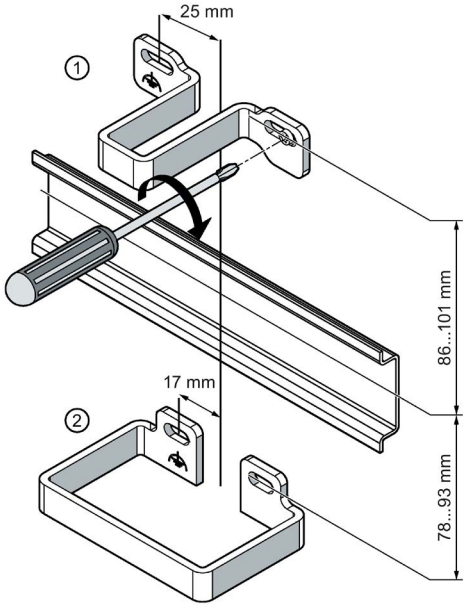
**Note**

Do not use the terminal clamps as strain relief!

## Procedure

Screw the shield clamps to the mounting plate above and below the top-hat rail.

The permissible distance between the module and the shield clamp is a minimum of 30 mm and a maximum of 45 mm.




① Upper shield clamp for 1 speed sensor terminal clamp
② Shield clamp for 4 IEPE input terminal clamps

## See also

Connecting to functional ground (Page 87)

# Connection

# 9

## 9.1 Safety instructions and guidelines

### Safety instructions

**⚠ CAUTION**

**Safe electrical isolation**

For the 24 V DC power supply, use only power supply units with safe electrical isolation in accordance with IEC 60364-4-41 or HD 384.04.41 (VDE 0100, Part 410), for example, in accordance with the PELV standard.

The supply voltage must be within the specified voltage range. Otherwise, function failures on the device cannot be excluded.

Applies to non-isolated system design:

Connect the terminal for GND 24 V from the 24 V power supply output to equipotential bonding for uniform reference potential. Select a connection point that is as central as possible.

### Wiring guidelines

General guidelines for the wiring of S7-1200 system components can be found in the S7-1200 Automation System System Manual (Page 13).

### Cable routing and grounding

**Note**

**Interference due to incorrect cable routing**

Route all analog signals (VIB1 to VIB4) spatially isolated from other cables to ensure that the measurement signals can be transmitted without interference.

Maintain this spatial separation throughout the entire cable route. This is the only way to provide optimal EMC protection.

**Note**

**Electromagnetic interference**

Make sure that adequate equipotential bonding is implemented for all plants or systems in which the SM 1281 is installed. E.g. by means of a low-impedance connection to a ground potential.

**Note**

**Securing the cable shielding**

The permissible distance between the module and the shield clamp is a minimum of 30 mm and a maximum of 45 mm.

Use the shield clamp set, which is available as accessory.

**Note**

**Strain relief**

Ensure that all cables and leads that protrude externally are equipped with adequate strain relief.

## Other requirements

**NOTICE**

**Damaged cables**

- The cables must be suitably dimensioned to ensure that they cannot be damaged. Make sure that the cables are suitable for the individual application.
- Observe the bending radii.

**⚠ CAUTION**

The cables must be specified for an ambient temperature of +75 °C.

ATTENTION: Utiliser des fils d'alimentation qui conviennent à une température de +75 °C au-dessus de la température ambiante.

## 9.2 Terminal assignment

The figure below shows the connecting terminals of the device and the associated block diagram:

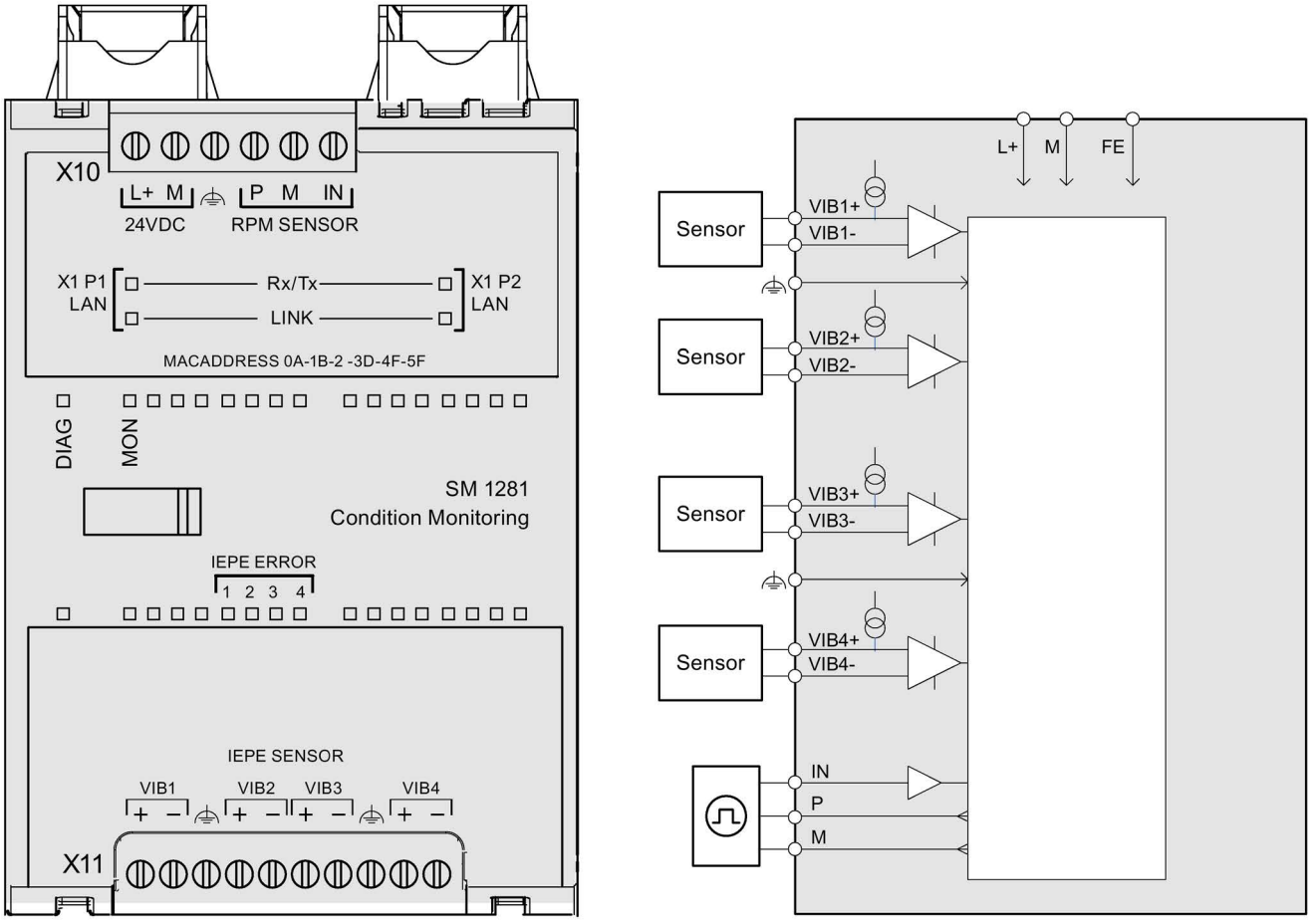



Figure 9-1 Connection diagram and block diagram

| **Terminal assignment X10** | | | | |
|---|---|---|---|---|
| 24 V DC power supply | | | RPM sensor (digital speed input) | |
| L+ | 24 V supply for SM 1281 (+) | | P | 24 V supply for speed sensor (+) |
| M | 24 V supply for SM 1281 (-) | | M | 24 V supply for speed sensor (-) |
| ⏚ | Functional grounding "Module" | | IN | Digital input |

| **Terminal assignment X11** | | | | |
|---|---|---|---|---|
| VIB1+ | IEPE sensor input 1 | | VIB3+ | IEPE sensor input 3 |
| VIB1- | IEPE sensor input 1 | | VIB3- | IEPE sensor input 3 |
| ⏚ | Functional grounding VIB | | ⏚ | Functional grounding VIB |
| VIB2+ | IEPE sensor input 2 | | VIB4+ | IEPE sensor input 4 |
| VIB2- | IEPE sensor input 2 | | VIB4- | IEPE sensor input 4 |

## 9.3 Attaching the cable shield

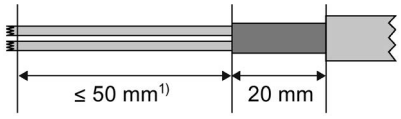
The following SM 1281 process signals must be connected via shielded cables:

- Speed sensor
- Sensor signals (VIB 1 to VIB 4)

The shields of the cables must be attached to the upper and/or lower shield clamps using the terminal connections. The shield clamp set can be ordered as an accessory (see Chapter Ordering data (Page 44)).

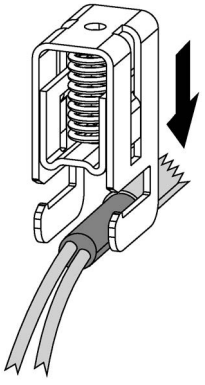
Proceed as follows:

1. Strip the cable.

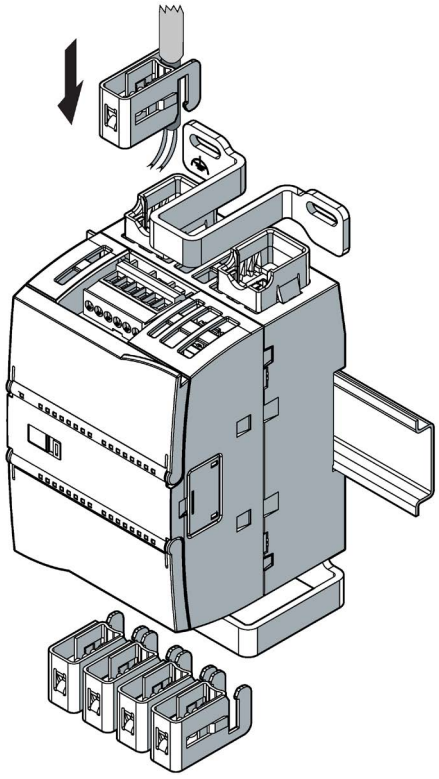



1) The length depends on the distance between the shield clamp and the device.

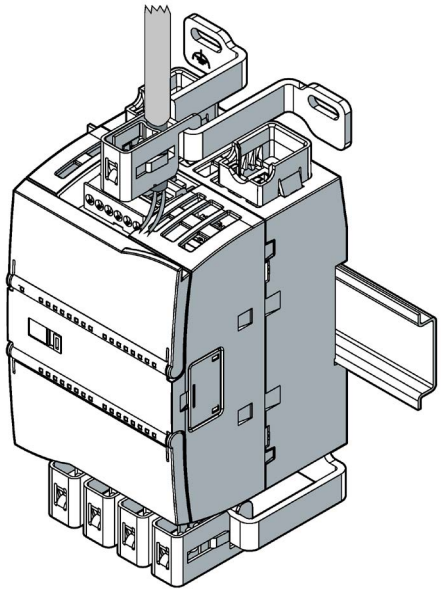
2. Press the terminal clamps onto the protective braided shield of the cable.



3. Slide the terminal clamps with cables onto the shield clamp.



4. The result should look like this:



## Setup with several SM 1281 modules

If you use several SM 1281 modules in your setup, then equivalent grounding of the cable shields is permitted, e.g. via a grounding rail.

# 9.4 24 V DC power supply

## 24 V DC power supply

An external 24 V DC power supply is connected to the SM 1281 via plug-in terminals. Purpose of the power supply:

- Power supply for the internal electronics of the SM 1281
- Constant power supply of the IEPE sensors
- Supply of the encoders for the digital speed input

The SIMATIC S7-1200 Power Supply PM1207 (6EP1332-1SH71) is suitable.

## Safety instructions

**⚠ CAUTION**

**Safe electrical isolation**

For the 24 V DC power supply, use only power supply units with safe electrical isolation in accordance with IEC 60364-4-41 or HD 384.04.41 (VDE 0100, Part 410), for example, in accordance with the PELV standard.

The supply voltage must be within the specified voltage range. Otherwise, function failures on the device cannot be excluded.

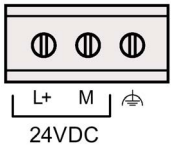
Applies to non-isolated system design:

Connect the terminal for GND 24 V from the 24 V power supply output to equipotential bonding for uniform reference potential. Select a connection point that is as central as possible.

## Connector pin assignment

The following figure shows the assignment of the terminals for the 24 V DC power supply on X10.

Table 9- 1 Terminal assignment for the 24 V DC power supply on X10

| | | |
|---|---|---|
|  | L+ | 24 V supply for SM 1281 (+) |
| | M | 24 V supply for SM 1281 (-) |
| | ⏚ | Functional grounding |

# 9.5 Connecting sensors

**⚠ WARNING**

**Voltage hazards**

**May cause death or serious injury**

The inputs of the SM1281 feature functional electrical isolation up to 500 V.

Only those sensors may be used that ensure safe electrical isolation up to the maximum level of the potentials configured for the plant.

It is imperative that you observe the insulation values of the sensors used and take additional measures, if required, to ensure safe electrical isolation.

**NOTICE**

**Material damage**

Connecting sensors during operation can lead to damage to the sensors and the device.

De-energize the system before you connect or replace sensors.

## 9.5.1 IEPE sensors

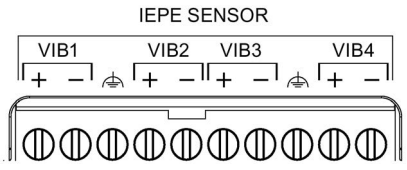
You can use all IEPE sensors (Integrated Electronics Piezo-Electric) that fulfill the specification for the relevant sensor inputs VIB1 to VIB4. We recommend that you use sensors from the Siemens portfolio (see Section Ordering data (Page 44)).

| NOTICE |
| --- |
| The maximum allowable wire length for the connection of IEPE sensors is 30 m. |

### Connector pin assignment

The following figure shows the terminal assignment for IEPE sensors on X11.

Table 9- 2 Terminal assignment for IEPE sensors on X11




| | |
| --- | --- |
| VIB1 | IEPE sensor input 1 |
| ⏚ | Functional grounding |
| VIB2 | IEPE sensor input 2 |
| VIB3 | IEPE sensor input 3 |
| ⏚ | Functional grounding |
| VIB4 | IEPE sensor input 4 |

### Measuring principle

The sensors are supplied by a constant current and form an operation point from this constant current that is comparable to a fixed resistor. For the SM 1281, the basis of this constant current source is the external 24 V power supply.

A Piezo crystal in the IEPE sensor generates a voltage signal proportional to the vibration acceleration. The signal is modulated up to the operation point with a sensor-dependent amplification, comparable to a variable resistor. The supply current and the measured signal are transmitted via the measurement cables (2-wire connection).

### Measuring range of the SM 1281

| NOTICE |
| --- |
| The measuring range of the SM 1281 is limited to the input voltage range of 6.2 V to 15.0 V. Values <6.2 V and values >15.0 V are flagged by the SM 1281 as invalid values and are not included in the evaluation. |

You can check the operation point of the IEPE sensors you used with the aid of the operating mode "RUN: System diagnostics" (Page 46).

## 9.5.2 Speed sensors

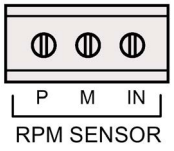
### Speed sensor

A speed sensor can be connected to the "RPM Sensor" terminal.

### Connector pin assignment

The following figure shows the terminal assignment for the speed encoder on X10.

Table 9- 3 Terminal assignment for the speed encoder on X10

| | | |
|---|---|---|
|  | P | 24 V supply for speed sensor (+) |
| | M | 24 V supply for speed sensor (-) |
| | IN | Digital input |

# 9.6 Connecting to functional ground

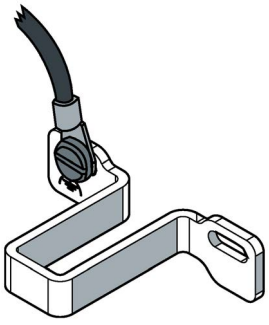
## Prerequisites

- The mounting plate must not be painted in the contact area of the shield clamps and must be connected at low-impedance to the cabinet ground.
- The conductor cross-section must be 2 $mm^2$ (AWG14).
- Ensure that the cable for the functional grounding is as short as possible.
- The functional grounding (FE) must not be made using a green/yellow conductor.

## Procedure

Connect all terminals with the symbol ⏚ (see Terminal assignment (Page 79)) to the screw connections of the shield clamps.

Use ring cable lugs for connecting the cables to the shield clamps.



# 9.7 Connecting Ethernet

The SM 1281 is equipped with an integrated Ethernet switch with 2 ports. The connections are designed as RJ45 sockets.

For the increased mechanical and electrical stress in industrial applications, we recommend the SIMATIC NET Industrial Ethernet FastConnect Twisted Pair Standard Cable with Fast Connect connections.

To increase the mechanical stability, in the delivery condition, retaining collars for the two Ethernet ports are attached on the lower part of the enclosure of the SM 1281, which are optimized for the SIMATIC NET Fast Connect RJ45 connection plugs.

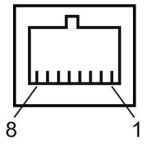
**⚠ CAUTION**

**Critical system state**

The Ethernet switch that is built into the SM 1281 is only in operation after the module is started up. A restart of the SM 1281 interrupts the Ethernet switch function.

As a result, existing Ethernet connections via the switch are interrupted for the duration of the start-up of the SM 1281. This can lead to critical system states.

## Pin assignment for Industrial Ethernet interfaces

| Industrial Ethernet | Pin | Pin assignment |
|---|---|---|
|  | 1 | Transmit Data (+) |
| | 2 | Transmit Data (-) |
| | 3 | Receive Data (+) |
| | 4 | Terminated |
| | 5 | Terminated |
| | 6 | Receive Data (-) |
| | 7 | Terminated |
| | 8 | Terminated |

**Note**

It is only permitted to connect shielded CAT5 cables (or cables of a higher standard) to the Ethernet socket.

# Commissioning 10

## 10.1 Commissioning of SM 1281 Condition Monitoring

### Prerequisites

- The SM 1281 is mounted and connected to the SIMATIC S7-1200 CPU via the bus connector (see S7-1200 Automation System System Manual (http://w3.siemens.com/mcms/industrial-automation-systems-simatic/en/manual-overview/Pages/Default.aspx)).
- The shield clamps are fitted (see Section Mounting the shield clamps (Page 76)).
- The sensors are installed.
- The SM 1281 and all other components are wired and connected.
- STEP 7 V13 SP1 Update 4 or higher is installed.

### Basic commissioning procedure

After the commissioning of the hardware, carry out the additional steps for commissioning in the TIA Portal, in the S7 user program, and on the SM 1281 websites.

### TIA Portal

1. Check in the TIA Portal whether the module "SM 1281" is available in the hardware catalog.

   If required, download the HSP SM 1281 Condition Monitoring from the Siemens Service&Support area (https://support.industry.siemens.com/cs/?lc=en-DE) and install it.
2. Integrating theSM 1281 library (Page 91) in STEP 7
3. Creating a project
4. Creating HW Config
5. Linking function blocks from the SM 1281 library to the user program.
6. Activate power supply

   The SM 1281 starts up. The DIAG LED illuminates green and signals that the device is in the error-free operating state.
7. Load project on the S7-1200 CPU
8. Optional: Create HMI interface for the visualization and control of the vibration monitoring with SM 1281 (TIA Portal WinCC required. Recommended: visualization via Comfort Panels or PC Runtime).

⇒ **The engineering in the TIA Portal is completed.**

### S7 user program

In the S7 user program, carry out the parameterization and start the monitoring:

1. Assign values to the module parameters, e.g. IP address, sensor sensitivity.
2. Assign values to the process parameters (RMS hysteresis).
3. Assign values to the dynamic process parameters (RMS limit values).
4. Transfer the parameters to the SM 1281 module via the `SetAllParameters` command.
5. Via the parameter `OpMode`, select the operating mode "RUN: Monitoring" and use the command `ActivateOpMode` command to switch the operating mode.

**⇒ The SM 1281 is in monitoring mode. It reports limit value violations of the process values vRMS and aRMS to the S7controller.**

### SM 1281 web pages

The SM 1281 web pages can only be selected via a supported browser with the set IP address:

1. Make (Page 152) settings for the frequency-selective monitoring.

**⇒ Parameterization has been completed.**

### Result

The SM 1281 Condition Monitoring has been successfully put into operation.

### Backup

Recommendation: Perform a data backup following commissioning:

1. Back up the limit values parameterized in the S7 user program, see Function blocks (Page 93).
2. Back up the CMS databases of the module, e.g. via download on the SM 1281 website "Save and restore" (Page 176).

# Integrating functions with the SM 1281 library 11

## 11.1 Function of the SM 1281 library

The SM 1281 signal module comes with the library "SM1281_Library" with STEP 7 blocks. The library permits the easy integration of the SM 1281 functions into your control program.

With the STEP 7 blocks from the "SM1281_Library", you can parameterize, control, and diagnose the SM 1281 configured in the device configuration in the TIA Portal.

The blocks in the "SM1281_Library" provide the following functions:

- Parameterization of the SM 1281
- Output of status and traffic light information
- Changing the operating mode
- Request fingerprint and raw data recording and output status information about the recording
- Automatic backup of valid parameter sets

Depending on the S7-1200 CPU used, up to seven SM 1281 signal modules can be integrated in the control program with the help of the blocks.

## 11.2 Software and hardware requirements

To be able to use the functionality of the library, the following hardware and software requirements must be complied with:

| Component | Article number | Number | Alternative |
|---|---|---|---|
| CPU S7-1215C<br>Variant: DC/DC/DC | 6ES7215-1AG40-0XB0 | 1 | SIMATIC S7-1200 CPUs FW 4.1 or higher (exception: The S7-1211 does not support further signal modules) |
| SM 1281 Condition Monitoring | 6AT8007-1AA10-0AA0 | 1 to 7 | |
| SIMATIC STEP 7 Basic V13 SP1 | 6ES7822-0AA03-0YA5 | 1 | SIMATIC STEP 7 Professional V13 SP1 |

Mixed operation with SM 1281 modules and S7-1200 modules is permissible.

## 11.3 Blocks

The "SM1281_Library" contains the following blocks:

| Type | Symbol | Description |
|---|---|---|
| Function block | SM1281_Module (Page 94) | Using the FB SM 1281_Module, the general module settings can be made and the status messages of the module can be monitored. |
| Function | SM1281_Channel (Page 102) | The FC SM1281_Channel can be assigned to a channel of the SM 1281. It permits the parameter assignment and monitoring of the corresponding vibration channel. |
| Global data block | SM1281_Status (Page 109) | The DB SM1281_Status provides all of the feedback messages, status and traffic light information of the SM 1281 in a structured manner. |
| Global data block | SM1281_Backup (Page 112) | The DB SM1281_Backup serves as memory for the automatic backup of parameter sets. |

### Library resources

If you are using only one module, the blocks in RAM occupy approximately 12 KB. The blocks also occupy about 800 bytes in memory for each additional module.

### Description

The blocks "SM1281_Module" and "SM1281_Channel" are absolutely essential for operating the SM 1281. They permits the parameter assignment and status monitoring of the module.

The parameters which are set via the blocks cannot be changed via the web server of the SM 1281.

The SM 1281 has module-specific and channel-specific settings and diagnostic information. The IP configuration, the selection and the feedback message about the current operating mode are module-specific, for example. The four vibration channels of the SM 1281, to which acceleration sensors for machine monitoring can be connected, are channel-specific.

## 11.3.1 FB SM1281_Module

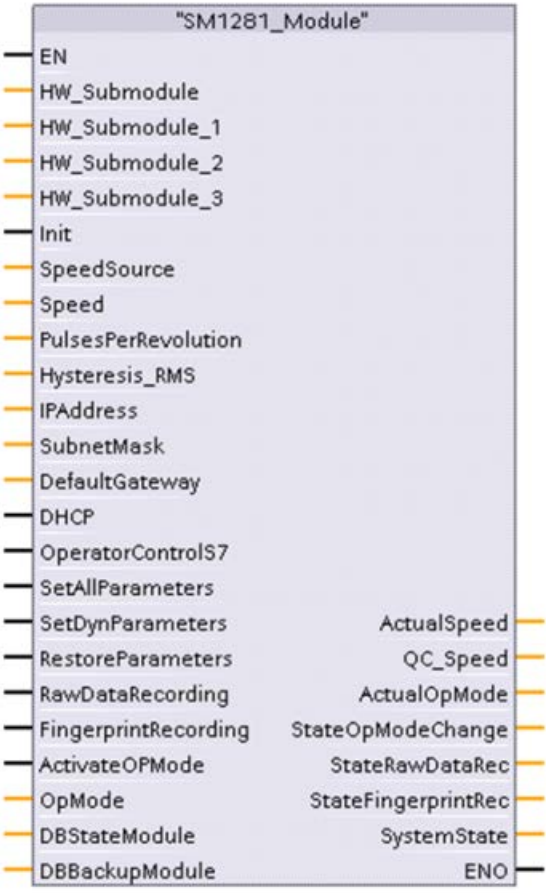



Figure 11-1 FB SM1281_Module

### Function

The "SM1281_Module" block offers the following functions:

- IP configuration of the SM 1281 module
- Speed configuration
- Transfer module and channel parameters to the SM 1281
- Request fingerprint and raw data recording
- Restore the parameter set
- Output module status and error information
- Select the operating mode of the SM 1281
- Switch the control priority between S7-1200 and SM 1281 webserver

| NOTICE |
| --- |
| **Inconsistent data when transferring parameters**<br>If the command `SetAllParameters` is interrupted by another command before it is successfully completed, inconsistencies may occur between the FB "SM1281_Module" and the DB "SM1281_Backup" due to the automatic operating mode switching.<br>Therefore, only execute one command at a time via the FB "SM1281_Module"! |

## References

The operation of the block is explained in Chapter Using blocks (Page 120) with the aid of use cases.

You can find the meanings of the parameters and of the error and status codes in the following tables.

#### 11.3.1.1 FB SM1281_Module - Parameters

### Input parameters

Table 11- 1 FB SM1281_Module - input parameters

| Parameters | Data type | Description |
|---|---|---|
| HW_Submodule | HW_SUBMODULE | Assignment to the first submodule of the SM 1281 in the device configuration |
| HW_Submodule_1 | HW_SUBMODULE | Assignment to the second submodule of the SM 1281 in the device configuration |
| HW_Submodule_2 | HW_SUBMODULE | Assignment to the third submodule of the SM 1281 in the device configuration |
| HW_Submodule_3 | HW_SUBMODULE | Assignment to the fourth submodule of the SM 1281 in the device configuration |
| Init | Bool | The SM 1281 is initialized via this input during the warm restart of the CPU. This input should be connected with the "FirstScan" system flag. |
| SpeedSource | Byte | Selection of the speed source:<br>1: S7-1200<br>2: DI - Digital input of the SM 1281 |
| Speed | Real | Speed value (rms) from S7-1200 (when used, the parameter `SpeedSource` must be "1") |
| PulsesPerRevolution | UInt | Pulses per revolution if the DI of the SM 1281 is used as speed source. Then a value between 1 and 100 must be specified here. |
| Hysteresis_RMS | USint | RMS hysteresis in % (based on the respective configured threshold value for the vibration channels) |
| IPAddress | DWord | IP address of the SM 1281 (hex-coded)<br>**Example IP 192.168.0.1:**<br>Decimal 192 → Hex C0<br>Decimal 168 → Hex A8<br>Decimal 0 → Hex 00<br>Decimal 1 → Hex 01<br>⇒ DWord `IPAddress` = C0A80001 |
| SubnetMask | DWord | Subnet mask of the SM 1281 (hex-coded)<br>**Example subnet mask 255.255.255.0:**<br>Decimal 255 → Hex FF<br>Decimal 255 → Hex FF<br>Decimal 255 → Hex FF<br>Decimal 0 → Hex 00<br>⇒ DWord `SubnetMask` = FFFFFF00 |
| DefaultGateway | DWord | Default gateway of the SM 1281 (hex-coded)<br>**Example IP 192.168.0.1:**<br>Decimal 192 → Hex C0<br>Decimal 168 → Hex A8<br>Decimal 0 → Hex 00<br>Decimal 254 → Hex FE<br>⇒ DWord `DefaultGateway` = C0A800FE |
| DHCP | Bool | Use of a DHCP server (automatic assignment of the IP address and subnet mask) |

| Parameters | Data type | Description |
|---|---|---|
| OperatorControlS7 | Bool | Write protection web interface of the SM 1281.<br>**True:** The S7-1200 has the control priority. Thus, the web interface can no longer be edited. The user who is currently logged on to the SM 1281 Web server is automatically logged off. He can no longer log in as long as this bit is set.<br>**False:** No commands are transferred from the S7-1200 to the SM 1281. This means that the SM 1281 can no longer be controlled via the blocks. Status, diagnostic and error information is still output via the blocks, however.<br>This parameter is cyclically transferred to the SM 1281. The transfer of the parameter via `SetAllParameters` is thus not required. |
| SetAllParameters | Bool | All module and channel parameters are transferred to the SM 1281 with a positive edge. |
| SetDynParameters | Bool | All dynamic parameters are transferred to the SM 1281 with a positive edge. |
| RestoreParameters | Bool | Restore the last valid parameter set with a positive edge and transfer to the SM 1281 |
| RawDataRecording | Bool | Request the recording of raw data |
| FingerprintRecording | Bool | Request fingerprint recording |
| ActivateOpMode | Bool | Activate the operating mode selected in the `OpMode` parameter. |
| OpMode | USInt | Preselection of the desired operating mode of the SM 1281.<br>0: STOP: System ready<br>1: RUN: Monitoring<br>2: RUN: Monitoring deactivated<br>3: RUN: Measuring<br>4: RUN: System diagnostics<br>Values >4 are interpreted as 0 (STOP: System ready) |

## Input/output parameters

Table 11- 2 FB SM1281_Module - input/output parameters

| Parameters | Data type | Description |
|---|---|---|
| DBStateModule | Struct | Reference to the module structure in the DB "SM1281_Status" |
| DBBackupModule | SM1281_Type_Moduleparameters | Reference to the module parameter structure in the DB "SM1281_Backup" |

## Output parameters

Table 11- 3 FB SM1281_Module - output parameters

| Parameters | Data type | Description |
|---|---|---|
| ActualSpeed | Real | Current speed in revolutions per minute |
| QC_Speed | USInt | Qualifier for speed, see table QC_Speed (Page 107) |
| ActualOpMode | USInt | Current operating mode of the SM 1281 |
| StateOpModeChange | USInt | Status of operating mode change |
| StateRawDataRec | USInt | Status of raw data recording |
| StateFingerprintRec | USInt | Status of fingerprint recording |
| SystemState | DWord | System state |

## Status and error displays ActualOpMode

Table 11- 4 FB SM1281_Module - Status and error displays ActualOpMode

| Status | Meaning |
|---|---|
| 0 | System not ready |
| 1 | Shutdown |
| 2 | Initializing |
| 3 | IDLE: Wait for S7-1200 |
| 4 | Error: System not ready |
| 5 | STOP: Configuration |
| 6 | STOP: System ready |
| 7 | RUN: System diagnostics |
| 8 | RUN: Measuring |
| 9 | RUN: Monitoring inhibited |
| 10 | RUN: Monitoring |

## Status and error displays StateOpModeChange

Table 11- 5 FB SM1281_Module - Status and error displays StateOpModeChange

| Status | Meaning | Remedy / notes |
|---|---|---|
| 0 | Last change successful | - |
| 1 | Change detected, attempt is made to execute | - |
| 2 | Error IP configuration | Check IP configuration |
| 3 | Error VIB1: Sensitivity of sensor | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 4 | Error VIB1: Speed ratio | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |

| Status | Meaning | Remedy / notes |
|---|---|---|
| 5 | Error VIB2: Sensitivity of sensor | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 6 | Error VIB2: Speed ratio | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 7 | Error VIB3: Sensitivity of sensor | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 8 | Error VIB3: Speed ratio | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 9 | Error VIB4: Sensitivity of sensor | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 10 | Error VIB4: Speed ratio | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 11 | Error VIB1: Limit value vRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` or `SetDynParameters` |
| 12 | Error VIB1: Limit value aRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` or `SetDynParameters` |
| 13 | Error VIB2: Limit value vRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` or `SetDynParameters` |
| 14 | Error VIB2: Limit value aRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` or `SetDynParameters` |
| 15 | Error VIB3: Limit value vRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` or `SetDynParameters` |
| 16 | Error VIB3: Limit value aRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` or `SetDynParameters` |
| 17 | Error VIB4: Limit value v-RMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` or `SetDynParameters` |
| 18 | Error VIB4: Limit value aRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` or `SetDynParameters` |
| 19 | Fault: RMS hysteresis | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 20 ... 26 | Not used | - |
| 27 | Error speed configuration | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 28 | Not assigned | - |
| 29 | Control priority S7 not active | The Web server has the control priority, therefore S7 cannot change the state. |
| 30 | Error VIB1: Filter combination vRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 31 | Error VIB1: Filter combination aRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 32 | Error VIB2: Filter combination vRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 33 | Error VIB2: Filter combination aRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 34 | Error VIB3: Filter combination vRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 35 | Error VIB3: Filter combination aRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |

| Status | Meaning | Remedy / notes |
|---|---|---|
| 36 | Error VIB4: Filter combination vRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 37 | Error VIB4: Filter combination aRMS | Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters` |
| 38 | Error VIB1: Duration v-RMS | Invalid parameter assignment - Check parameters and load in SM 1281 with `SetAllParameters` |
| 39 | Error VIB1: Duration a-RMS | Invalid parameter assignment - Check parameters and load in SM 1281 with `SetAllParameters` |
| 40 | Error VIB2: Duration v-RMS | Invalid parameter assignment - Check parameters and load in SM 1281 with `SetAllParameters` |
| 41 | Error VIB2: Duration a-RMS | Invalid parameter assignment - Check parameters and load in SM 1281 with `SetAllParameters` |
| 42 | Error VIB3: Duration v-RMS | Invalid parameter assignment - Check parameters and load in SM 1281 with `SetAllParameters` |
| 43 | Error VIB3: Duration a-RMS | Invalid parameter assignment - Check parameters and load in SM 1281 with `SetAllParameters` |
| 44 | Error VIB4: Duration v-RMS | Invalid parameter assignment - Check parameters and load in SM 1281 with `SetAllParameters` |
| 45 | Error VIB4: Duration a-RMS | Invalid parameter assignment - Check parameters and load in SM 1281 with `SetAllParameters` |
| 46 ... 254 | Not assigned | - |
| 255 | Error CMS internal | Restart the device. If the error occurs again contact Siemens Customer Support. |

## Status and error displays StateFingerprintRec

Table 11- 6 FB SM1281_Module - Status and error displays StateFingerprintRec

| Status | Meaning | Remedy / notes |
|---|---|---|
| 0 | IDLE | Status at startup |
| 1 | Recording ongoing | - |
| 2 | Last recording was successful | - |
| 3 | Error in the last recording | This error occurs if the control priority is not with the S7-1200 CPU, for example. |

## Status and error displays StateRawDataRec

Table 11- 7 FB SM1281_Module - Status and error displays StateRawDataRec

| Status | Meaning | Remedy / notes |
|---|---|---|
| 0 | IDLE | Status at startup |
| 1 | Recording ongoing | - |
| 2 | Last recording was successful | - |
| 3 | Error in the last recording | This error occurs if the control priority is not with the S7-1200 CPU, for example. |

## Status and error displays SystemState

Table 11- 8 FB SM1281_Module - Status and error displays SystemState

| Status (bit no.) | Meaning | Remedy / notes |
|---|---|---|
| 0 | VIB1: aRMS monitoring failed | Monitoring was not possible over a long period of time. |
| 1 | VIB2: aRMS monitoring failed | Monitoring was not possible over a long period of time. |
| 2 | VIB3: aRMS monitoring failed | Monitoring was not possible over a long period of time. |
| 3 | VIB4: aRMS monitoring failed | Monitoring was not possible over a long period of time. |
| 4 | VIB1: vRMS monitoring failed | Monitoring was not possible over a long period of time. |
| 5 | VIB2: vRMS monitoring failed | Monitoring was not possible over a long period of time. |
| 6 | VIB3: vRMS monitoring failed | Monitoring was not possible over a long period of time. |
| 7 | VIB4: vRMS monitoring failed | Monitoring was not possible over a long period of time. |
| 8 | VIB1: Monitoring of the acceleration spectrum failed | Monitoring was not possible over a long period of time. |
| 9 | VIB2: Monitoring of the acceleration spectrum failed | Monitoring was not possible over a long period of time. |
| 10 | VIB3: Monitoring of the acceleration spectrum failed | Monitoring was not possible over a long period of time. |
| 11 | VIB4: Monitoring of the acceleration spectrum failed | Monitoring was not possible over a long period of time. |
| 12 | VIB1: Monitoring of the velocity spectrum failed | Monitoring was not possible over a long period of time. |
| 13 | VIB2: Monitoring of the velocity spectrum failed | Monitoring was not possible over a long period of time. |
| 14 | VIB3: Monitoring of the velocity spectrum failed | Monitoring was not possible over a long period of time. |
| 15 | VIB4: Monitoring of the velocity spectrum failed | Monitoring was not possible over a long period of time. |
| 16 | VIB1: Monitoring of the envelope spectrum failed | Monitoring was not possible over a long period of time. |
| 17 | VIB2: Monitoring of the envelope spectrum failed | Monitoring was not possible over a long period of time. |
| 18 | VIB3: Monitoring of the envelope spectrum failed | Monitoring was not possible over a long period of time. |
| 19 | VIB4: Monitoring of the envelope spectrum failed | Monitoring was not possible over a long period of time. |
| 20 | Speed measurement failed | The speed measurement has failed. |
| 21 | Memory space critical | The memory space on the internal Flash is >90% full. |
| 29 | Version error: SM1281 FW newer than SM1281 Lib | Incompatible version of FB and FW |
| 30 | Version error: SM1281 Lib newer than SM1281-FW | Incompatible version of FB and FW |
| 31 | Internal error | - |

## See also

FC SM1281_Channel - Parameters (Page 103)

## 11.3.2 FC SM1281_Channel

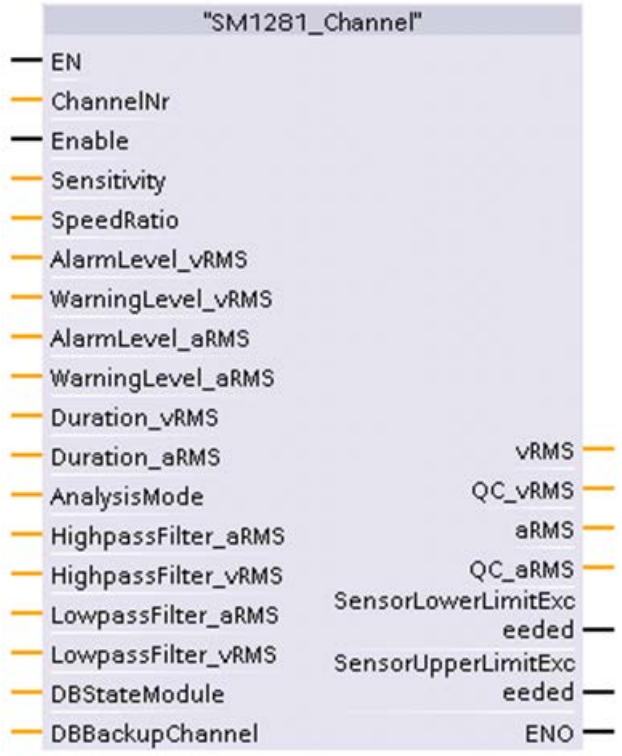



Figure 11-2 FC SM1281_Channel

## Function

The "SM1281_Channel" block offers the following functions:

- Channel-specific parameter setting
- Output of channel-specific status and error information

For each channel of the SM 1281 that is used, a call of the "SM1281_Channel" function is needed.

The assignment of the function call to the corresponding module is done via the input parameters `SM1281_Status` and `SM1281_Backup` (the data type instances of the respective module must be created there). The channel (number) to be configured is defined on the respective SM 1281 via the input parameter `ChannelNR`.

## References

The operation of the block is explained in Chapter Using blocks (Page 120) with the aid of use cases.

You can find the meanings of the parameters and of the error and status codes in the following tables.

### 11.3.2.1 FC SM1281_Channel - Parameters

## Input parameters

Table 11- 9 FC SM1281_Channel - Input parameters

| Parameters | Data type | Description |
|---|---|---|
| ChannelNR | USInt | Assignment to the channel of the SM 1281: Channel number 1-4<br>A channel number <1 is interpreted as Channel 1.<br>A channel number >4 is interpreted as Channel 4. |
| Enable | Bool | Permits enabling and disabling of the channel. |
| Sensitivity | Real | Sensor sensitivity in mV/g (>0.001) |
| SpeedRatio | Real | Speed ratio (>0) |
| AlarmLevel_vRMS | Real | Limit value alarm vRMS in mm/s<br>The value range is limited to 0.0...255.99609375 by an internal conversion to a 16-bit fixed point number!<br>Values <0 are interpreted as 0,<br>values >255.99609375 are interpreted as 255.99609375.<br>0: The limit value is not monitored. |
| WarningLevel_vRMS | Real | Limit value warning vRMS in mm/s<br>The value range is limited to 0.0...255.99609375 by an internal conversion to a 16-bit fixed point number!<br>Values <0 are interpreted as 0,<br>values >255.99609375 are interpreted as 255.99609375.<br>0: The limit value is not monitored.<br>`WarningLevel_vRMS` must be less than the associated `AlarmLevel_vRMS`. |
| AlarmLevel_aRMS | Real | Limit value alarm aRMS in m/s²<br>The value range is limited to 0.0...255.99609375 by an internal conversion to a 16-bit fixed point number!<br>Values <0 are interpreted as 0,<br>values >255.99609375 are interpreted as 255.99609375.<br>0: The limit value is not monitored. |
| WarningLevel_aRMS | Real | Limit value warning aRMS in m/s²<br>The value range is limited to 0.0...255.99609375 by an internal conversion to a 16-bit fixed point number!<br>Values <0 are interpreted as 0,<br>values >255.99609375 are interpreted as 255.99609375.<br>0: The limit value is not monitored.<br>`WarningLevel_aRMS` must be less than the associated `AlarmLevel_aRMS`. |

| Parameters | Data type | Description |
|---|---|---|
| Duration_vRMS | USInt | Duration for characteristic values vRMS:<br>0: 3 revolutions<br>1-60: 1-60 seconds<br>61: 2 minutes<br>62: 3 minutes<br>63: 4 minutes<br>64: 5 minutes<br>65: 6 minutes<br>66: 7 minutes<br>67: 8 minutes<br>68: 9 minutes<br>69: 10 minutes |
| Duration_aRMS | USInt | Duration for characteristic values aRMS:<br>0: 3 revolutions<br>1-60: 1-60 seconds<br>61: 2 minutes<br>62: 3 minutes<br>63: 4 minutes<br>64: 5 minutes<br>65: 6 minutes<br>66: 7 minutes<br>67: 8 minutes<br>68: 9 minutes<br>69: 10 minutes |
| AnalysisMode | USInt | Analysis mode:<br>0: Standard<br>1: Moving aRMS<br>2: Moving vRMS |
| HighpassFilter_aRMS | USInt | Preselection limit frequency high-pass filter aRMS:<br>0: 0.1 Hz (not allowed with AnalysisMode = 0. Default)<br>1: 2 Hz<br>2: 10 Hz<br>3: 100 Hz<br>4: 1000 Hz<br>5: 2000 Hz |
| HighpassFilter_vRMS | USInt | Preset limit frequency high-pass filter vRMS:<br>0: 0.1 Hz (not allowed with AnalysisMode = 0. Default)<br>1: 2 Hz<br>2: 10 Hz<br>3: 100 Hz |

| Parameters | Data type | Description |
|---|---|---|
| LowpassFilter_aRMS | USInt | Preselection low-pass filter limit frequency aRMS:<br>0: 2 Hz<br>1: 10 Hz<br>2: 100 Hz<br>3: 1000 Hz<br>4: 2000 Hz<br>5: 5000 Hz<br>6: 10000 Hz |
| LowpassFilter_vRMS | USInt | Preselection low-pass filter limit frequency vRMS:<br>0: 2 Hz<br>1: 10 Hz<br>2: 100 Hz<br>3: 1000 Hz<br>4: 2000 Hz |

## Explanation of input parameters

### Parameters for duration

The module calculates the characteristic values for aRMS and vRMS via a configurable time interval. Specify the duration individually for each channel and separately for both aRMS and vRMS using the "SM1281_Channel" function. The adjustable value range for the duration is 0 … 600s.

A preset with the value "0" is a special case: This preset means that the module interprets the characteristic values "as soon as possible". The module requires at least 3 revolutions for the calculation. The guaranteed cycle time is 2 s starting with a velocity of 600 rpm.

### Parameters for analysis mode

Use the "AnalysisMode" parameter to set the method for calculating a characteristic value channel-by-channel. You can choose between an intermittent calculation (standard) and a moving calculation (moving aRMS or moving vRMS). The moving calculation is limited to two channels per module. If you select the moving calculation for more than two channels, the module reports an error at an operating mode change to RUN and the change fails.

For the analysis mode, you can set one of three values for each channel:

- Standard

  In the "Standard" analysis mode, the module stores the raw data of the vibrating channel in a buffer (intermittent method) according to the configured duration. The module then calculates the characteristic values for aRMS and vRMS; the two characteristic values are always based on the same raw data start time. This module also cyclically determines the three spectra of acceleration, vibration velocity and the envelope of the vibration acceleration.

  You can set a maximum of 10 s for the duration. If you set a longer duration, the module reports an error at an operating mode change to RUN and the change fails.

  The calculation period for determining the characteristic values can exceed the configured duration.

- Moving aRMS

  In analysis mode "Moving aRMS", the module calculates the parameter for vRMS with an incremental, block-by-block analysis of the raw data (16k samples). Spectra and characteristic value of vRMS can not be determined.

  The duration can be adjusted in 10 min intervals. You may not set the value "0" (3 revolutions) for the "Duration" parameter: If you set the value "0", the module reports an error at an operating mode change to RUN and the change fails.

  The duration for the first RMS characteristic value is approximately equal to the configured duration; then the module provides new RMS characteristic values every 2 seconds.

- Moving vRMS

  In analysis mode "Moving vRMS", the module calculates the parameter for vRMS with an incremental, block-by-block analysis of the raw data (16k samples). Spectra and characteristic value of aRMS can not be determined.

  The duration can be adjusted in 10 min intervals. You may not set the value "0" (3 revolutions) for the "Duration" parameter: If you set the value "0", the module reports an error at an operating mode change to RUN and the change fails.

  The duration for the first RMS characteristic value is approximately equal to the configured duration; then the module provides new RMS characteristic values every 2 seconds.

#### Parameters for high-pass and low-pass filter

If you set an illegal value for the parameters "HighpassFilter_aRMS", "HighpassFilter_vRMS", "LowpassFilter_aRMS" or "LowpassFilter_vRMS", the "SM1281_Module" block generates an error message at the "StateOpModeChange" output parameter.

It is not permitted to set the high-pass filter with the cut-off frequency 0.1 Hz for the "Standard" analysis mode.

## Input/output parameters

Table 11- 10 FC SM1281_Channel - Input/output parameters

| Parameters | Data type | Description |
|---|---|---|
| DBStateModule | Struct | Reference to the module structure (Page 109) in the DB "SM1281_Status".<br>The assignment to the FB "SM1281_Module" or to the SM 1281 in the device configuration also takes place at this point. |
| DBBackupChannel | SM1281_Type_Channelparameters | Reference to the channel parameter structure (Page 112) in the DB "SM1281_Backup". |

## Output parameters

Table 11- 11 FC SM1281_Channel - Output parameters

| Parameters | Data type | Description |
|---|---|---|
| vRMS | Real | Speed vRMS in mm/s |
| QC_vRMS | USInt | Qualifier speed vRMS (see table Status and error displays QC_vRMS) |
| aRMS | Real | Interval rms value of vibration acceleration aRMS in m/s² |
| QC_aRMS | USInt | Qualifier interval rms value of vibration acceleration aRMS (see table Status and error displays QC_aRMS) |
| SensorLowerLimitExceeded | Bool | Sensor measuring range undershot |
| SensorUpperLimitExceeded | Bool | Sensor measuring range exceeded |

## Status and error displays QC

Table 11- 12 FC SM1281_Channel - Status and error displays QC_Speed

| Status | Meaning |
|---|---|
| 0 | Do not evaluate (no function) |
| 1 | Good |
| 2 | Not calculated yet |
| 3 | Cannot be calculated |

## Status and error displays QC_vRMS

Table 11- 13 FC SM1281_Channel - Status and error displays QC_vRMS

| Status | Meaning |
|---|---|
| 0 | Do not evaluate (no function) |
| 1 | Good |
| 2 | Not calculated yet |
| 3 | Cannot be calculated |

## Status and error displays QC_aRMS

Table 11- 14 FC SM1281_Channel - Status and error displays QC_aRMS

| Status | Meaning |
|---|---|
| 0 | Do not evaluate (no function) |
| 1 | Good |
| 2 | Not calculated yet |
| 3 | Cannot be calculated |

## 11.3.3 DB SM1281_Status

### Function

The global data block "SM1281_Status" contains all status, traffic light and error information of the SM 1281. The data is stored structured by module and channel.

The data for an SM 1281 module is created in the data block. When more than one SM 1281 is used, the parameter "Module1" can be copied and pasted as "Module2". The names of the parameters "Module", "Channel_1", "Channel_2", "Channel_3", "Channel_4" can be renamed as required.

### See also

Status and actual displays (Page 58)

### 11.3.3.1 DB SM1281_Status - Parameter

### Parameters

Table 11- 15 DB SM1281_Status - Parameter

| Parameters | Data type | Description |
|---|---|---|
| **Module1** | **Struct** | All status and actual values of the SM 1281 are stored in this PLC data type.<br>When there are several SM 1281 modules, the parameter `Module1` can be copied and pasted as `Module2` in the DB "SM1281_Status". |
| **Module** | **SM1281_Type_ModuleStatus** | This structure contains module-specific status and actual values. |
| ActualSpeed | Real | Current speed in revolutions per minute |
| QC_Speed | USInt | Qualifier for speed (see table QC_Speed (Page 107)) |
| ActualOpMode | USInt | Current operating mode of the SM 1281 |
| StateOpModeChange | Word | Status of operating mode change |
| StateFingerprintRec | USInt | Status of raw data recording |
| StateRawDataRec | USInt | Status of fingerprint recording |
| SystemState | DWord | System state |
| **InternalData** | **SM1281_Type_Moduleparameters** | Internal data, not relevant for users |
| **InternalData_1** | **Struct** | Internal data, not relevant for users |
| **Channel_1** | **SM1281_Type_ChannelStatus** | All status and actual values of the first channel of the SM 1281 are stored in this structure. |
| vRMS | Real | Interval rms value of the vibration velocity vRMS in mm/s |
| aRMS | Real | Interval rms value of vibration acceleration aRMS in m/s² |
| QC_vRMS | USInt | Qualifier interval rms value of the vibration velocity vRMS (see table QC_vRMS (Page 107)) |

| Parameters | Data type | Description |
|---|---|---|
| QC_aRMS | USInt | Qualifier interval rms value of vibration acceleration aRMS (see table QC_aRMS (Page 108)) |
| Sensor offset | Real | Sensor operating point |
| **MonState_vRMS** | **Struct** | Monitoring status vRMS |
| NotValid | Bool | Do not evaluate (status unknown) |
| Good | Bool | Good (green) |
| Warning | Bool | Warning (yellow) |
| Alarm | Bool | Alarm (red) |
| **MonState_aRMS** | **Struct** | Monitoring status aRMS |
| NotValid | Bool | Do not evaluate (status unknown) |
| Good | Bool | Good (green) |
| Warning | Bool | Warning (yellow) |
| Alarm | Bool | Alarm (red) |
| **MonState_a(f)** | **Struct** | Monitoring status acceleration spectrum |
| NotValid | Bool | Do not evaluate (status unknown) |
| Good | Bool | Good (green) |
| Warning | Bool | Warning (yellow) |
| Alarm | Bool | Alarm (red) |
| **MonState_v(f)** | **Struct** | Monitoring status velocity spectrum |
| NotValid | Bool | Do not evaluate (status unknown) |
| Good | Bool | Good (green) |
| Warning | Bool | Warning (yellow) |
| Alarm | Bool | Alarm (red) |
| **MonState_e(f)** | **Struct** | Monitoring status envelope spectrum |
| NotValid | Bool | Do not evaluate (status unknown) |
| Good | Bool | Good (green) |
| Warning | Bool | Warning (yellow) |
| Alarm | Bool | Alarm (red) |
| **MonState_e(f)_BPFO** | **Struct** | Monitoring status envelope spectrum BPFO (ball passing frequency outer race) |
| NotValid | Bool | Do not evaluate (status unknown) |
| Good | Bool | Good (green) |
| Warning | Bool | Warning (yellow) |
| Alarm | Bool | Alarm (red) |
| **MonState_e(f)_BPFI** | **Struct** | Monitoring status envelope spectrum BPFI (ball passing frequency inner race) |
| NotValid | Bool | Do not evaluate (status unknown) |
| Good | Bool | Good (green) |
| Warning | Bool | Warning (yellow) |
| Alarm | Bool | Alarm (red) |
| **MonState_e(f)_FTF** | **Struct** | Monitoring status envelope spectrum FTF (fundamental train frequency) |
| NotValid | Bool | Do not evaluate (status unknown) |

| Parameters | Data type | Description |
|---|---|---|
| Good | Bool | Good (green) |
| Warning | Bool | Warning (yellow) |
| Alarm | Bool | Alarm (red) |
| **MonState_e(f)_BSF** | **Struct** | Monitoring status envelope spectrum BSF (ball spin frequency) |
| NotValid | Bool | Do not evaluate (status unknown) |
| Good | Bool | Good (green) |
| Warning | Bool | Warning (yellow) |
| Alarm | Bool | Alarm (red) |
| **SensorState** | **Struct** | Sensor state |
| NotValid | Bool | Do not evaluate (e.g. sensor is not parameterized) |
| Connected | Bool | Connected sensor |
| LowerLevelExeeded | Bool | Sensor measuring range undershot |
| UpperLevelExeeded | Bool | Sensor measuring range exceeded |
| **InternalData** | **SM1281_Type_Channelparameters** | Internal data, not relevant for users |
| **Channel_2** | **SM1281_Type_ChannelStatus** | All status and actual values of the second channel of the SM 1281 are stored in this structure. |
| **Channel_3** | **SM1281_Type_ChannelStatus** | All status and actual values of the third channel of the SM 1281 are stored in this structure. |
| **Channel_4** | **SM1281_Type_ChannelStatus** | All status and actual values of the fourth channel of the SM 1281 are stored in this structure. |

## See also

FC SM1281_Channel - Parameters (Page 103)

## 11.3.4 DB SM1281_Backup

### Function

If all of the parameters have been successfully transferred to the SM 1281, they are backed up as a parameter set in the global and retentive data block "SM1281_Backup". The backed up parameters can be restored via the input parameter `RestoreParameters` of the "SM1281_Module" block.

### 11.3.4.1 DB SM1281_Backup - Parameter

### Parameters

Table 11- 16 DB SM1281_Backup - Parameter

| Parameters | Data type | Description |
|---|---|---|
| **Module_1** | **Struct** | |
| **Module parameters** | **SM1281_Type_Moduleparameters** | This structure contains the automatically backed up module parameters. |
| SpeedSource | Byte | Selection of the speed source:<br>1: S7-1200<br>2: DI - Digital input of the SM 1281 |
| PulsesPerRevolution | UInt | Pulses per revolution if the DI of the SM 1281 is used as speed source. The value must be greater than 0. |
| Hysteresis_RMS | USint | RMS hysteresis in % (based on the respective configured threshold value for the vibration channels) |
| IPAddress | DWord | IP address of the SM 1281 |
| SubnetMask | DWord | Subnet mask of the SM 1281 |
| DefaultGateway | DWord | Default gateway of the SM 1281 |
| DHCP | Bool | Use of a DHCP server (automatic assignment of the IP address and subnet mask) |
| **Parameters_Channel_1** | **SM1281_Type_Channelparameters** | This structure contains the automatically backed up parameters of channel 1. |
| ChannelNr | USInt | Channel number |
| Enable | Bool | Specifies whether the channel is enabled or disabled. |
| Sensitivity | Real | Sensitivity of sensor |
| SpeedRatio | Real | Speed ratio |
| AlarmLevel_vRMS | Real | Limit value alarm vRMS in mm/s |
| WarningLevel_vRMS | Real | Limit value warning vRMS in mm/s |
| AlarmLevel_aRMS | Real | Limit value alarm aRMS in m/s² |
| WarningLevel_aRMS | Real | Limit value warning aRMS in m/s² |
| Duration_vRMS | USInt | Duration for characteristic values vRMS |
| Duration_aRMS | USInt | Duration for characteristic values aRMS |
| AnalysisMode | USInt | Analysis mode |
| HighpassFilter_aRMS | USInt | Preset limit frequency high-pass filter aRMS: [1] |

| Parameters | Data type | Description |
|---|---|---|
| HighpassFilter_vRMS | USInt | Preset limit frequency high-pass filter vRMS: [1] |
| LowpassFilter_aRMS | USInt | Preset limit frequency low-pass filter aRMS: [1] |
| LowpassFilter_vRMS | USInt | Preset limit frequency low-pass filter vRMS: [1] |
| **Parameters_Channel_2** | **SM1281_Type_Channelparameters** | This structure contains the automatically backed up parameters of channel 2. |
| **Parameters_Channel_3** | **SM1281_Type_Channelparameters** | This structure contains the automatically backed up parameters of channel 3. |
| **Parameters_Channel_4** | **SM1281_Type_Channelparameters** | This structure contains the automatically backed up parameters of channel 4. |

[1] It an illegal value is given as the preset, an error message is generate at the "SM1281_Module" via the `StateOpModeChange` output parameter.

# 11.4 Working with the library

## 11.4.1 Integrating the library in STEP 7

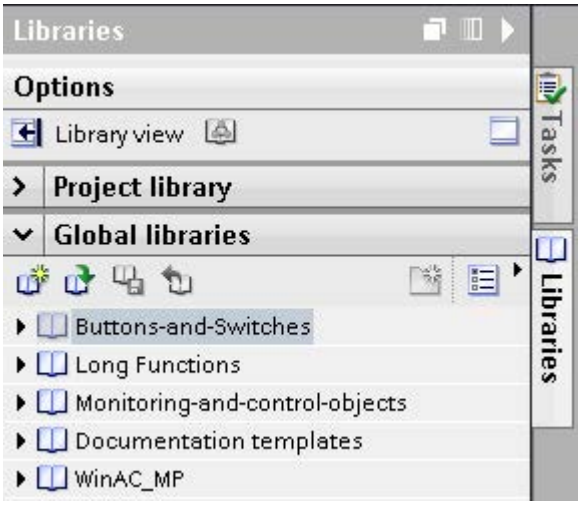
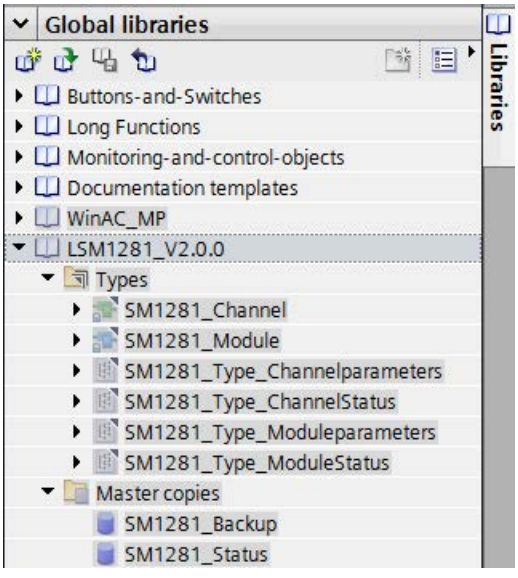
### Requirement

A STEP 7 project with an S7-1200 CPU and at least one configured SM 1281 must be available.

### Integrating the library in STEP 7

You can download the SM 1281 library via the Support (https://support.industry.siemens.com/cs/?lc=en-DE).

To integrate the library "SM1281_Library" in your STEP 7 project, proceed as described here:

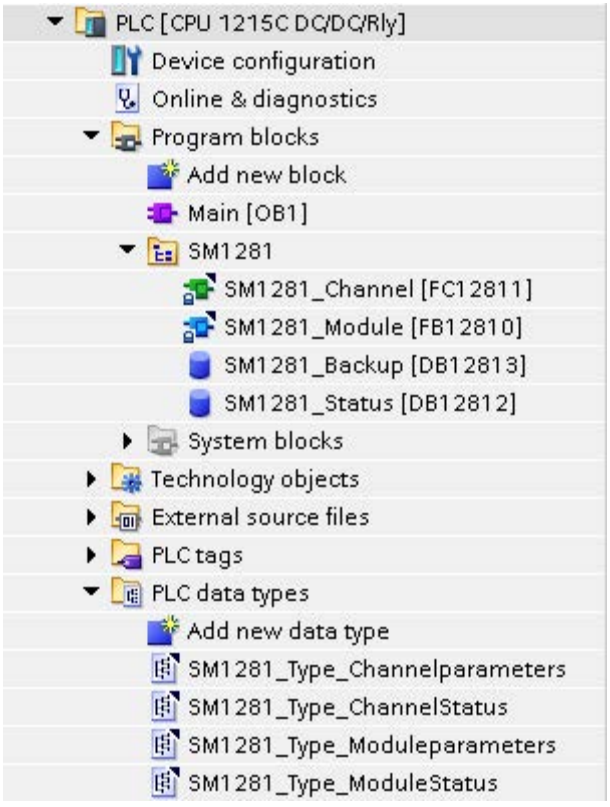
| No. | Step | View in the TIA Portal |
|---|---|---|
| 1 | The library is available as ZIP archive.<br>Unzip the ZIP archive into a folder on your PC, from which you would like to open the global library.<br>Choose "Options > Global libraries > Retrieve library" from the menu to do so. | - |
| 2 | Open the library.<br>To do this, open the display of the global libraries on the right in the TIA Portal.<br>In the display, you can open the library "SM1281_Library".<br>To do this, press the button for opening a library, select the storage location with the unzipped ZIP archive and the library file, and press the "Open" button of the Open dialog. |  |
| 3 | In the opened global library, you see all of the components it contains.<br>• Types<br>The needed PLC data types, the "SM1281_Channel" function, and the "SM1281_Module" function block are saved here.<br>• Copy templates<br>The two global data blocks are saved here. |  |

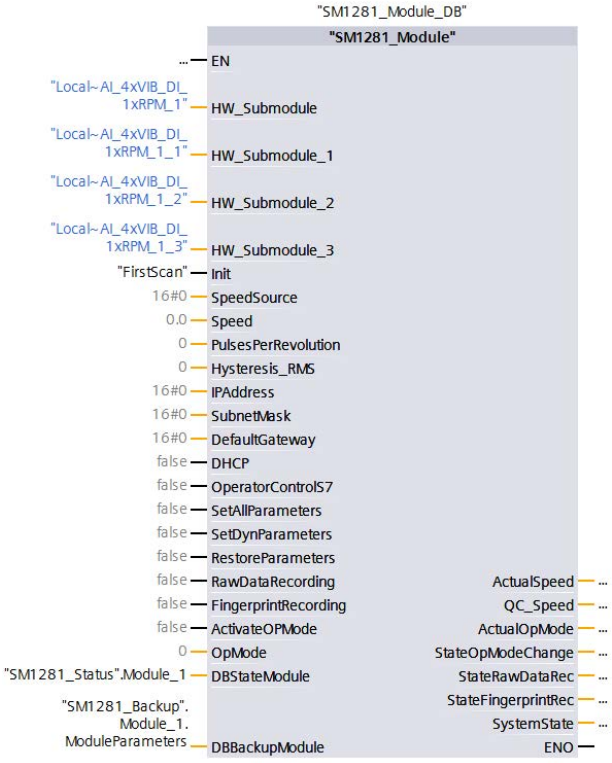
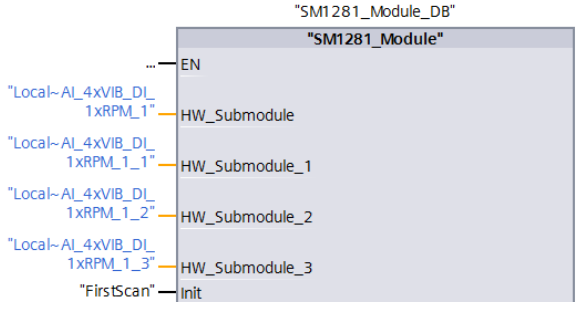
## Result

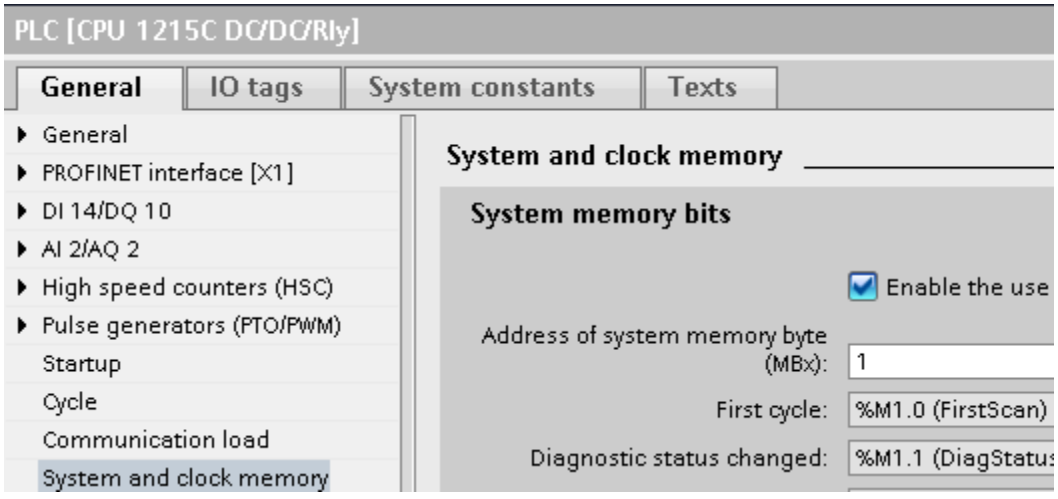
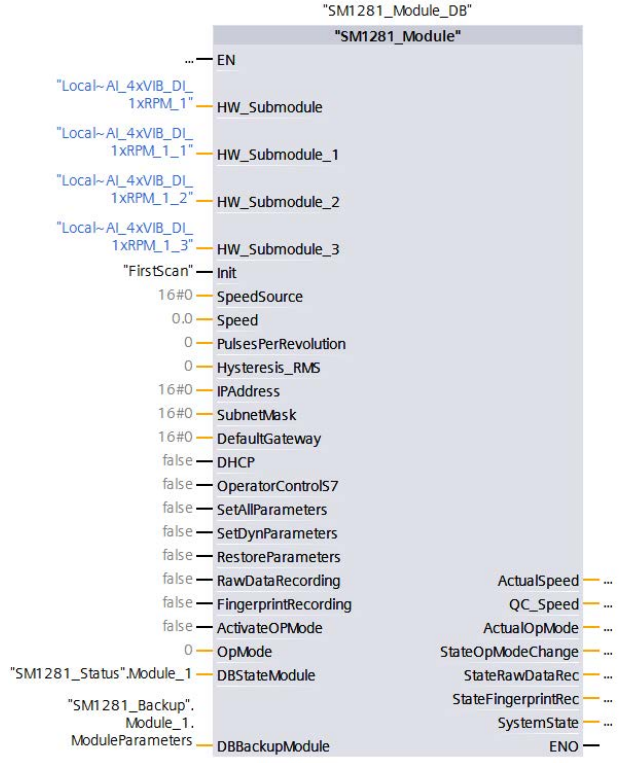
The library is integrated in STEP 7 and you can use the blocks of the library.

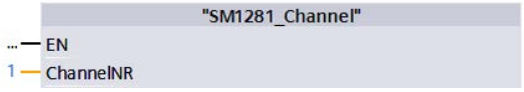
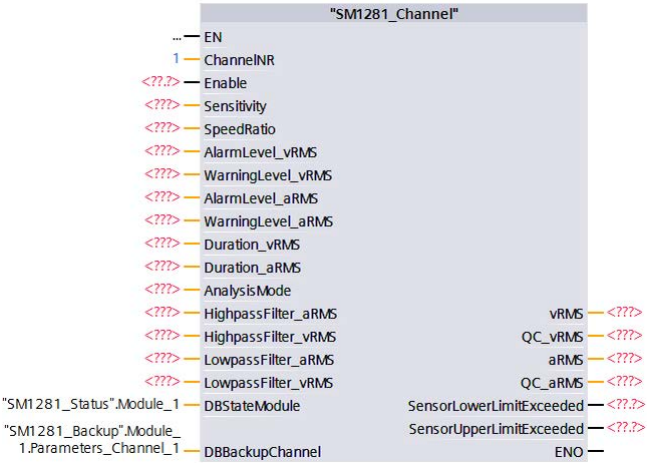
## 11.4.2 Integrating blocks in STEP 7

The steps for integrating the blocks of the "SM1281_Library" in your STEP 7 program are listed below

| No. | Step | View in the TIA Portal |
|---|---|---|
| 1 | To import the function block "SM1281_Module" and the function "SM1281_Channel" in your user program, drag and drop the function block and the function from the "Types" folder (from the global library) to the "Program blocks" folder of the S7-1200 CPU of your TIA Portal project.<br>The PLC data types that are referenced in the blocks are automatically copied as well.<br>Drag and drop the data blocks "SM1281_Status" and "SM1281_Backup" from the "Copy templates" folder (from the global library) to the "Program blocks" folder of the S7-1200 CPU of your TIA Portal project.<br>**Result**:<br>All of the needed blocks from the "SM1281_Library" are contained in your user program (see figure). |  |
| 2 | Calling the "SM1281_Module" function block in the user program:<br>To be able to use the function block in the user program, it must be opened in a cyclic organization block, e.g. in OB1 "Main". | - |

| No. | Step | View in the TIA Portal |
|---|---|---|
| 3 | After you have opened the block in a cyclic organizational block and have created an instance data block, assign an SM 1281 from the hardware configuration to the block.<br>This is done via the four input parameters:<br>• `HW_Submodule`<br>• `HW_Submodule_1`<br>• `HW_Submodule_2`<br>• `HW_Submodule_3`<br>Double-clicking on the input field of one of the input parameters and clicking on the button causes a list of the available HW submodules to appear.<br>At this point, select the respective HW submodule of the SM 1281 that belongs to the input parameter. The SM 1281 is divided into four HW submodules. |  |
| 4 | After you have assigned an SM 1281 to the block, assign the system flag for the first cycle of your S7-1200 CPU to the input parameter `Init`. |  |

| No. | Step | View in the TIA Portal |
|---|---|---|
| | If necessary, you must activate the system flag under the properties of the S7-1200 CPU in the device configuration beforehand. | |
| |  | |
| 5 | Assign the corresponding element from the data blocks "SM1281_Status" and "SM1281_Backup" to the input/output parameters `DBStateModule` and `DBBackupModule`.<br><br>To do this, connect the input/output parameter `DBStateModule` to the variable "Module1" of the data type "Struct" from the "SM1281_Status" data block.<br><br>Connect the input/output parameter `DBBackupModule` with the variable "Module parameters" of the data type "SM1281_Type_Moduleparameters" from the "Module1" structure in the "SM1281_Backup" data block.<br>**Result**:<br>After you have performed all of the steps, the block is connected (see figure).<br><br>For each SM 1281, a call of the block "SM1281_Module" is necessary in the user program. When more than one SM 1281 is used, the data structures in the data blocks "SM1281_Status" and "SM1281_Backup" must be expanded by the necessary number of modules, e.g. by copying and pasting the module structure. |  |

| No. | Step | View in the TIA Portal |
|---|---|---|
| 6 | Next, call the function "SM1281_Channel" in a cyclic organization block in the user program.<br>For each channel of the SM 1281 that is used, a call of the "SM1281_Channel" function is needed. If you only use one channel, you also only need one call of the "SM1281_Channel". | - |
| 7 | Assign a channel of the SM 1281 to the function. This is done via the `ChannelNR` input parameter. The valid values at this point are integer numbers from 1 to 4. |  |
| 8 | In the last step, assign the corresponding element from the data blocks "SM1281_Status" and "SM1281_Backup" to the input/output parameters `DBStateModule` and `DBBackupChannel`.<br>To do this, connect the input/output parameter `DBStateModule`, as in Step 4, to the variable "Module1" of the data type "Struct" from the "SM1281_Status" data block.<br>To do this, connect the input/output parameter `DBBackupChannel` with the variable "Parameters_Channel_1" of the data type "SM1281_Type_Channelparameters" from the "Module1" structure in the "SM1281_Backup" data block. For channel 2, the variable "Parameters_Channel_2" etc. accordingly.<br>**Result**:<br>After you have performed all of the steps, the block is connected (see figure).<br>The remaining input and output parameters must still be connected to the user program.<br>Repeat steps 6 to 8 for each additional channel and adapt the parameters to the channel accordingly. |  |

## 11.4.3 Using blocks

### Requirement

**Note**

**Configure SM 1281**

The SM 1281 can only be operated and configured if it is ready.

The SM 1281 is ready if it is in the state "STOP: Configuration" in "STOP: System ready" or in one of the RUN operating modes. In all other cases, no operation of the module via the S7-1200 CPU is possible!

For the following use cases, the module and channel parameters must be assigned valid values.

The following describes use cases which are possible with the library blocks.

### 11.4.3.1 Select operating mode/CPU restart

The SM 1281 has the following operating modes:

- (0) STOP: System ready
- (1) RUN: Monitoring
- (2) RUN: Monitoring inhibited
- (3) RUN: Measuring
- (4) RUN: System diagnostics

The current operating mode is displayed on the output parameter `ActualOpMode` of the "SM1281_Module" block. This can differ from the selected operating mode in the following cases, for example:

- The selection of the operating mode failed (e.g. because invalid parameters were transferred to the module previously).
- The SM 1281 is not ready.
- The selected operating mode has not yet been confirmed via `ActivateOpMode`.

## Selecting an operating mode

The following describes how to select an operating mode:

| No. | Step | Note |
|---|---|---|
| 1 | Select the desired operating mode via the corresponding index at the input parameter `OpMode` of the "SM1281_Module" block. | |
| 2 | Confirm selection with positive edge at the input parameter `ActivateMode`. | The SM 1281 now attempts to set the selected operating mode. This may take a few seconds.<br>You can discern whether the selected operating mode has been successfully adopted via the error code at the output parameter `StateOpModeChange`. If the requested operating mode has not been successfully adopted, information about the cause is displayed here. The assignment of the error codes can be found in the Table (Page 98). |

**Note**

If a new operating mode is selected, the feedback message "Last switchover successful" (0) is displayed during the switchover of the operating mode via the output parameter `StateOpModeChange`, before the selected operating mode is reached. The background for this is that the SM 1281 carries out several internal mode changes depending on the request.

**Note**

As long as a mode change is being carried out, no new operating mode be requested. A new selection is rejected in this case.

## Behavior in the event of a CPU restart and failure of the SM 1281

For a CPU restart (warm restart), the parameters that are set on the blocks are automatically transferred to the SM 1281 and the operating mode selected at the input parameter `OpMode` is set. If there are invalid parameters at the block interfaces, the SM 1281 remains in the mode "STOP: Configuration" or "STOP: System ready" and an error message is output at the output parameter `StateOpModeChange`. If the parameterization is wrong, it must be corrected and reloaded. If the import is successful, the desired operating mode can then be set.

If the SM 1281 fails on its own, e.g. due to an interruption of the power supply, the operating mode that is selected at the input parameter `OpMode` is also automatically set after the restart of the module.

### 11.4.3.2 All parameters are transferred to the SM 1281

The parameters pending at the block interfaces are only transferred to the SM 1281 upon request.

All of the parameters which are present at the input parameters of the blocks "SM1281_Module" and "SM1281_Channel" are transferred via a positive edge at the input parameter `SetAllParameters`.

Depending on the current operating mode of the SM 1281, a switch of operating modes is automatically carried out.

**Note**

**Interruption of the monitoring**

The request "Transfer all parameters to the SM 1281" leads to the operating mode "STOP: Configuration".
This briefly interrupts any currently running monitoring.

This is necessary because the SM 1281 cannot import some parameters in RUN mode. After the successful import of the parameters in the SM 1281, the operating mode that was active before the transfer of the parameters is restored.

If the parameters were not successfully transferred, an error message is displayed at the output parameter `OpModeChangeStatus` if an operating mode changeover fails.

**Note**

As long as the transfer of the parameters has not completed, no new parameters can be transferred. A new request is rejected in this case.

### 11.4.3.3 Transferring dynamic parameters to the SM 1281

In addition to the capability of transferring all of the parameters to the SM 1281, you can also transfer only the dynamic parameters. This is only possible in the mode "RUN: Monitoring" or "RUN: Monitoring deactivated".

The SM 1281 does not carry out a change of operating modes to a STOP mode when importing dynamic parameters. This has the advantage that the measuring mode/monitoring mode is not interrupted in contrast to `SetAllParameters`.

The dynamic parameters, which are present at the input parameters of the block "SM1281_Channel", are transferred via a positive edge at the input parameter `SetDynParameters`.

The limit values listed below can be changed via this command. It is not possible, however, to activate or deactivate the limit value monitoring via this mechanism. To do this, it is necessary to transfer **all** of the parameters to the SM 1281.

#### Dynamic parameters

The four dynamic parameters serve as limit values of the vRMS and aRMS monitoring:

| Parameters | Data type | Description |
|---|---|---|
| AlarmLevel_vRMS | Real | Limit value alarm vRMS in mm/s |
| WarningLevel_vRMS | Real | Limit value warning vRMS in mm/s |
| AlarmLevel_aRMS | Real | Limit value alarm aRMS in m/s² |
| WarningLevel_aRMS | Real | Limit value warning aRMS in m/s² |

**Note**

As long as the transfer of the parameters has not completed, no new parameters can be transferred. A new request is rejected in this case.

### 11.4.3.4 Requesting fingerprint recording

A fingerprint, i.e. the current state of the machine, can be saved on the "SM1281_Module" block via the input parameter `FingerprintRecording`. A fingerprint is requested via a positive edge. Depending on the request, one fingerprint is saved in the fingerprint database for each active vibration channel on the SM 1281 module (maximum 100 fingerprints).

The status of the recording is displayed on the output parameter `StateFingerprintRec` (see status and error displays table (Page 100)).

**Note**

As long as recording is running, no new recording can be requested.

A new recording can only be requested when the current recording has been successfully completed or the recording could not be carried out due to an error!

## See also

FB SM1281_Module - Parameters (Page 96)

### 11.4.3.5 Request recording of raw data

The SM 1281 is able to store raw data in the form of WAV files. The raw data contains high-resolution recordings of the vibration inputs of the device and the speed.

Such a recording can be requested via a positive edge at the input parameter `RawDataRecording` of the "SM1281_Module" block.

The status of the recording is displayed on the output parameter `StateRawDataRec` (see status and error displays table (Page 100)).

**Note**

As long as recording is running, no new recording can be requested. A new recording can only be requested when the current recording has been successfully completed or the recording could not be carried out due to an error!

## See also

FB SM1281_Module - Parameters (Page 96)

### 11.4.3.6 Backing up and restoring parameters

For each successful transition to the operating mode "RUN: Monitoring", the last parameters transferred to the SM 1281 are automatically backed up in the retentive data block "SM1281_Backup". This ensures that all of the parameters which had previously been transferred to the SM 1281 are valid. If, for example, the SM 1281 is not set to a RUN state after an erroneous parameterization, the last successfully transferred parameters can be restored. In this way, the SM 1281 can then be set to the desired operating mode.

A valid parameter set can be restored by a positive edge at the input `RestoreParameters` on the "SM1281_Module" block. Basically, all of the parameters are transferred from the "SM1281_Backup" data block to the SM 1281. Depending on the operating mode, internal changes of operating mode are carried out to import the parameters.

After the parameters are successfully restored, the last operating mode of the SM 1281 is restored. After the parameters have been successfully restored, the desired operating mode can be set via `ActivateMode`.

**Note**

While the parameters are being restored, no commands can be set via the blocks.

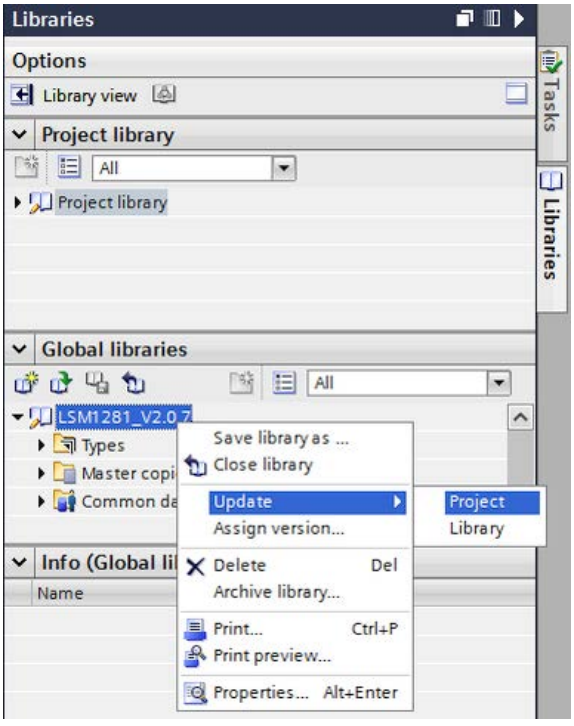
# 11.5 Update library

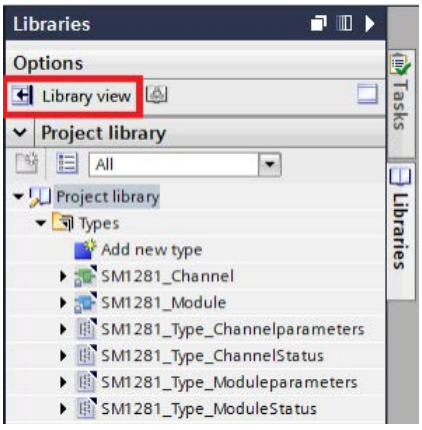
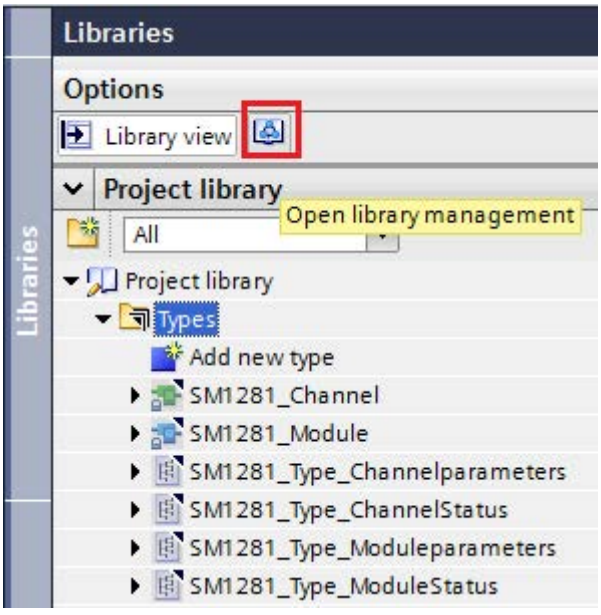
## Update library

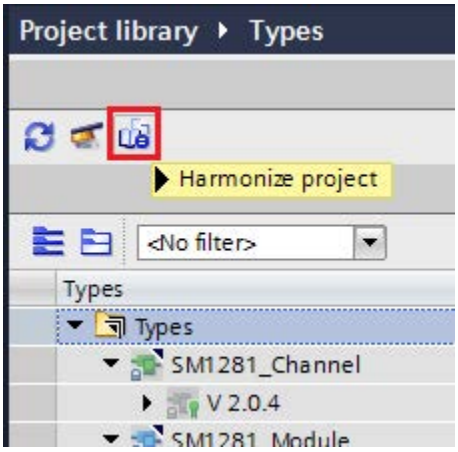
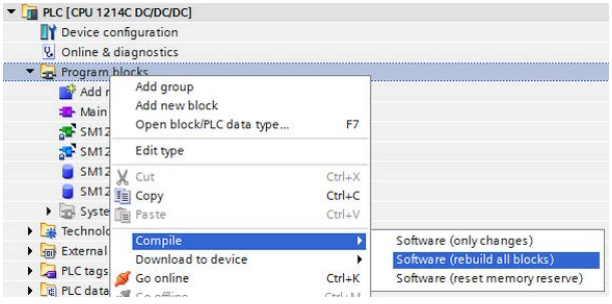
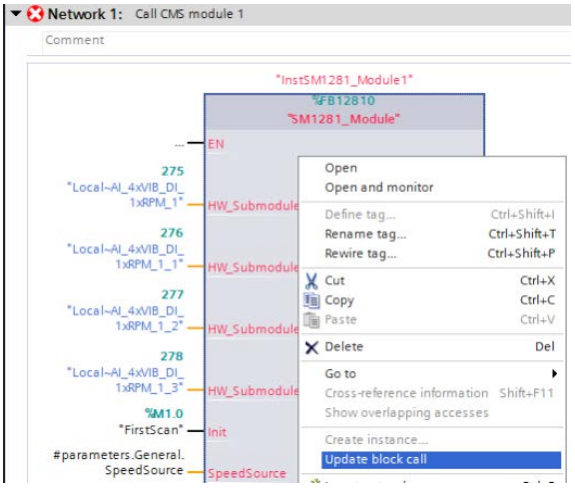
For operation of the SM1281, it is important that the firmware of the module as well as the version of the library match. Always use the blocks from the V1.x library for modules with firmware version V1.x, and always use the blocks from the V2.x library for modules with firmware version V2.x.

If a module with firmware version V1.x is replaced by a module with firmware version V2.x, update your S7 user program and use the blocks from the V2.x library. Keep in mind that you have to compile the complete software after the update and not only the changes.

For instructions on updating the library, see the following overview.

| No. | Step | View in the TIA Portal |
|---|---|---|
| 1 | Retrieve and open the new version of the library as described inIntegrating the library in STEP 7 (Page 114). | |
| 2 | Right-click the global library and select the "Update > Project" command from the shortcut menu.<br>The "Update project" dialog opens. |  |
| 3 | Select the entire project for the update. Select the "Delete all unused versions of affected types" check box to delete all older versions of the updated types from the project library. | |

| No. | Step | View in the TIA Portal |
|---|---|---|
| 4 | Click "OK" to confirm. The update is performed.<br>The following changes were made to the project:<br>The most recent version of the select types is available in the project library. The older versions were deleted. All instances within the selected devices have been updated to the latest version of the associated types. | |
| 5 | Open the library view by clicking the "Library View" button in the task card libraries. |  |
| 6 | Select the Types folder in the library view and open the library management by clicking the "Library Manager" button. |  |

| No. | Step | View in the TIA Portal |
|---|---|---|
| 7 | Click on the "Harmonize project" button in the library management to match up the name of the updated library elements to the original name. |  |
| 8 | Close the library view and do a complete compile for the blocks in your STEP 7 project. |  |
| 9 | Since the interface of the blocks has changed, it is usually necessary to manually update the interface of the blocks in the call environment (OB, FC, FB).<br>To do this, open the OB, FC or FB in which the SM1281 blocks are called. Update the interface by right-clicking on the block -> Refresh.<br>Once you have updated all SM1281 bocks in the project, you still may have to interconnect the new or modified parameters. |  |

## See also

S7 Professional V13.1 (https://support.industry.siemens.com/cs/de/en/view/109011420)

# Parameter assignment/configuring 12

## 12.1 Overview

The settings for the SM 1281 can be made via the TIA Portal and via the SM 1281 Web server:

**Basic settings via the TIA Portal and in the S7 user program:**

- Network settings
- Speed
- Limit values vRMS and aRMS
- Sensitivity of sensor

**Expanded settings via the SM 1281 Web server:**

- device name, language, password
- Channel name
- Settings for spectral analysis

## 12.2 Setting initialization data via the TIA Portal

The initialization data is transferred from the user program to the SM 1281 module. It is valid for a module or for a channel.

- You can set the following **module parameters** for an SM 1281:
  - `SpeedSource`.
  - `Speed`
  - `PulsesPerRevolution`
  - Hysteresis RMS (`Hysteresis-RMS`)
  - IP configuration (`IPAddress`, etc.)
- You can set the following **channel parameters** per channel:
  - Channel active/inactive (`Enable`)
  - Sensitivity of sensor (`Sensitivity`)
  - Transformation ratio (`SpeedRatio`)
  - Alarm and warning limits vRMS and aRMS (`AlarmLevel_...`, `WarningLevel_...`)
  - Duration vRMS and aRMS (`Duration_...`)
  - Analysis mode (`AnalysisMode`)
  - High-pass and low-pass filter for vRMS and aRMS (`HighpassFilter_...`, `LowpassFilter_...`)

**Note**

The description of the parameters can be found in the SM 1281 library:

- Module parameters (Page 96)
- Channel parameters (Page 103)

# 12.3 Parameterizing via the SM 1281 web user interface

The following chapters describe the web user interface with the full functional range for parameterizing and displaying data.

The website for HMI panels has a limited scope of functions. It is described in Chapter Website for HMI panels (Page 184).

## 12.3.1 Software and hardware requirements

### Supported browsers

The web pages are designed to be used and displayed in the following browsers:

- Mozilla Firefox 31
- Internet Explorer 10
- Internet Explorer 11

**Note**

**Display problems**

If other browsers are used, display problems may occur.

### Browser settings

The websites uses cookies. Accept the use of cookies in the browser settings. Otherwise unwanted effects may result.

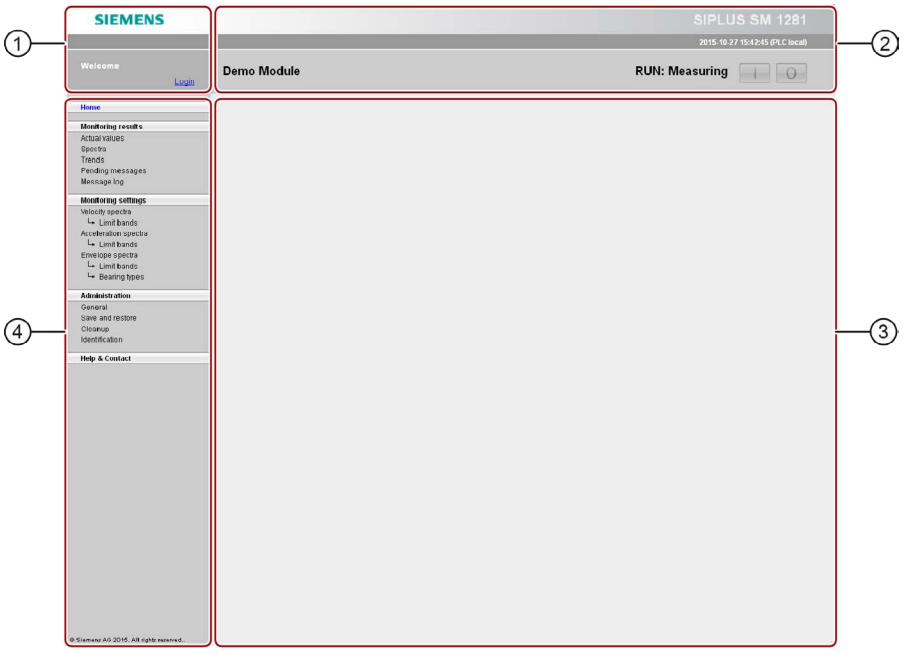
### Screen resolution

The web pages have been optimized for a screen resolution of 1280 x 1024 pixels.

## 12.3.2 General operation

### 12.3.2.1 Structure of the user interface

The web pages are structured as follows:




① **Login area**
This area contains:

- Name of the logged in user.
- Login/logoff function

② **Module overview**
This area contains:

- Device name
- Current operating mode, see Section Operating modes (Page 46)
- Button for switching to STOP if the device is in RUN
- Capability of switching to the device mode "RUN: Monitoring" or "RUN: Measuring" if the device is in STOP

③ **Work area**:
This area contains:

- Name of the page that was selected in the navigation area
- The selected web page with all the associated contents and parameters.

④ **Navigation area**
This area contains:

- Navigation tree that displays all the web pages that can be selected for the device
- Highlighting of the currently selected entry in the navigation tree

### 12.3.2.2 Logging in / logging out

#### Requirement

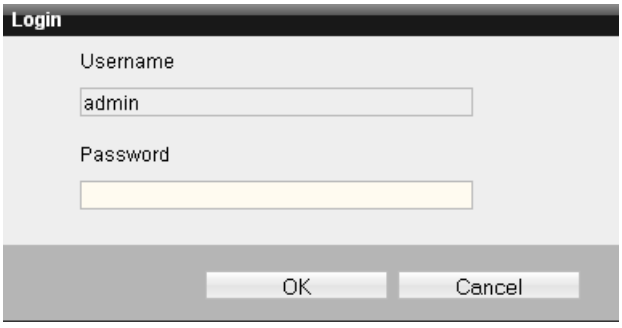
You have the operator authorization for the websites via the S7 user program.

#### Logging in / logging out

Before you can modify the device parameters, you must first log in. If you are not logged in, you will have read-only access to the SM 1281.

You can log in and log out on any selected web page.

To log in, click on "Login" in the log-in area. The following dialog appears:




Enter the log-in data and confirm with OK.

- Default user name: admin
- Default password: 0000 (four times "zero")

**Note**

Change the default settings after the first logon under General (Page 173).

**Note**

Multiple simultaneous user sessions (web sessions) are possible in principle, i.e. more than one user can access the same SM 1281 via the website from different PCs. The device only permits one login at a time, i.e. after a user has logged in, the others will only have read access.

**Note**

If you are inactive for a long time, there is no automatic logoff.

### 12.3.2.3 Setting the language for the device

The language for the web interface can be switched over between German and English. The language is set on the "Administration > "General" (Page 173) page.

**Note**

The language of the web interface is assigned to the SM 1281 device, not to the web session. This means that all users accessing at the same time will use the same language. If a user switches the language, all other users accessing at the same time will be affected by the language switchover.

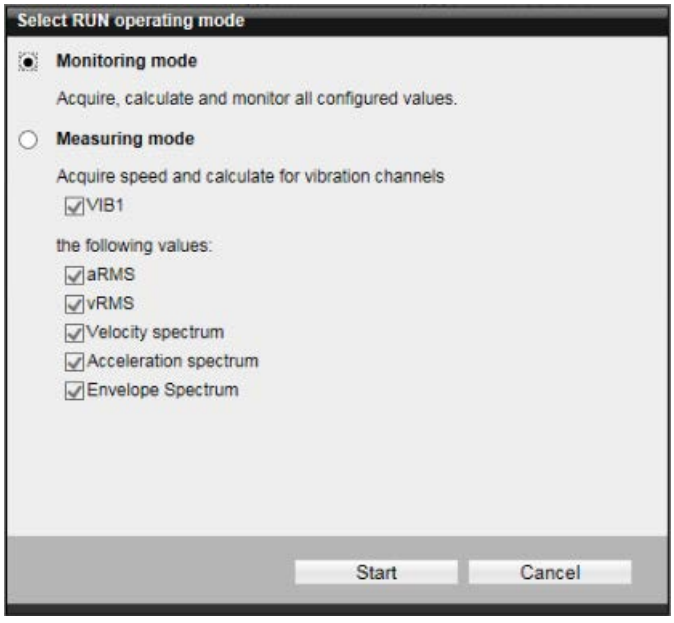
### 12.3.2.4 Changing operating mode

#### Changing the operating mode

The current operating mode is displayed to the left of the buttons [ I ] / [ O ].

You can switch to STOP mode from any page using the buttons.


You can switch from STOP mode to the modes "RUN: Monitoring" or "RUN: Measuring".




#### Monitoring mode

In the monitoring mode (RUN: Monitoring), all configured measured variables are constantly acquired or calculated, monitored, and recorded as trends.

### Measuring mode

You can decide during any change to the measurement mode (RUN: Measuring) via a dialog, which IEPE channels will be used and which measured values (RMS, spectra) will be calculated.

The configuration chosen for measurement mode is automatically stored and will be offered next time you switch to measurement mode.

When switching to the operating mode "RUN: Measuring" via the S7 controller, all of the measured variables (RMS, spectra) are always calculated.

## 12.3.2.5 Editing and saving values and settings

### Generally valid rules

- Only elements that you are allowed to modify can be edited.
- Only elements that you can use directly (in the current operating mode) can be edited.

### Entering values

- Decimal places are set for each input field. Rounding is performed automatically when you exit the input field.
- Decimal values must always be entered using a point ("."). This is the case regardless of which language is configured on the web pages (English or German).

### Incorrect inputs

The input is automatically checked when you exit the input field.

- In the case of incorrect inputs, a tool tip will appear with the error message
- On multiple errors, all affected fields will be marked
- On saving, the values of an input field are either imported completely, if no error is found, or the data remains unchanged if an error is found on saving.

### Saving data

Save the data using the "Save" button only. The "Save" button is offered if you have made changes on the web page.

### 12.3.2.6 Browser-specific operation

#### Browser-specific operation

- Multiple browser tabs or windows are supported. Changes made on one tab will not appear on other tabs until the changes have been saved and the other tabs have been reloaded.
- "Forward" and "Back" browser buttons are supported. If you have not saved the changes, the "Do you want to exit this page?" dialog appears. On confirming the dialog, the changes are lost, also if you go "Back", because the page is reloaded.
- Refresh (F5) using the browser is supported. The behavior here is identical to "Next"/"Back", i.e. the dialog "Do you want to leave this page?" appears and unsaved changes are lost.

### 12.3.2.7 Error messages

#### Error messages

If an error occurs during operation or a data request, or if an action is not possible, a dialog box will be opened in the workspace that describes the error in more detail.

**Example:**

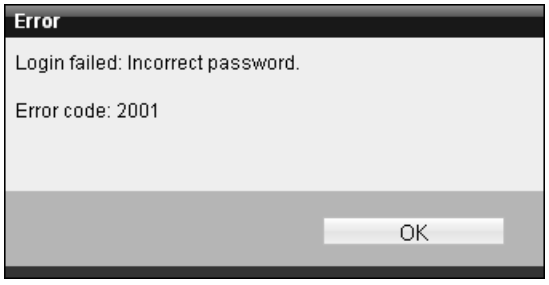



Figure 12-1 Example of an error message

## 12.3.3 Home page

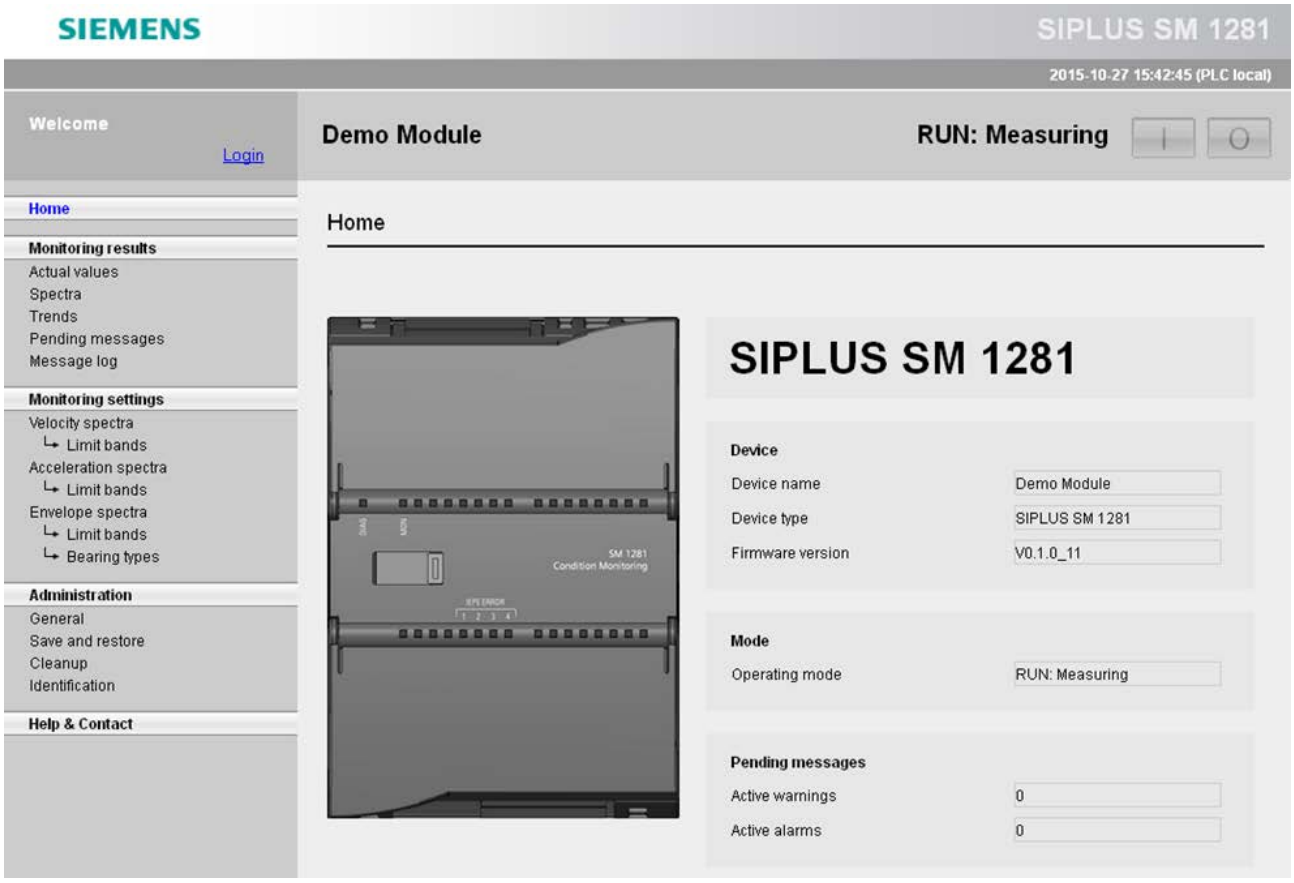
### 12.3.3.1 Home

On the home page, important system values are displayed.

To open the page, click "Home" in the navigation area.

### Display data

The home page shows a figure of the device. An overview contains information about the device, the operating mode, and pending messages.




### Device

| | |
|---|---|
| Device name | The device name defined by the user is displayed here. |
| Device type | The device type is displayed here. This cannot be changed. |
| Firmware version | Installed firmware version. |

### Operating mode

Display of the current operating mode:

| | |
|---|---|
| STOP: System ready | Device ready / no monitoring. |
| RUN: Measuring | Measured values are acquired / reference values are acquired / no monitoring. |
| RUN: Monitoring | Measured values are acquired and monitored |
| RUN: Monitoring inhibited | Measurements are performed / monitoring is suppressed. |
| RUN: System diagnostics | All of the parameterized vibration channels are measured. No further processing of the vibration data takes place. |
| Shutdown | Device is shutting down. A warm restart will be performed after a few seconds. |
| ERROR: System not ready | Device not ready |

### Pending messages

| | |
|---|---|
| Active warnings | Number of active warnings. |
| Active alarms | Number of active alarms. |

To obtain detailed information about the message, click on one of the output fields. You go directly to the website "Pending Messages" (Page 149).

## 12.3.4 Monitoring values

The **monitoring results** encompass the websites on which you can view and evaluate the monitoring responses.

The following monitoring results are available:

- Actual values (Page 139)
- Spectra (Page 142)
- Trends (Page 146)
- Pending messages (Page 149)
- Message log (Page 150)

### 12.3.4.1 Actual values

On the "Actual values" page, you can read the current measured values of the system. To open the web page, click "Monitoring results > Actual values" in the navigation area.

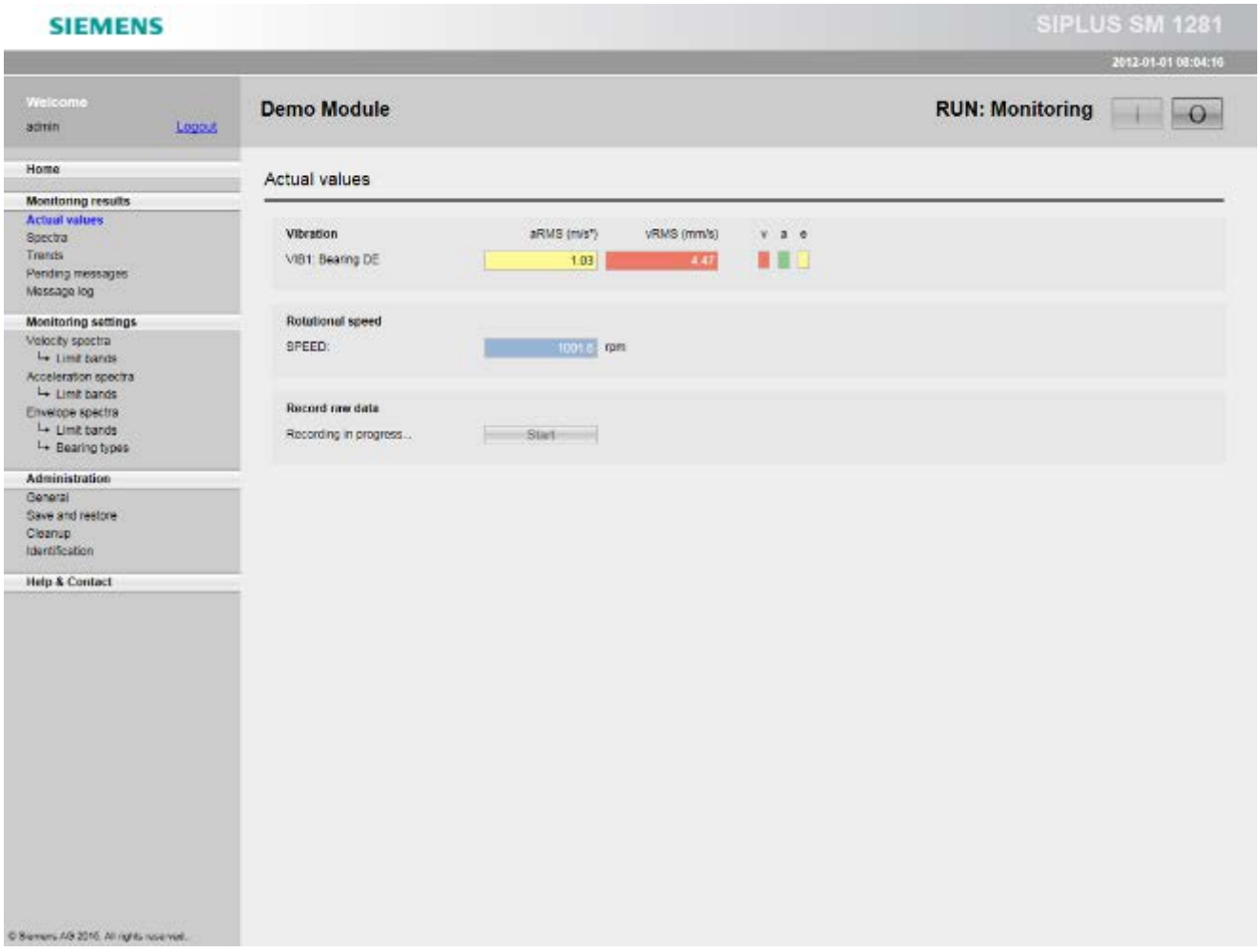
#### Vibration

The last calculated vRMS and aRMS values and their monitoring statuses and the monitoring statuses of the activated frequency-selective analysis methods are displayed here for all of the parameterized and activated vibration channels.

The calculated vRMS and aRMS values have colored backgrounds, depending on their respective monitoring state. The monitoring statuses of the activated frequency-specific analysis methods are displayed with stylized LEDs with colors that indicate the status (see table below).

#### Speed

The speed that is valid for the speed channel is displayed here.



## Display of values

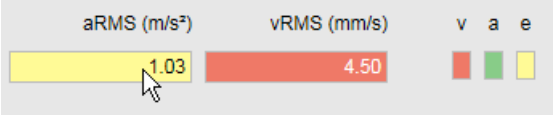
| Display of value | Meaning |
|---|---|
| ??? | The value is configured but not yet known, or the calculation has not yet finished.<br>The sensor or connecting cable may be defective. |
| <Value>? | The value has been calculated, but the result is uncertain. An uncertain result can arise, for example, if the value is located in an implausible value range, or if the sensor or connecting cable is defective. This is indicated by the gray background to the display area. |
| <Value> | The value has been calculated and is judged to be correct. This is indicated by the green, yellow, red or blue background to the display area. |

## Color identification

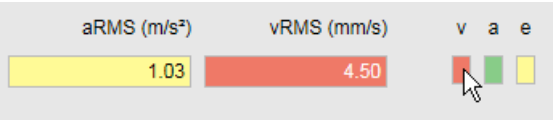
Correctly calculated values are highlighted using different background colors to indicate any limit transgressions.

| Color identification | | Meaning |
|---|---|---|
| Gray | | Measured value acquisition has not been performed or is faulty. |
| Light blue | | Measured value acquisition is OK. Value is not being monitored, however. |
| Green | | Measured value acquisition is OK. Value is being monitored. There has been no limit transgression. |
| Yellow | | Measured value acquisition is OK, value is being monitored, and a warning limit has been transgressed. |
| Red | | Measured value acquisition is OK, value is being monitored, and an alarm limit has been transgressed. |

## Display trends

| | |
|---|---|
| Clicking one of the fields with the mouse will take you directly to the page with the associated trend.<br>You can use the mouse to jump to a trend for:<br>• Speeds<br>• vRMS, aRMS |  |

## Displaying spectra

| | |
|---|---|
| Clicking one of the fields v, a, e with the mouse will take you directly to the page with the relevant type of spectrum.<br>v = velocity spectrum v(f)<br>a = acceleration spectrum a(f)<br>e = envelope spectrum env(f) |  |

## Recording raw data

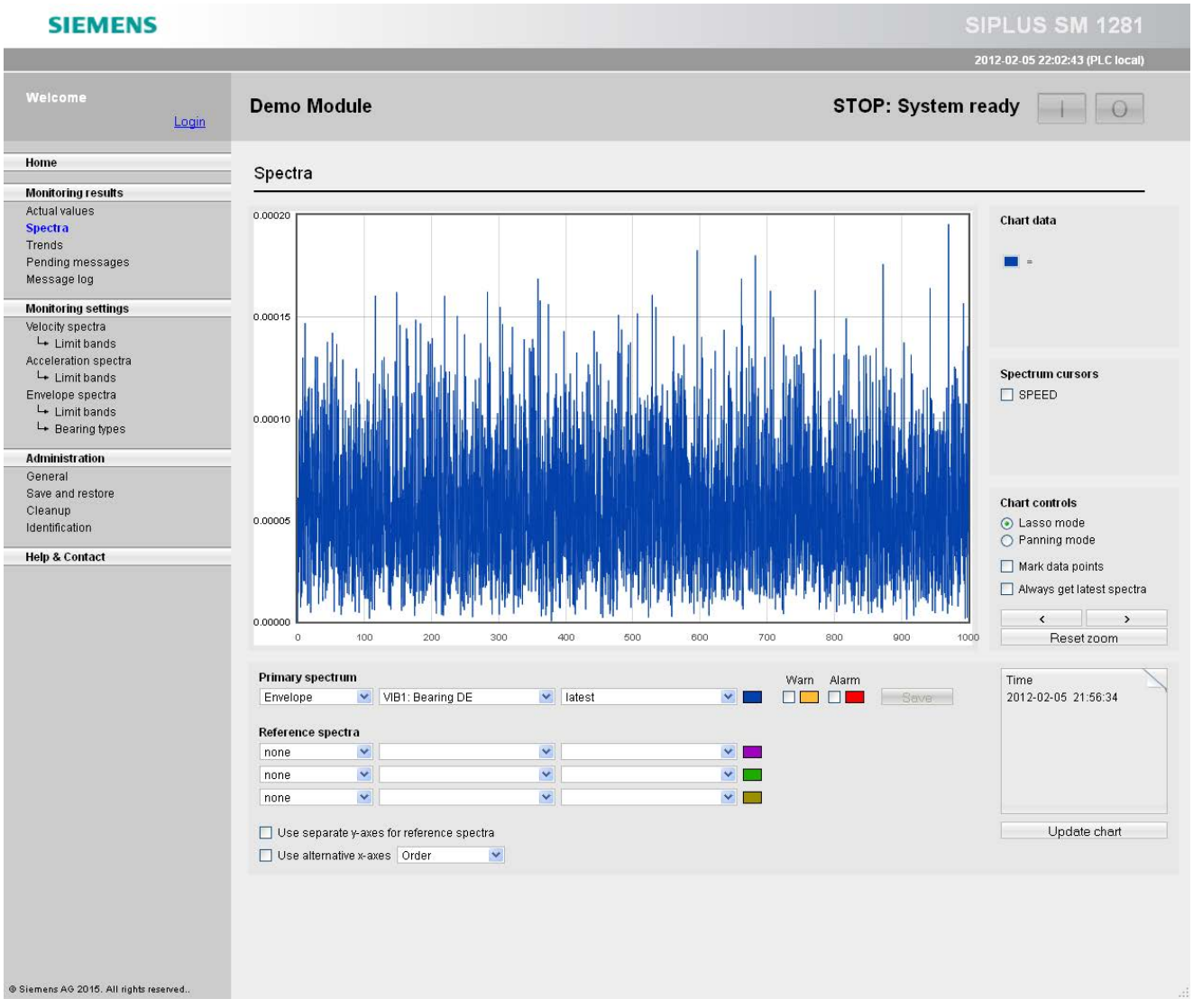
With the "Start" button, you can save the current measured values as raw data in a file.

### 12.3.4.2 Spectra

On the "Spectra" web page, you can display spectra in a chart and save fingerprints of current spectra. One primary spectrum and up to three reference spectra can be displayed at the same time. The following types of spectrum can be displayed:

- Velocity spectrum
- Acceleration spectrum
- Envelope spectrum

To open the web page, click "Monitoring results > Spectra" in the navigation area.




In the figure, the x axis shows the frequency and the y axis shows the amplitude. Alternatively, you can also set a scaling in "Revolutions per minute" or a non-unit "Order" (quotient of frequency and speed) for the x axis.

## Primary spectrum, reference spectra

To display spectra, choose one primary spectrum and up to three reference spectra.

To define a spectrum, select

- the type of spectrum: velocity, acceleration, envelope curve
- the IEPE channel: VIB1, VIB2...
- Either the current spectrum that was calculated last or a spectrum stored as a fingerprint

For the primary spectrum, you can additionally display the warning and alarm limits.

Clicking the "Update chart" button applies your settings and updates the chart display.

The color scheme for displaying the maximum of four curves is permanently defined.

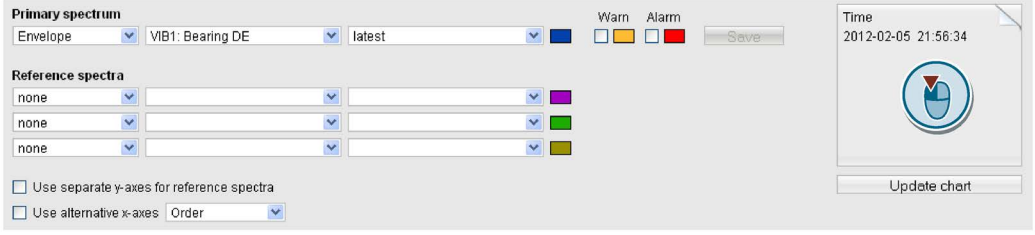
You can define whether the X axis of all displayed spectra is scaled alternatively. For this, you can choose a scaling by speed (in 1 / minute) and by order (non-unit scaling as factor of the speed assigned to the spectrum).

You can define whether only the Y axis of the primary spectrum will be displayed or whether each reference spectrum will be displayed on a separate Y axis.

**Note**

**Save settings**

Your settings are only saved if the "Update chart" button has been pressed.




The current spectrum can only be displayed if the relevant IEPE channel has been configured and the spectrum has been calculated. Spectra from fingerprints, on the other hand, can be displayed irrespective of the current configuration and the current operating mode.

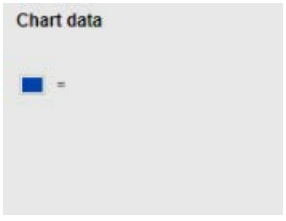
### Saving a fingerprint

If a current frequency spectrum is displayed as the primary spectrum, you can save it with "Save" as a fingerprint with a freely selectable name.

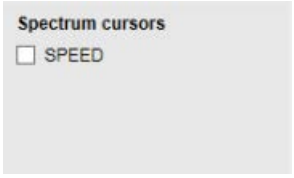
### Displaying other data

You can display further relevant data for each spectrum. Clicking the button (1) with the mouse pages through the following displays: Time stamp, aRMS, vRMS, speed.

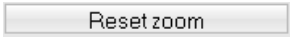
## Chart data

| | |
|---|---|
|  | The frequency corresponding to the horizontal position of the mouse pointer is displayed.<br>When you move the mouse pointer over the curves and limits displays, the associated values will be displayed. |

## Cursor

| | |
|---|---|
|  | For the selected primary spectrum, you can display markings in the charts based on the associated speed and the currently stored bearing type:<br>• For all spectra: Speed cursor (with multiples)<br>• For envelope spectrum: Bearing fault frequencies (with multiples)<br>Meaning of the abbreviations:<br>BPFO: **B**all **P**assing **F**requency **O**uter race<br>BPFI: **B**all **P**assing **F**requency **I**nner race<br>FTF: **F**undamental **T**rain **F**requency (cage rotation)<br>BSF: **B**all **S**pin **F**requency (rolling element rotation) |

## Chart controls

| | |
|---|---|
|  | **Lasso mode:** You show a magnified view of a specific section using the mouse wheel or lasso (drag the rectangle over the required area using the left mouse button). |
| | **Panning mode:** In this mode, you can pan the area of the screen being displayed holding the left mouse button down. |
| | **Show data points:**<br>Highlight / hide curve interpolation points. |
| | **Always get latest spectra:**<br>Active (checkbox selected): Cyclic updating of the displayed spectra<br>Inactive (checkbox cleared): No cyclic updating of the displayed spectra. The current spectra available when this checkbox is cleared are retained until the checkbox is selected again.<br>**NOTE:** Even if cyclic updating is not active, the current spectra are still calculated and monitoring for limit violations is performed. The monitoring results for the current spectra are displayed on the "Actual values" web page. |
|  | With these buttons, you can horizontally shift the displayed frequency band. |
|  | This button resets the display to the original time range. |
|  | Apply settings and update chart display |

### 12.3.4.3 Trends

On the "Trends" web page, you can display characteristic values / measured values recorded by the system in a trend chart.

Optionally, vRMS, aRMS, velocity and recorded spectra values can be displayed. The time interval can be selected.

To open the web page, click "Monitoring results"> Trends" in the navigation area.


The x axis shows the time; the y axis the respective measured value in the appropriate units.

**Note**

**Gaps in the display**

Trend values are only entered into the archive and displayed in the trend chart if the SM 1281 is in the RUN mode. Gaps in the display (see figure) show that the module was not in the RUN mode.

## Primary trend, reference trends

To display trend charts, you can choose

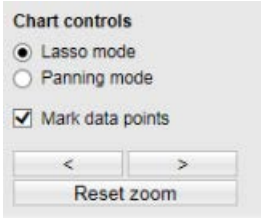
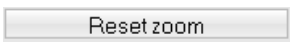
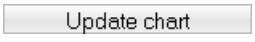
- any channel-related measured value as a primary value, e.g. aRMS on VIB1,
- up to three further channel-related values as reference values, e.g. vRMS on VIB2.

Recorded spectra values are selected by choosing the spectrum (envelope, acceleration, velocity), of the channel (VIB1 - VIB4) and trend name (assigned by user to the corresponding limit bands). Fields for trend names are grayed out and have no function if an RMS or velocity (instead of a spectrum) is selected in the affected row.


Up to 4 channel can be displayed at the same time. For each selected value, the minimum, maximum, and/or average value can be displayed. Up to 12 curves can be displayed in a fixed color scheme. For the "primary trend" you can additionally display the current warning and alarm limits specified by the S7.

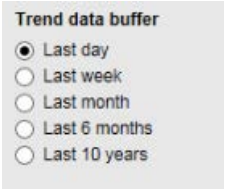
You can define whether only the Y axis of the "primary trend" will be displayed or whether each "reference trend" will be displayed on a separate Y axis.

## Chart controls

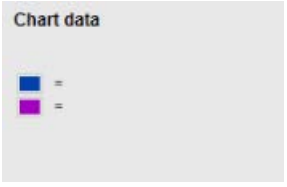
| | |
|---|---|
|  | **Lasso mode:** A specific section can be magnified using the mouse wheel or lasso (drag the rectangle over the required area using the left mouse button).<br>This zoom setting is retained if the chart is updated.<br>NOTE: For zooming, fresh data is not fetched from the archive, i.e. a display that has been compressed due to the volume of data will not be displayed with a higher resolution through zooming. To do this, a smaller time interval must be selected. |
| | **Panning mode:** In this mode, the area of the screen being display can be shifted holding the left mouse button down. "Panning mode" can only be active if "Lasso mode" is inactive. |
| | **Show data points:** Highlight / hide curve interpolation points.<br>NOTE: It is only appropriate to display the points if the display is already relatively detailed, i.e. when there are only a few curve points in the curve window. |
|  | With these buttons, you can horizontally shift the displayed time range. |
|  | This button resets the display to the original time range. |
|  | Apply settings and update chart display. |

## Trend data buffer

Trend data is only displayed for the selected time period if the duration in the RUN states is greater than the resolution of the selected time period.

| | |
|---|---|
|  | Here, you can define which time range will be displayed from the trend data buffer. The smaller the time range chosen, the finer the time resolution of the data and therefore the greater the precision.<br>• Last day: 1 minute (lowest resolution - high accuracy)<br>• Last week: 10 minutes<br>• Last month: 30 minutes<br>• Last 6 months: 3 hours<br>• Last 10 years: 24 hours (highest resolution - low accuracy) |

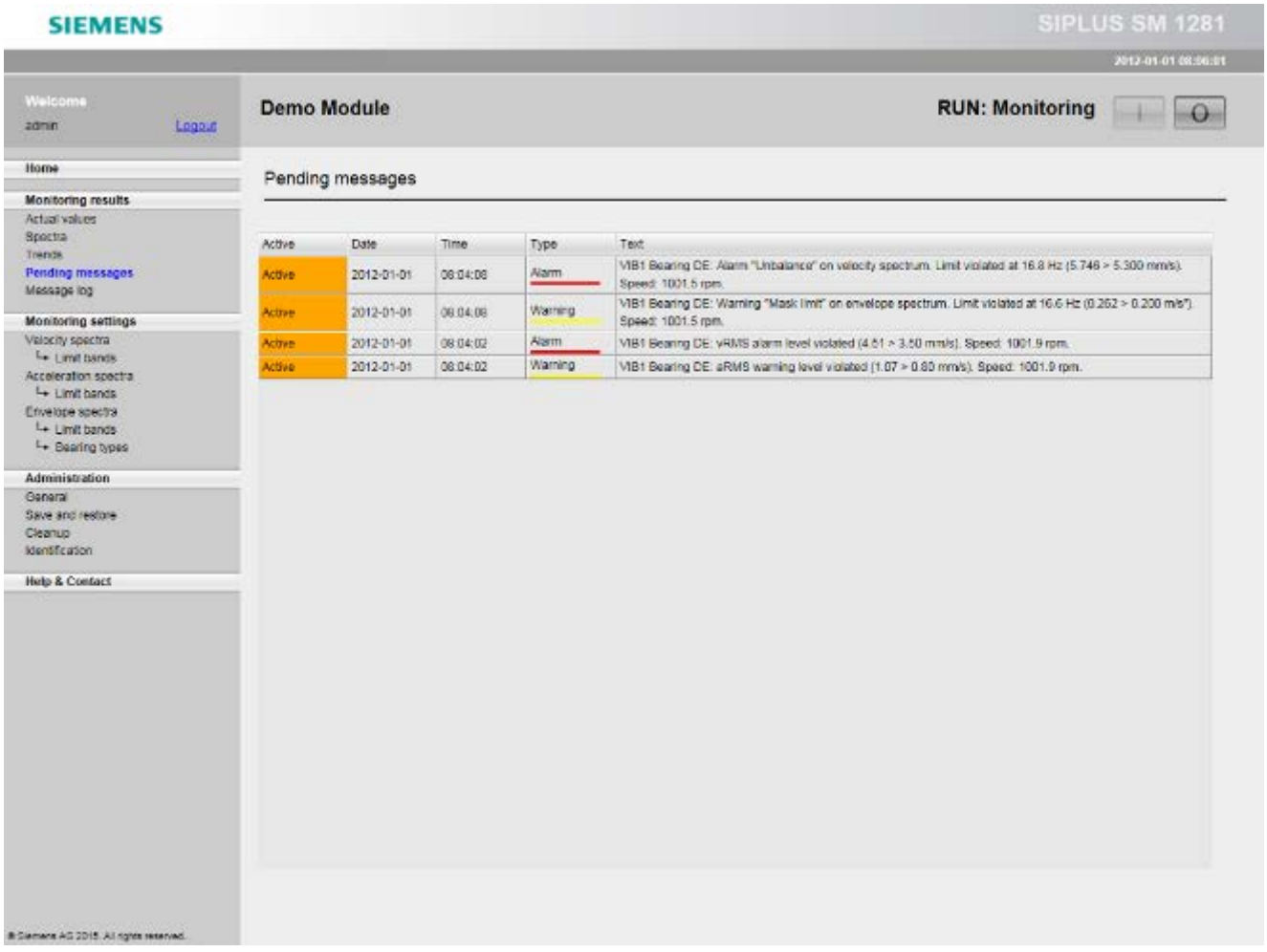
## Chart data

| | |
|---|---|
|  | The instant corresponding to the horizontal position of the mouse pointer is displayed. When you move the mouse pointer over the curves and limits displays, the associated numerical values will be displayed. |

### 12.3.4.4 Pending messages

All currently active messages are displayed on this website.

To open the page, click "Monitoring results > Pending messages" in the navigation area.



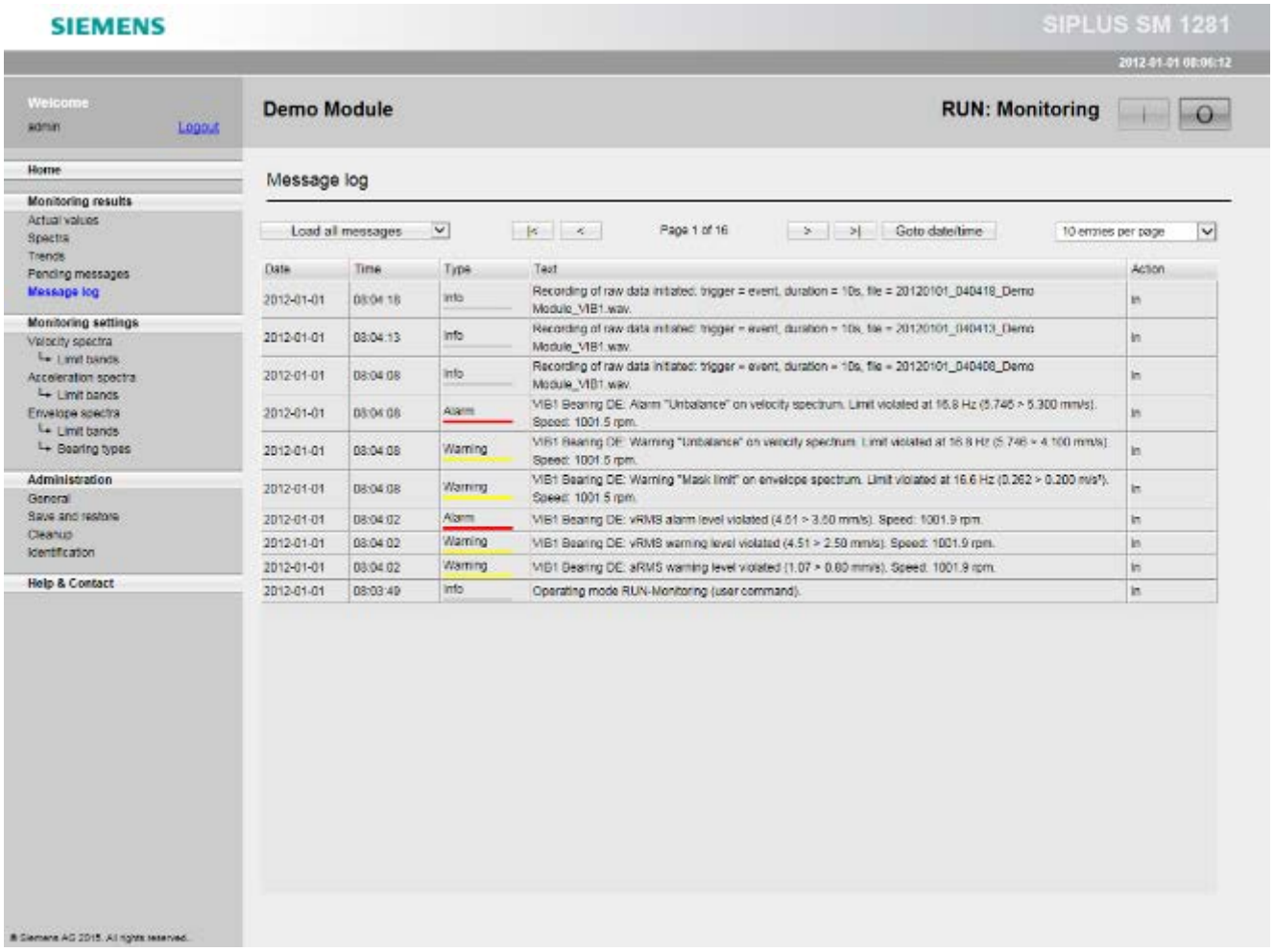

The list of messages is sorted by the time of creation of the message, most recent first.

### 12.3.4.5 Message log

On this web page, you can view the message history.

To open the page, click "Monitoring results > Message log" in the navigation area.

The list of messages is sorted by the time of creation of the message, most recent first.




## Display filter

For displaying messages, you can use the following filters via a dropdown menu:

| Filter | Meaning |
|---|---|
| Load all messages | Display All Messages |
| Load process messages | Only Display Process Messages |
| Load system messages | Only Display System Messages |

After selecting an entry, this entry can be clicked.

Via a further selection box, you can select between 10 and 200 entries per page.

## Displaying messages in the message log

| Action | Description | Remarks |
|---|---|---|
| In | A message has arrived. | Example: A warning limit has been exceeded. |
| Out | A message has gone. | Example: The previously overshot warning limit has been undershot again. |
| Out (cleanup) | A message has been automatically set to "Gone" by the system. | This is performed when the relevant channel can no longer be monitored, e.g. if data recording fails or the mode changes to STOP. |

## Navigating in the message log

| | |
|---|---|
| \|< < | To the first item / one page back |
| > >\| | One page forward / to the last item |
| Goto date/time | Opens a dialog box in which you state the time from which the entries will be displayed. |

Navigating in the message log does not cause the most recent messages to be loaded. You can update the messages using the display filters (Load all messages, Load process, Load system).

## 12.3.5 Monitoring configuration

The **monitoring settings** encompass the websites which you need for setting the parameters for the monitoring algorithms and for defining the monitoring responses.

Three spectra are available for monitoring:

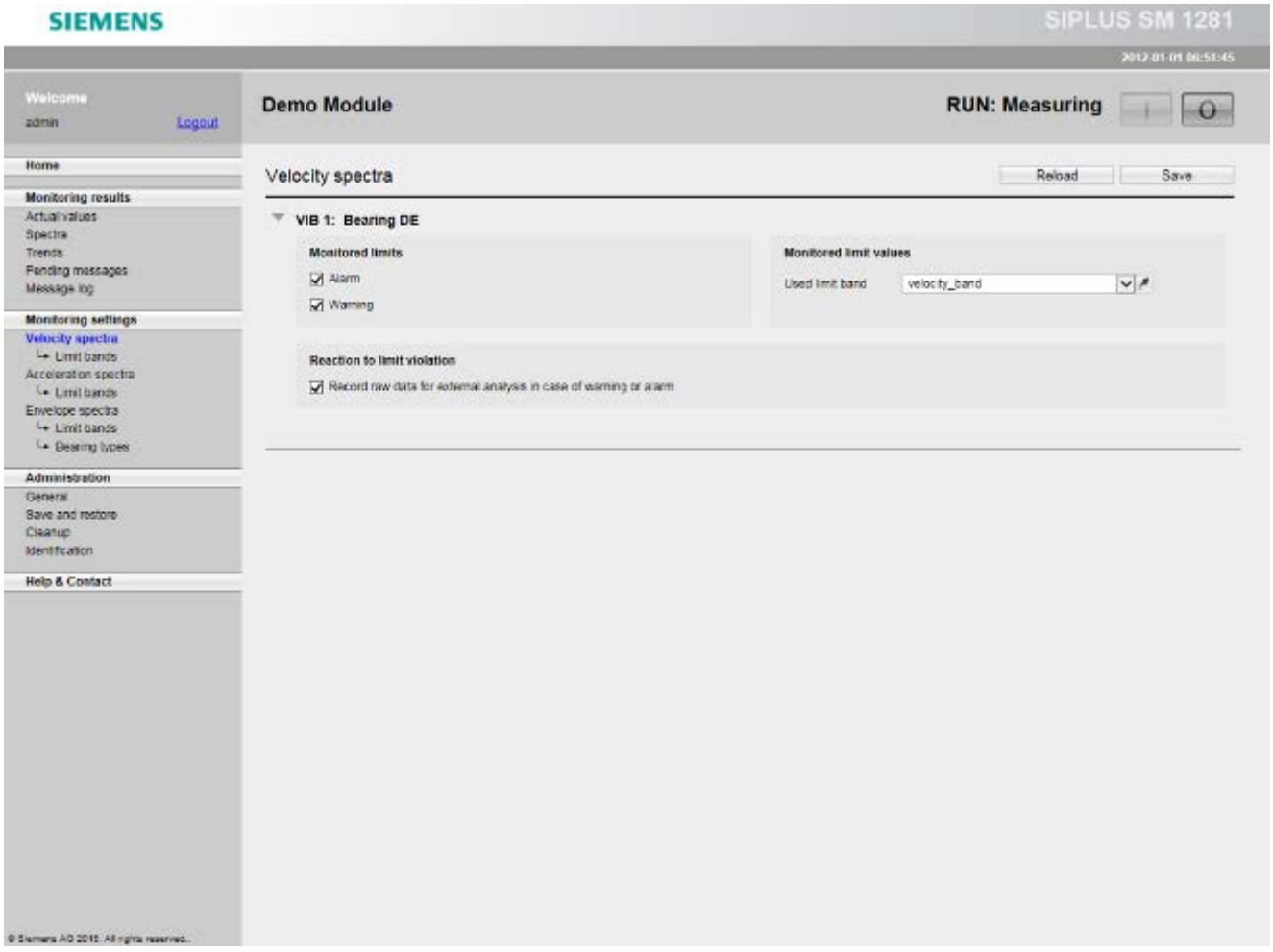
- Velocity spectrum (Page 153)
  - Velocity spectrum > Limit bands (Page 155)
- Acceleration spectrum (Page 159)
  - Acceleration spectrum > Limit bands (Page 161)
- Envelope spectrum (Page 165)
  - Envelope spectrum > Limit bands (Page 167)
  - Envelope spectrum > Bearing types (Page 170)

### 12.3.5.1 Velocity spectra

On the "Velocity spectra" page, you can activate the limits and define the associated limit bands. The settings refer exclusively to the vibration channels and the "velocity spectrum" monitoring method.

**Note**

You can only make changes in the operating mode "STOP: System ready".

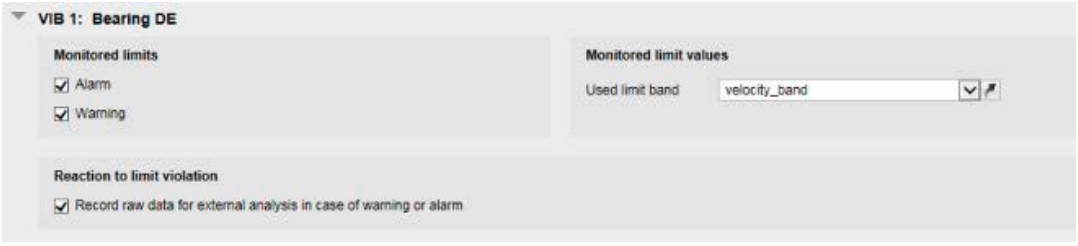



## Monitored limits

Activate or deactivate monitoring of the warning / alarm limits for this channel.

## Monitored limit band

All of the previously created and saved limit bands can be selected via the selection box. You can assign a monitoring band from the list of the defined limit bands (Page 155). This band contains information as to which frequencies must be checked as well as the limits for the frequencies to be checked.




The icon will take you directly to the page of the currently selected limit frequency band.

## Reaction to limit violation

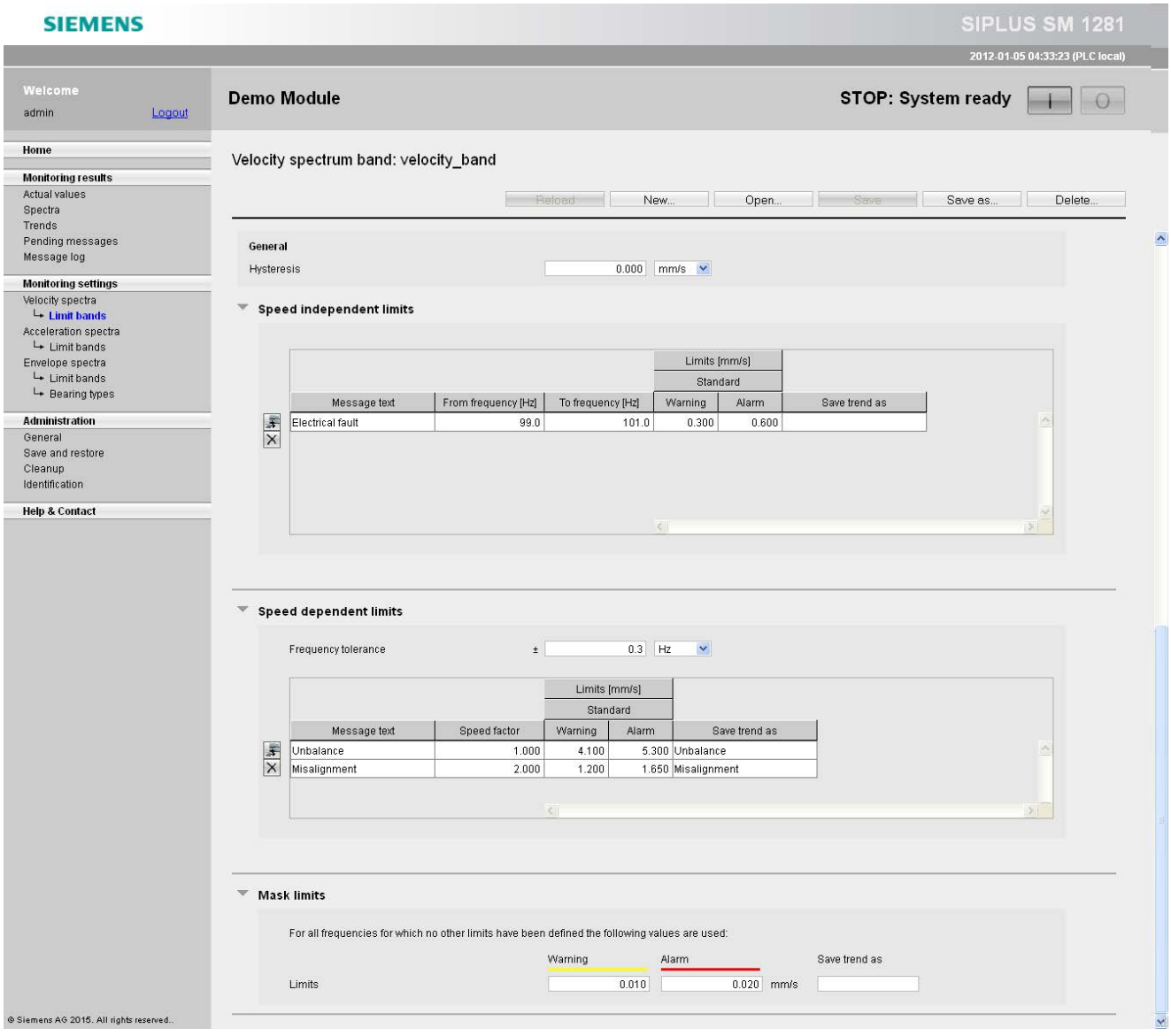
Here you activate the response to a limit violation.

- Start raw data recording

### 12.3.5.2 Velocity spectra > Limit bands

On the "Velocity spectrum band" page, you can create, modify and administer the limit bands for the velocity spectrum.

You can define speed-independent limits and speed-dependent limits.




## General

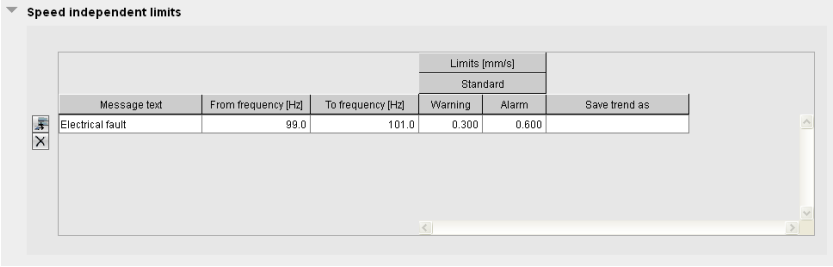
Here you define the hysteresis (Page 54) for the limit bands. This value applies to the entire limit band defined here.

You can specify the value in mm/s or as a percentage.

## Speed-independent limits

Speed-independent peak monitoring of absolute frequency bands.

For each speed-independent monitoring function, you can specify a message text. This text will be included in the relevant process message to provide a clearer explanation when a limit is violated.




The warning limits and alarm limits in the tables do not have to be filled out completely. In this way, you can configure any partial amount of the potential monitoring.

You can also assign a trend name for each monitoring. If a trend name is assigned, the maximum value of the vibration velocity within the frequency range of the monitoring of all velocity spectra assigned to this threshold band is saved under this name as a trend.

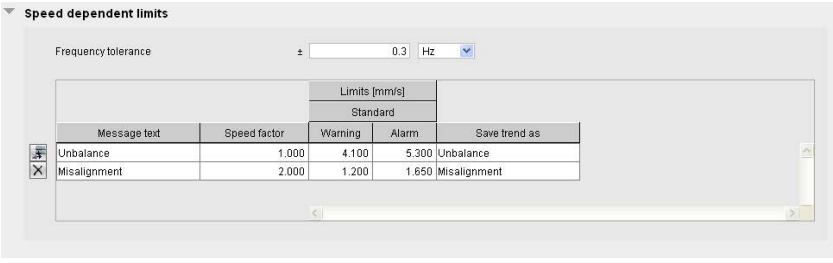
## Speed-dependent limits

Speed-dependent peak monitoring of individual frequencies with settable frequency tolerance for monitoring.

For speed-dependent peak monitoring of individual frequencies, a frequency tolerance band for monitoring can be set.

The frequency tolerance can be specified absolutely in hertz or relatively as a percentage. It states the band around a certain frequency in the spectrum that will be monitored for limits. The default value for the frequency tolerance is ±0.3 Hz.

For each speed-dependent monitoring function, you can specify a message text. This text will be included in the relevant process message to provide a clearer explanation when a limit is violated.




The warning limits and alarm limits in the tables do not have to be filled out completely. In this way, you can configure any part of the monitoring functions.

You can also assign a trend name for each monitoring. If a trend name is assigned, the maximum value of the vibration velocity within the frequency range of the monitoring of all velocity spectra assigned to this threshold band is saved under this name as a trend.

## Mask limits

Limits of the mask frequency band for monitoring remaining frequencies to cover the entire spectrum.

The mask range covers the frequencies that are not monitored by the method defined above.

You can also assign a trend name for the mask range. If a trend name is assigned, the maximum value of the vibration velocity of the frequencies covered by the mask band of all velocity spectra assigned to this threshold band is saved under this name as a trend.

## Operating functions

### Inserting/deleting rows

You can insert new rows and delete rows using the buttons to the left of the table.

| Button | Meaning |
|---|---|
|  | Inserting a row<br>A new row is always added at the end of the table. |
|  | Deleting a row<br>Selecting the row to be deleted |

### Creating, loading, saving, deleting limit bands

| Button | Meaning |
|---|---|
| Reload | All entries on the page are rejected and the previous values are displayed again. |
| New ... | You can create a new band of limits using the "New ..." button. A window opens in which the name for the new limit band must be entered. After the "OK" button has been clicked, a new band is created with the specified name. Unsaved changes to existing bands are lost as a result. The new band of limits is not saved until the "Save" button is clicked. |
| Open ... | When the "Open …" button is clicked, a window opens that contains a list of saved limit bands. After a list entry has been selected and the "OK" button has been clicked, the selected limit band is loaded and displayed. |
| Save | With the "Save" button, the changes of the currently loaded limit band will be saved. |
| Save as ... | With the "Save as …" button, an existing limit band can be saved with a new name. A window opens in which the new name can be entered. After the "OK" button has been clicked in the window, the limit band is saved with the new name and also displayed as the current limit band. Limit bands can be copied in this manner. After the copy has been edited, the changes must be saved by clicking the "Save" button. |
| Delete ... | You can delete an existing limit band from the archive using the "Delete ..." button. A window opens that contains the name of the currently displayed limit band. After the "OK" button has been clicked, the limit band of this name will be deleted from the archive. The first limit band found in the archive will then be displayed as the current limit band. |

## Trend name assignment

**Note**

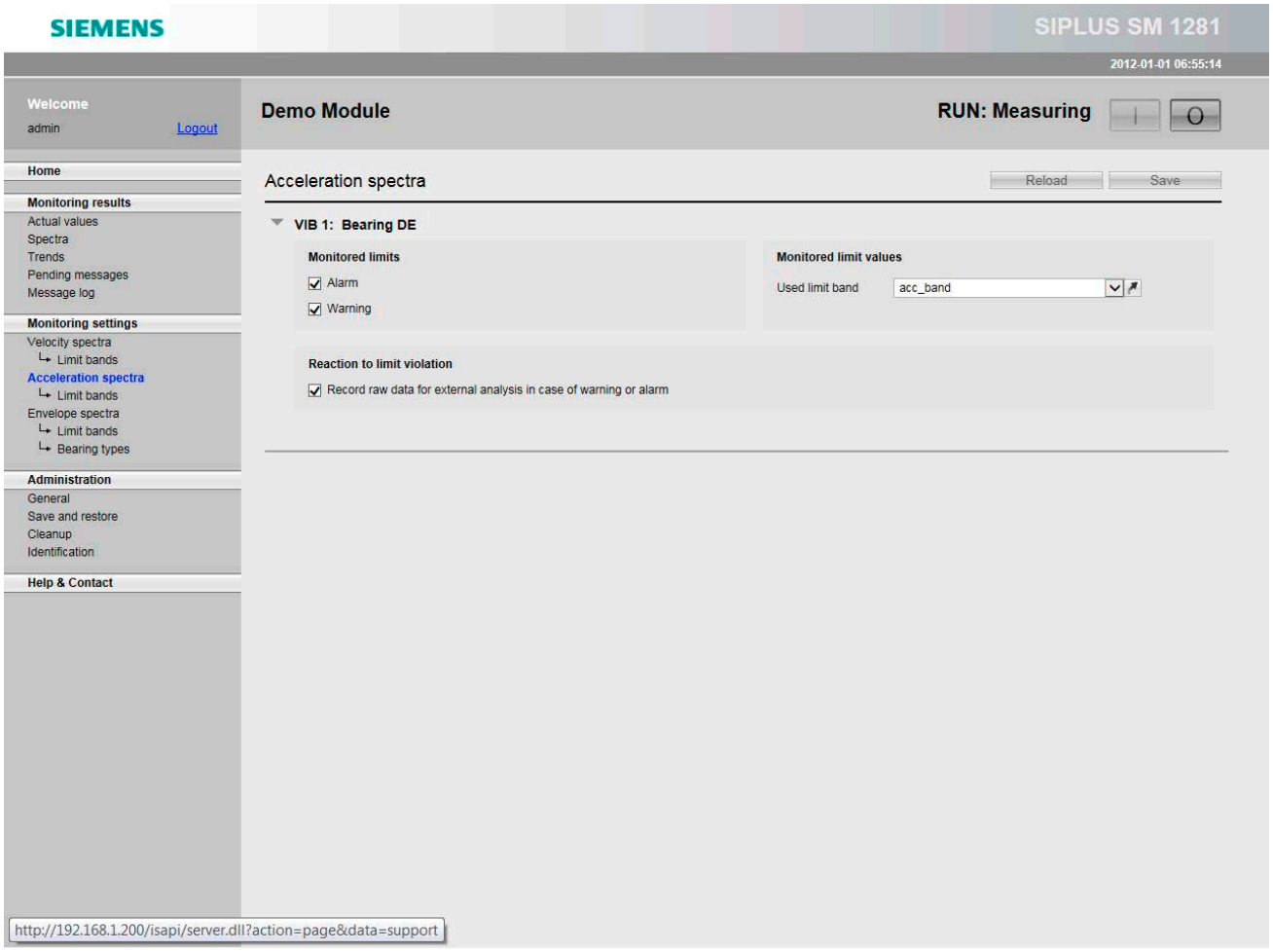
Save the trends under the names that you have not used yet. If you save a trend under a name that has already been used, it may be possible that outdated values are still saved under this name.

### 12.3.5.3 Acceleration spectra

On the "Acceleration spectra" page, you can activate the limits and define the associated limit bands. The settings refer exclusively to the vibration channels and the "acceleration spectrum" monitoring method.

**Note**

You can only make changes in the operating mode "STOP: System ready".




## Monitored limits

Activate or deactivate monitoring of the warning / alarm limits for this channel.

## Monitored limit band

All of the previously created and saved limit bands can be selected via the selection box. You can assign a monitoring band from the list of the defined limit bands (Page 161). This band contains information as to which frequencies must be checked as well as the limits for the frequencies to be checked.


The link icon will take you directly to the page of the currently selected limit frequency band.

## Reaction to limit violation

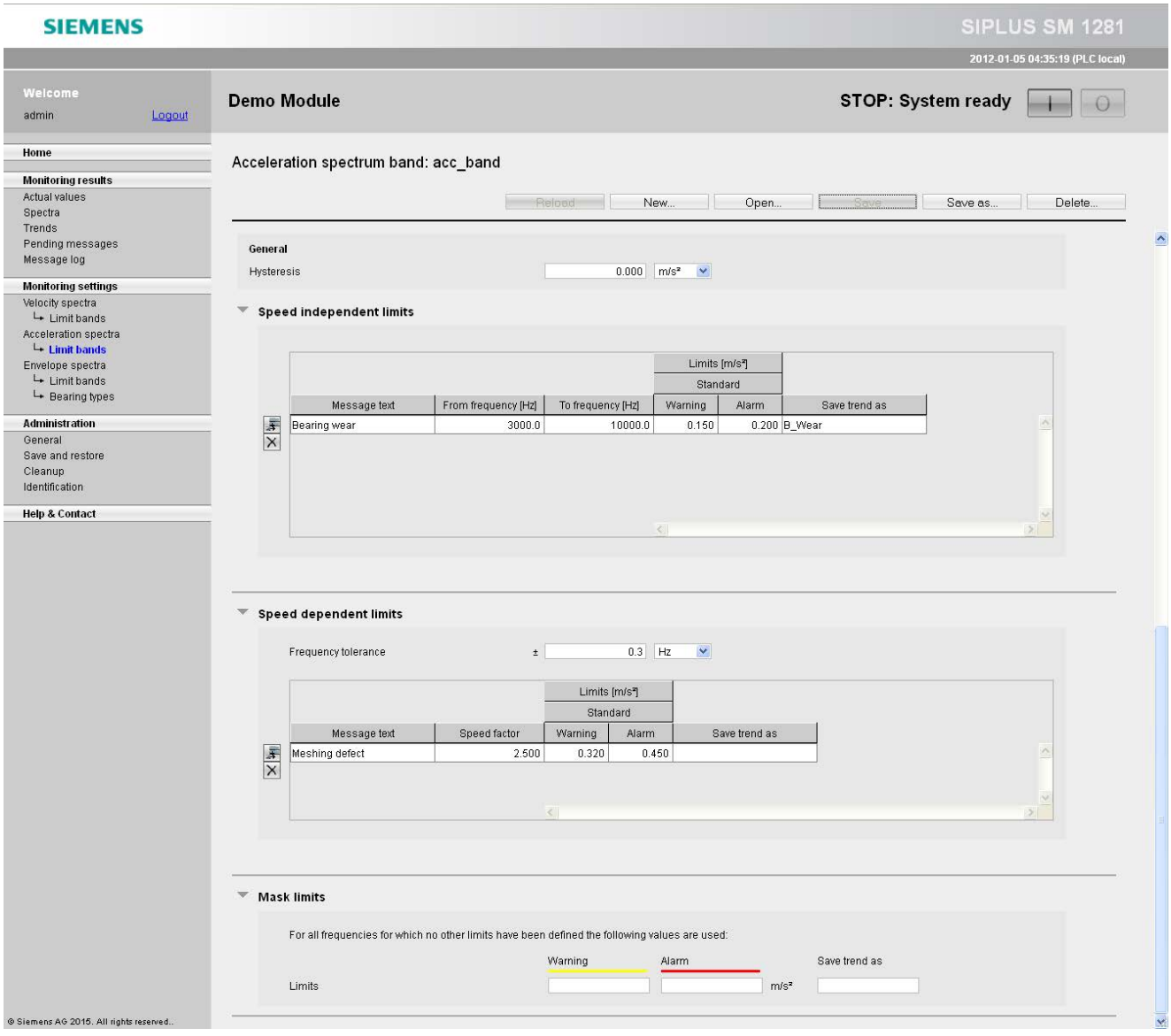
Here you activate the response to a limit violation.

- Start raw data recording

### 12.3.5.4 Acceleration spectra > Limit bands

On the "Acceleration spectrum band" page, you can create, modify and administer the limit bands for the acceleration spectrum.

You can define speed-independent limits and speed-dependent limits.




## General

Here you define the hysteresis (Page 54) for the limit bands. The value applies to all the limit bands defined here.

You can specify the value in m/s² or as a percentage.

## Speed-independent limits

The limits you create here are speed-independent. For each speed-independent monitoring function, you can specify a message text. This text will be included in the relevant process message to provide a clearer explanation when a limit is violated.

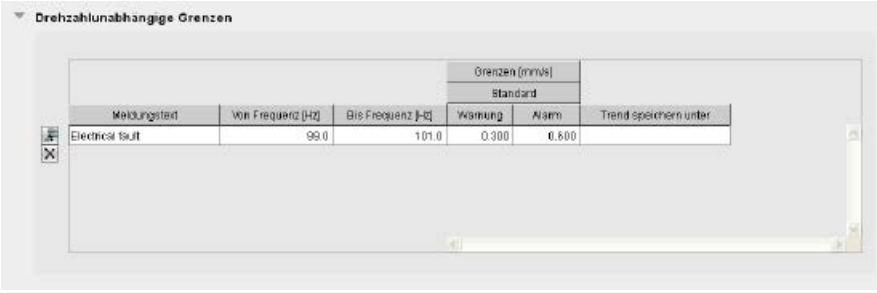



Figure 12-2 Speed-independent limits

The warning limits and alarm limits in the tables do not have to be filled out completely. In this way, you can configure any part of the monitoring functions.

You can also assign a trend name for each monitoring. If a trend name is assigned, the maximum value of the vibration acceleration within the frequency range of the monitoring of all acceleration spectra assigned to this threshold band is saved under this name as a trend.

## Speed-dependent limits

Speed-dependent peak monitoring of individual frequencies with settable frequency tolerance for monitoring.

The frequency to be monitored is entered as a multiple of the simple rotation frequency ("Rotational speed factor").

For speed-dependent peak monitoring of individual frequencies, a frequency tolerance band for monitoring can be set.

The frequency tolerance can be specified absolutely in hertz or relatively as a percentage. It states the band around a certain frequency in the spectrum that will be monitored for limits. The default value for the frequency tolerance is ±0.3 Hz.

For each speed-dependent monitoring function, you can specify a message text. This text will be included in the relevant process message to provide a clearer explanation when a limit is violated.

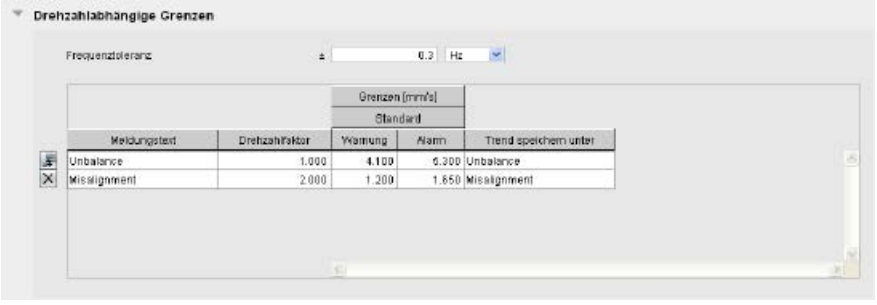



Figure 12-3 Speed-dependent limits

The warning limits and alarm limits in the tables do not have to be filled out completely. In this way, you can configure any part of the monitoring functions.

You can also assign a trend name for each monitoring. If a trend name is assigned, the maximum value of the vibration acceleration within the frequency range of the monitoring of all acceleration spectra assigned to this threshold band is saved under this name as a trend.

## Mask limits

Limits of the mask frequency band for monitoring remaining frequencies to cover the entire spectrum.

The mask range covers the frequencies that are not monitored by the method defined above.

You can also assign a trend name for the mask range. If a trend name is assigned, the maximum value of the vibration acceleration within the frequency range of the monitoring of all acceleration spectra assigned to this threshold band is saved under this name as a trend.

## Operating functions

### Inserting/deleting rows

You can insert new rows and delete rows using the buttons to the left of the table.

| Button | Meaning |
|---|---|
|  | Inserting a row<br>A new row is always added at the end of the table. |
|  | Deleting a row<br>Selecting the row to be deleted |

### Creating, loading, saving, deleting limit bands

| Button | Meaning |
|---|---|
| Reload | All entries on the page are rejected and the previous values are displayed again. |
| New ... | You can create a new band of limits using the "New ..." button. A window opens in which the name for the new limit band must be entered. After the "OK" button has been clicked, a new band is created with the specified name. Unsaved changes to existing bands are lost as a result. The new band of limits is not saved until the "Save" button is clicked. |
| Open ... | When the "Open …" button is clicked, a window opens that contains a list of saved limit bands. After a list entry has been selected and the "OK" button has been clicked, the selected limit band is loaded and displayed. |
| Save | With the "Save" button, the changes of the currently loaded limit band will be saved. |

| Button | Meaning |
|---|---|
| Save as ... | With the "Save as …" button, an existing limit band can be saved with a new name. A window opens in which the new name can be entered. After the "OK" button has been clicked in the window, the limit band is saved with the new name and also displayed as the current limit band. Limit bands can be copied in this manner. After the copy has been edited, the changes must be saved by clicking the "Save" button. |
| Delete ... | You can delete an existing limit band using the "Delete ..." button. A window opens that contains the name of the currently displayed limit band. After the "OK" button has been clicked, the limit band of this name will be deleted from the archive. The first limit band found in the archive will then be displayed as the current limit band. |

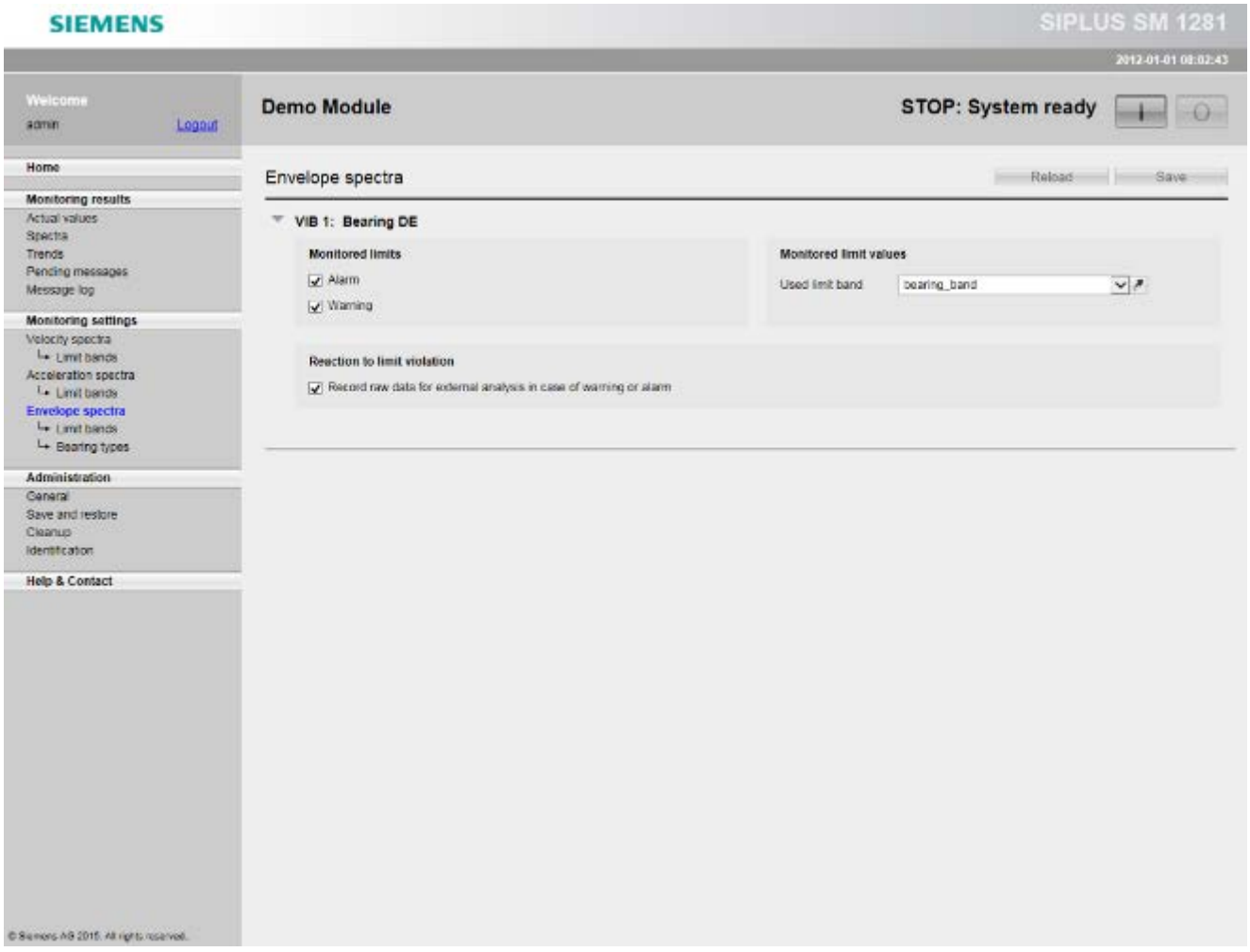
## Trend name assignment

**Note**

Save the trends under the names that you have not used yet. If you save a trend under a name that has already been used, it may be possible that outdated values are still saved under this name.

### 12.3.5.5 Envelope spectra

On the "Envelope spectra" page, you can activate the limits and define the associated limit bands. The settings refer exclusively to the vibration channels and the "envelope spectrum" monitoring method.

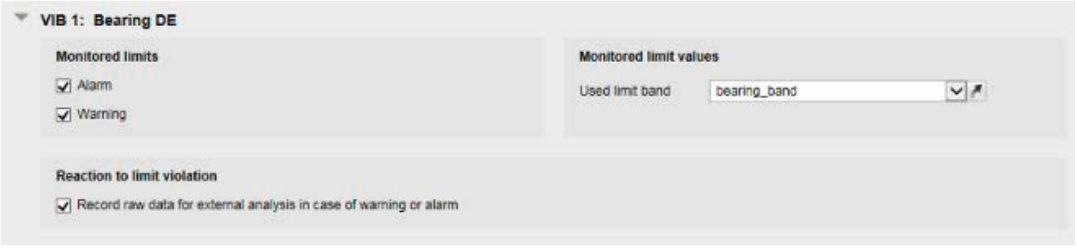



#### Monitored limits

Activate or deactivate monitoring of the warning / alarm limits for this channel.

## Monitored limit band

All of the previously created and saved limit bands can be selected via the selection box. You can assign a monitoring band from the list of the defined limit bands (Page 167). This band contains information as to which frequencies must be checked as well as the limits for the frequencies to be checked.




The icon will take you directly to the page of the currently selected limit frequency band.

## Reaction to limit violation

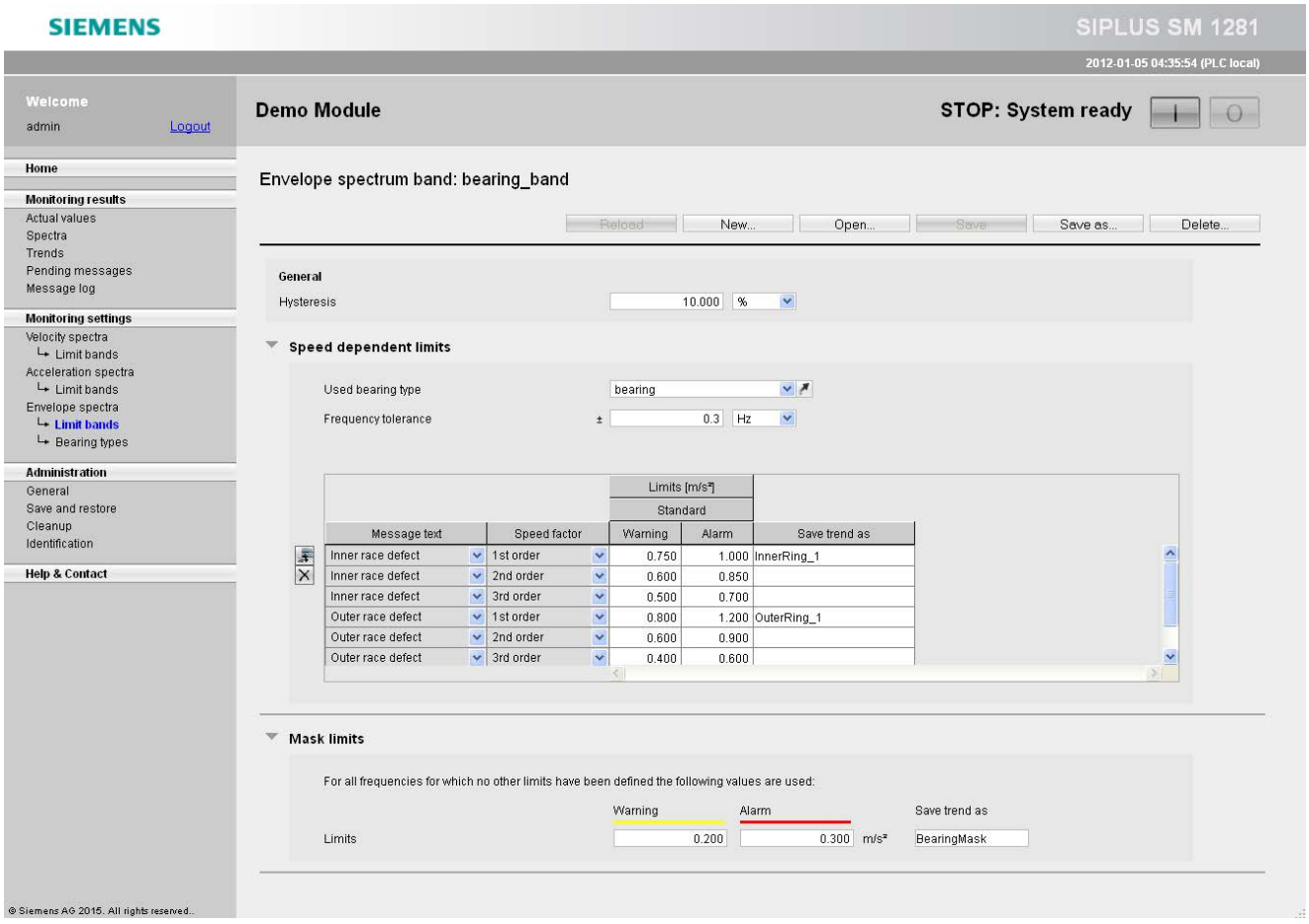
Here you activate the response to a limit violation.

- Start raw data recording

### 12.3.5.6 Envelope spectra > Limit bands

On the "Envelope spectrum band" page, you can create, modify and administer the limit bands for the envelope spectrum.

You can define speed-dependent limits.




## General

Here you define the hysteresis (Page 54) for the limit bands. This value applies to the entire limit band defined here.

You can specify the value in $m/s^2$ or as a percentage.

## Speed-dependent limits

Speed-dependent peak monitoring of individual frequencies with settable frequency tolerance for monitoring.

Select a bearing from the list of defined bearings. Bearings are defined on the website "Envelope spectra > Bearing types" (Page 170).

For speed-dependent monitoring of individual frequencies, a frequency tolerance band for monitoring can be set.

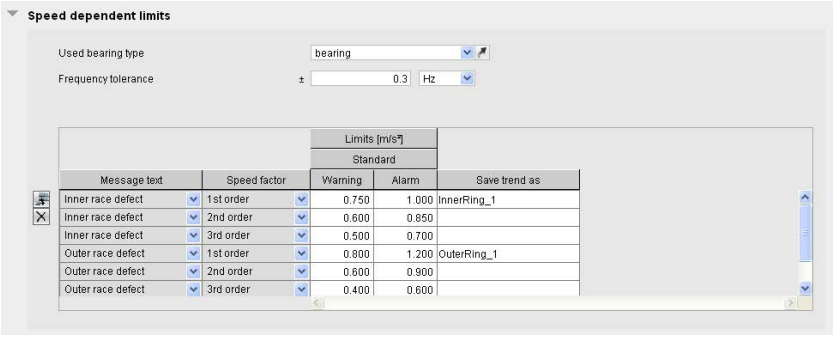
The frequency tolerance can be specified absolutely in hertz or relatively as a percentage. It states the band around a certain frequency in the spectrum that will be monitored for limits. The default value for the frequency tolerance is ±0.3 Hz.

The message texts for the 4 types of damage are predefined and can be selected under "Message text".

This text will be included in the relevant process message to provide a clearer explanation when a limit is violated.

The thresholds can be specified for up to five orders of magnitude (multiples of the respective fault frequencies).

You can configure not only the predefined bearing frequencies but also any speed-dependent monitoring functions.




The warning limits and alarm limits in the tables do not have to be filled out completely. In this way, you can configure any part of the monitoring functions.

You can also assign a trend name for each monitoring. If a trend name is assigned, the maximum value of the envelope within the frequency range of the monitoring of all envelop spectra assigned to this threshold band is saved under this name as a trend.

## Mask limits

Limits of the mask frequency band for monitoring remaining frequencies to cover the entire spectrum.

The mask frequency band covers the frequencies not covered by the methods stated above.

You can also assign a trend name for each monitoring. If a trend name is assigned, the maximum value of the envelope within the frequency range of the monitoring of all envelop spectra assigned to this threshold band is saved under this name as a trend.

## Operating functions

### Inserting/deleting rows

You can insert new rows and delete rows using the buttons to the left of the table.

| Button | Meaning |
|---|---|
|  | Inserting a row<br>A new row is always added at the end of the table. |
|  | Deleting a row<br>Selecting the row to be deleted |

### Creating, loading, saving, deleting limit bands

| Button | Meaning |
|---|---|
| Reload | All entries on the page are rejected and the previous values are displayed again. |
| New ... | You can create a new band of limits using the "New ..." button. A window opens in which the name for the new limit band must be entered. After the "OK" button has been clicked, a new band is created with the specified name. Unsaved changes to existing bands are lost as a result. The new band of limits is not saved until the "Save" button is clicked. |
| Open ... | When the "Open …" button is clicked, a window opens that contains a list of saved limit bands. After a list entry has been selected and the "OK" button has been clicked, the selected limit band is loaded and displayed. |
| Save | With the "Save" button, the changes of the currently loaded limit band will be saved. |
| Save as ... | With the "Save as …" button, an existing limit band can be saved with a new name. A window opens in which the new name can be entered. After the "OK" button has been clicked in the window, the limit band is saved with the new name and also displayed as the current limit band. Limit bands can be copied in this manner. After the copy has been edited, the changes must be saved by clicking the "Save" button. |
| Delete ... | You can delete an existing limit band using the "Delete ..." button. A window opens that contains the name of the currently displayed limit band. After the "OK" button has been clicked, the limit band of this name will be deleted from the archive. The first limit band found in the archive will then be displayed as the current limit band. |

## Trend name assignment

**Note**

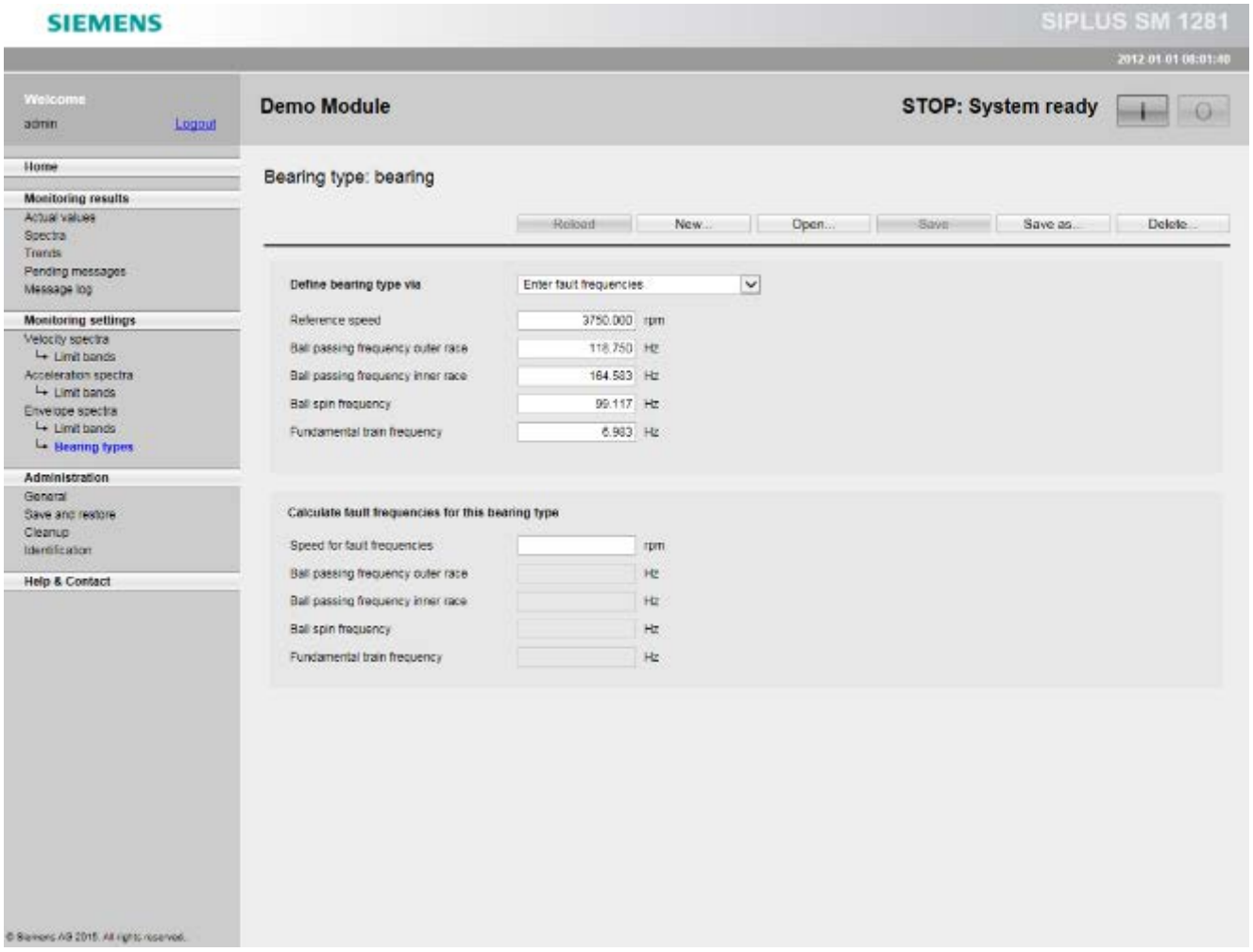
Save the trends under the names that you have not used yet. If you save a trend under a name that has already been used, it may be possible that outdated values are still saved under this name.

### 12.3.5.7 Envelope spectra > Bearing types

On the "Bearing types" page, you can create, modify and administer the data for the different bearing types.

The data stored for each bearing type is used in the bearing analysis to determine the fault frequencies for the outer race, inner race, rolling elements (balls) and cage. The limit bands for bearing analysis contain limits in accordance with these fault frequencies.

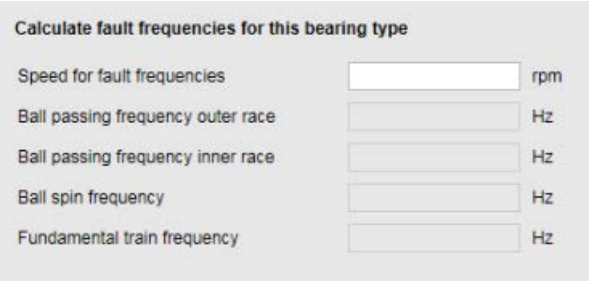
To open the page, click "Monitoring settings > Envelope spectra > Bearing types" in the navigation area.




You can choose between the following two input modes for the bearing type parameter:

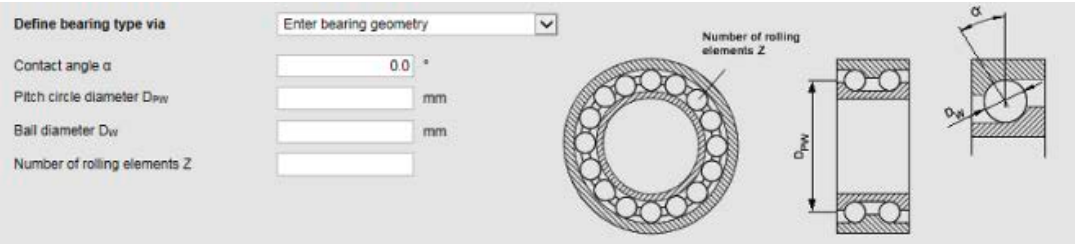
- Direct entry of the fault frequencies
- Input of the bearing geometry

## Direct entry of the fault frequencies




For direct entry of the frequencies, you enter a speed as the reference value and the bearing fault frequencies for outer race, inner race, rolling element and cage. An incomplete entry of the fault frequencies is also accepted, but in this case you will be unable to activate monitoring of the bearing for a particular type of damage.

## Input of the bearing geometry




For entry of the bearing geometry, four geometric characteristic values are specified:

- Contact angle of the rolling element (ball) in the cage α
- Ball diameter $D_{\rho W}$
- Ball diameter $D_W$
- Number of balls Z

## Fault frequency calculator

The "Bearing types" menu contains a fault frequency calculator. After a speed ("Speed for fault frequencies") has been entered, the bearing fault frequencies for outer race and inner race, the rolling element and cage are displayed immediately for the current bearing type.

**Note**

Bearing types can be installed on the device using a CSV-based import on the "Save and restore" page.

## 12.3.6 Administration

**Administration** encompasses the websites on which you can manage the SM 1281 and the data:

- General (Page 173)
- Save and restore (Page 176)
- Cleanup (Page 179)
- Identification (Page 182)

**Note**

You can only make changes in the operating mode "STOP: System ready".

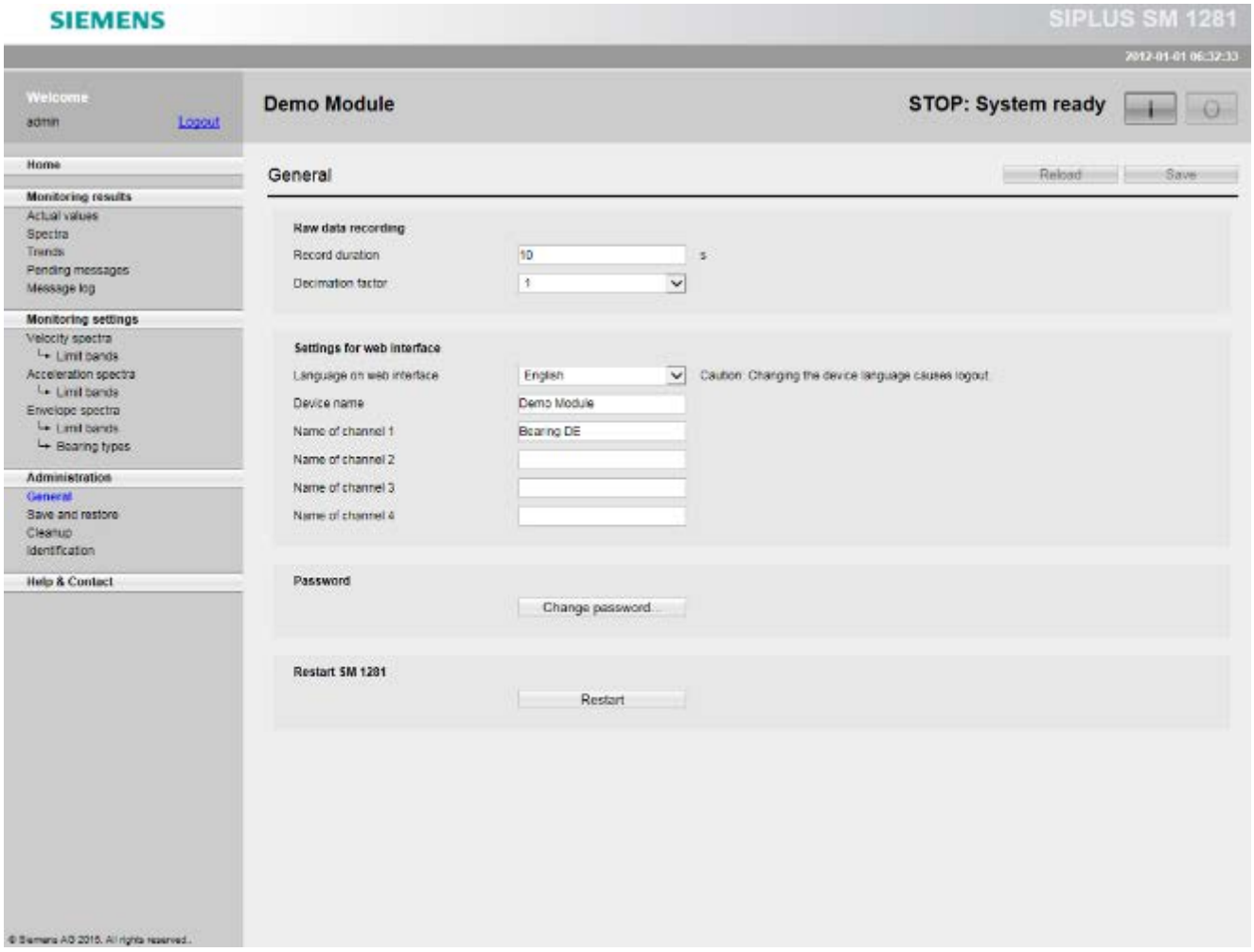
### See also

Factory settings and default settings (Page 181)

### 12.3.6.1 General

You can make general administration settings on the "General" page: Click "Save" to save inputs.

To open the page, click "Administration > General" in the navigation area.




## Recording raw data

- Recording time: You can enter 1 to 90 seconds.
- Decimation factor: The decimation reduces the scan rate and, as a result, the size of the raw data file. As a result, more raw data recordings are possible.

  The maximum recording duration is independent of the decimation factor.

## Web interface settings

- Device name: Here you enter the name of the device. It will appear in the title area and on the page Identification (Page 182).
- Device language: You can switch the language of the web interface between English and German.

  A change of languages logs off the user.

**Note**

To be able to make entries, he must log in again after being logged off.

## Password

To change the password stored in the device, click "Change password". The corresponding dialog box opens. Enter the old and new password, and repeat the new password. The password must have a length between 4 and 40 characters. The following characters are permissible:

- Uppercase and lowercase letters: a to z and A to Z, no umlauts
- Numbers: 0 to 9
- Special characters "-" and "_"

| NOTICE |
| --- |
| **Safely keeping the password** |
| Once the password is set, the configuration/parameterization cannot be changed without entering the password. The password also cannot be changed or reset. |
| Therefore, keep your password safe! |

## Restarting SM 1281

A system restart can be performed by clicking the "Restart" button, for a firmware update.

**Note**

**During the restart**

During the restart, operation via the browser is not possible, because the connection to the device has been interrupted.

**Note**

**After the restart**

To be able to make entries, you must log in again after the restart.

**CAUTION**

**Critical system state**

The Ethernet switch that is built into the SM 1281 is only in operation after the module is started up. A restart of the SM 1281 interrupts the Ethernet switch function.

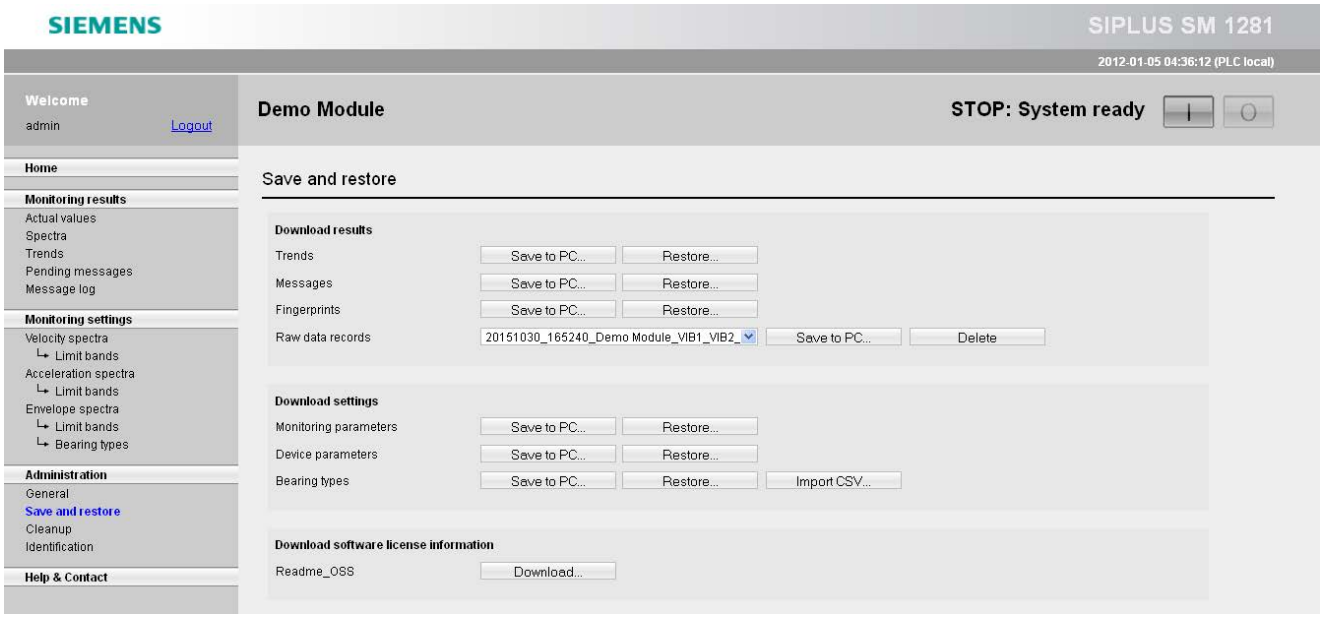
As a result, existing Ethernet connections via the switch are interrupted for the duration of the start-up of the SM 1281. This can lead to critical system states.

### 12.3.6.2 Save and restore

On the "Save and restore" page, you can download data that is stored in the device. This data can be used for the data exchange with a different SM 1281 device.

The raw data can be further processed using software that can read WAV files.

To open the page, click "Administration > Save and restore" in the navigation area.




## Uploading and downloading results

| | |
|---|---|
| Trends | Trends are the measured variables stored in the various time resolutions. |
| Messages | Messages created based on events, e.g. limit value violations. |
| Fingerprints | All the "Fingerprints" are saved in this database file. |
| Raw data records | Raw data are recorded in WAV files. A WAV file is generated for each recording of raw data.<br>• Downloading raw data:<br>Select a file from the list of existing files and click the "Save to PC..." button next to it.<br>• Deleting raw data:<br>Select a file from the list of existing files and click the "Delete" button next to it. |

## Uploading and downloading settings

| Download data | Description |
|---|---|
| Monitoring parameters | This file contains all monitoring parameters, e.g. limit bands, responses to limit violations. |
| Device parameters | This database file contains the device parameters. |
| Bearing types | This database file contains all the types of bearings that have been defined.<br>In addition to uploading and downloading the database of storage types, you can click the "Import CSV ..." button to apply a CSV file with additional storage types to the existing database. |

## Importing file with storage type as CSV file

You can import a CSV file with the "Import CSV ..." button and apply up to 1000 storage types per import to the existing database.

You have to create a UTF 8 coded data record for each storage type. Each data record consists of 6 data fields that are separated by a semicolon.

Enter the data record in the following order and use a new row for each data record:

- Name of the storage type
- Fault frequency of outer race damages at reference speed (in Hz)
- Fault frequency of inner race damages at reference speed (in Hz)
- Fault frequency of cage damages at reference speed (in Hz)
- Fault frequency of rolling element damages at reference speed (in Hz)
- Reference speed (in 1/min)

The name of the storage type is limited to 40 characters, whereby the following characters are not permitted: `\,",',%,{,},[,],<,>` and `;`

If you enter decimal numbers, use a dot "." as separator between pre-decimal and decimal places.

If the system detects an error during the import, e.g. a syntax error, you will receive an error message and the system aborts the import; there is no change to the database for storage types.

SM 1281 reports the successful import of the data in the alarm log of the web server. You can find additional information in section Message log (Page 150)

## Password

Downloading of files from the device is secured by an additional authentication. The default login name must be entered as the default login name "admin". The password required is the one that was most recently set in the device administration on the appropriate web page. If the password was not changed here, the default password "0000" (four times zero) applies.

### Download software license information

Here, you can download the license conditions of the open source software used in the SM 1281 system as a PDF file.

### 12.3.6.3 Cleanup

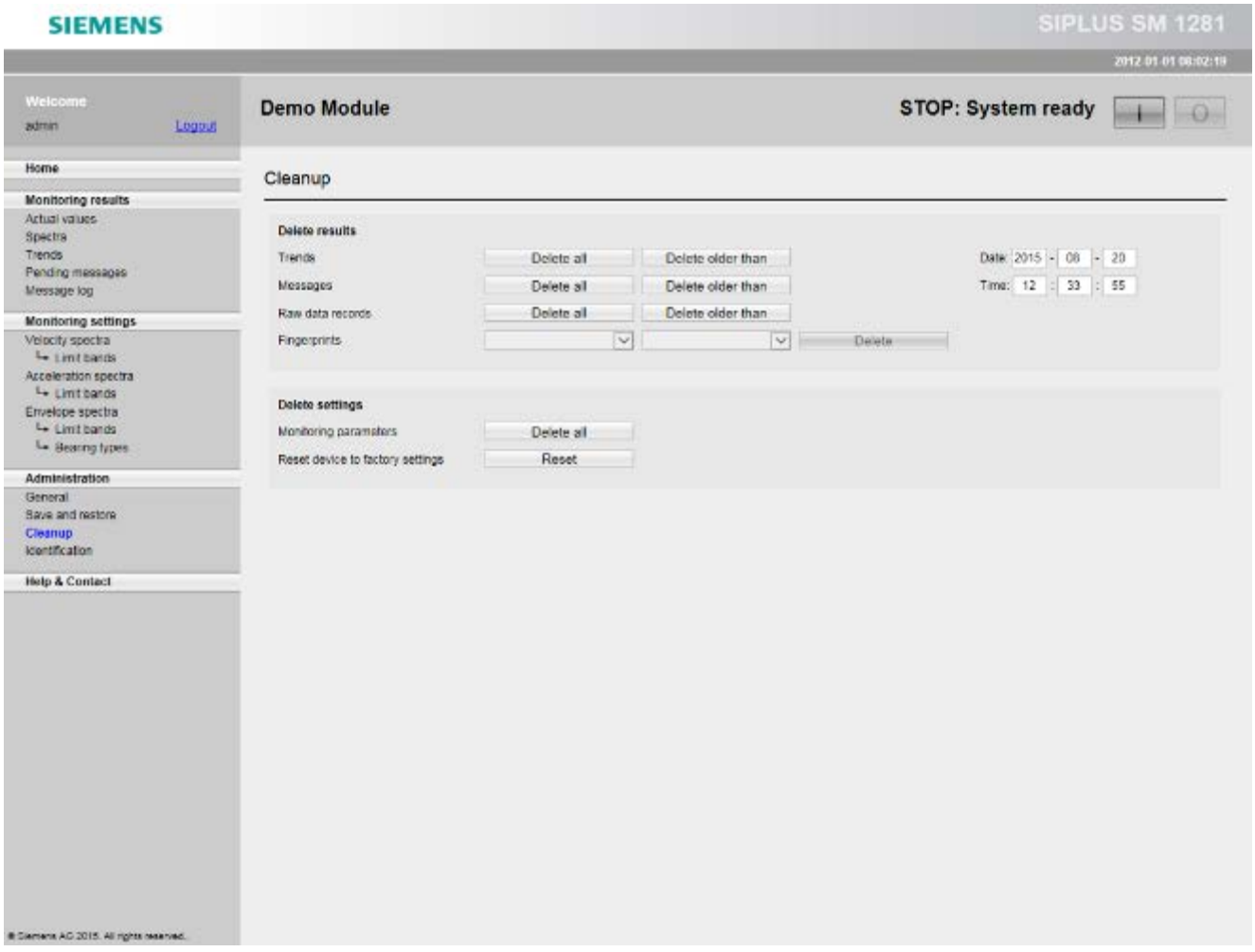
On the "Cleanup" page, you can delete unneeded data from the device or reset the device to the factory settings.
The following data can be deleted:

- Trends
- Messages
- Raw data records
- Fingerprints
- Monitoring parameters

**Note**

Deleted data cannot be restored.

To open the page, click "Administration > Cleanup" in the navigation area.



### Requirement

In "RUN" mode, you can delete the "Fingerprints" and the "Raw data records." All other functions of the "Cleanup" page can only be performed in STOP mode.

### Deleting trends, messages, raw data records

You have the following options for deleting trends, messages, and raw data records:

- Delete all data in one step
- Delete only data that are older than a set time

When you open the page, the current date and time are automatically entered as the default setting. Enter the required values for the time from which all values are to be deleted in the date and time fields.

Safety query: Clicking on the "Delete all" button or "Delete older than" button opens a dialog box, in which you must confirm the deletion. The data will only be deleted after confirming with "OK".

Deletion is performed in the background and, depending on the quantity of data, can take several minutes. If the cleanup procedure is not completed before the device is switched off, the data will not be deleted or only incompletely deleted.

### Deleting fingerprints

Fingerprints are saved with a name with reference to the channel.

The names of all fingerprints saved are available in a dropdown list from which you select the fingerprint to be deleted. Delete the selected fingerprint with the "Delete" button. A dialog box opens in which you must confirm deletion.

### Deleting monitoring parameters

The following time-dependent data is deleted or reset to default values:

- Monitored limits and monitored limit band for the frequency-selective analysis method
- Reaction to limit violation
- Limit bands

**Note**

The device is inoperable during the deletion process.

## Resetting device to factory settings

The following actions are performed using the "Reset" button:

- Deletion of all recorded data (historical data, messages, raw data, fingerprints)
- Deletion of all monitoring parameters
- Resetting the device parameters
- Resetting the password

**Note**

Bearing data is excluded from this function. This is always retained.

## Factory settings and default settings

The table shows the delivery state of the settings in the device. If a cleanup action is performed on the parameters, or if a database is deleted via WebDAV or FTP, the affected part of the system data is returned to this status or recreated with this status.

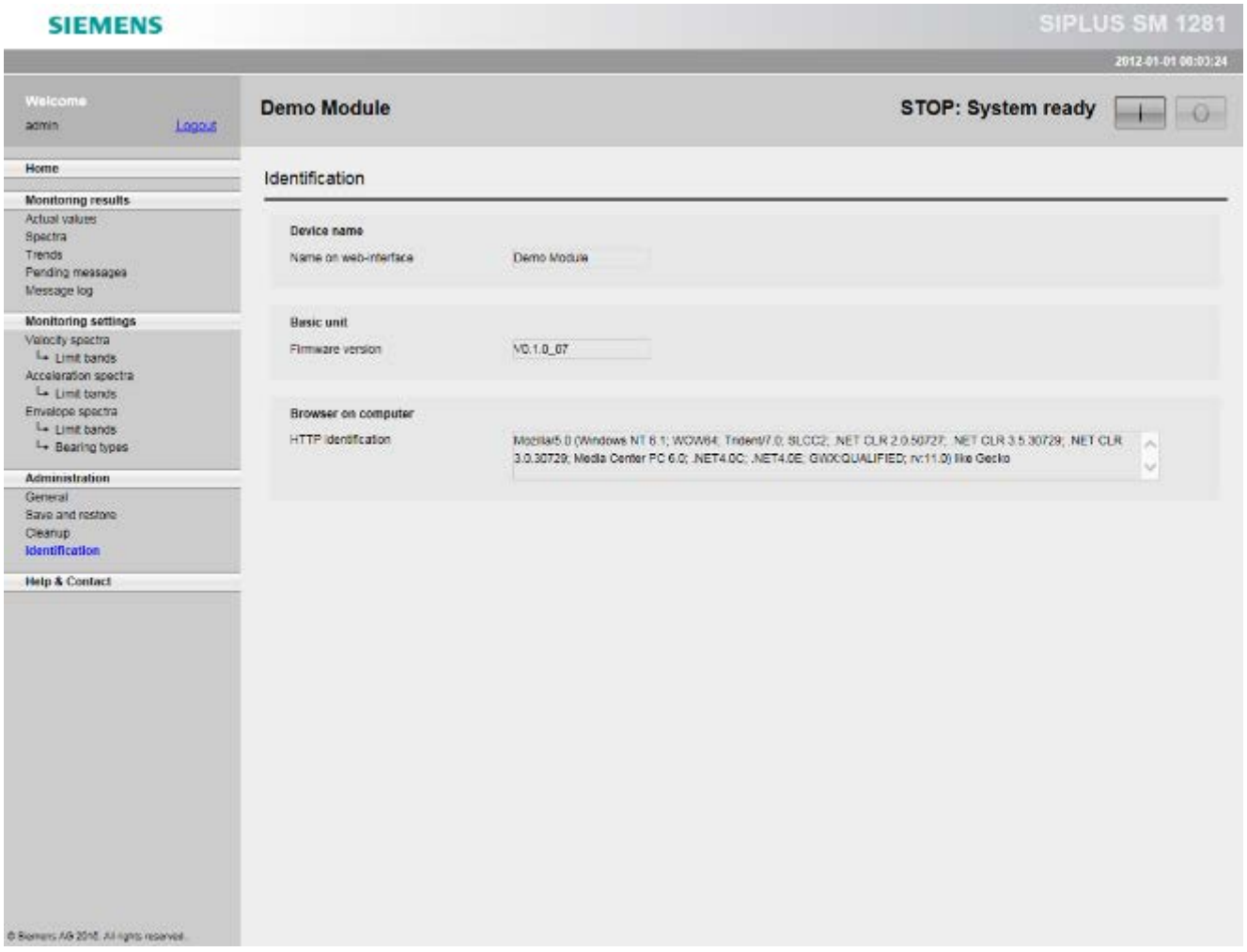
Table 12- 1 Default settings of the SM 1281

| Parameter groups | Default |
|---|---|
| Device configuration [Factory settings] | Module name is " " |
| Diagnostic parameters [Factory settings] [Delete monitoring parameters] | All reactions for all channels are deactivated. |
| | All diagnostic methods for all vibration channels are deactivated. |
| | All reactions to diagnostic methods of the vibration channels are deactivated. |
| Threshold values of the vibration analysis procedures [Factory settings] [Delete monitoring parameters] | All alarm and warning limits are deactivated. |
| | All threshold values are 0. |
| | All hysteresis values are 0. |
| Limit bands [Factory settings] [Delete monitoring parameters] | No limit bands are available. |
| Bearing types | No bearing types exist in the delivery status. |
| | The bearing types are not affected by reset/delete operations. |
| | They must be deleted manually by the user. |
| Historical data [Factory settings]: | No messages, trends, and fingerprints are stored. |
| User account [Factory settings] | User name = "admin" |
| | Password = "0000 (four times "zero") |

### 12.3.6.4 Identification

On the "Identification" page, you can display information about the system and the browser.

To open the page, click "Administration > Identification" in the navigation area.



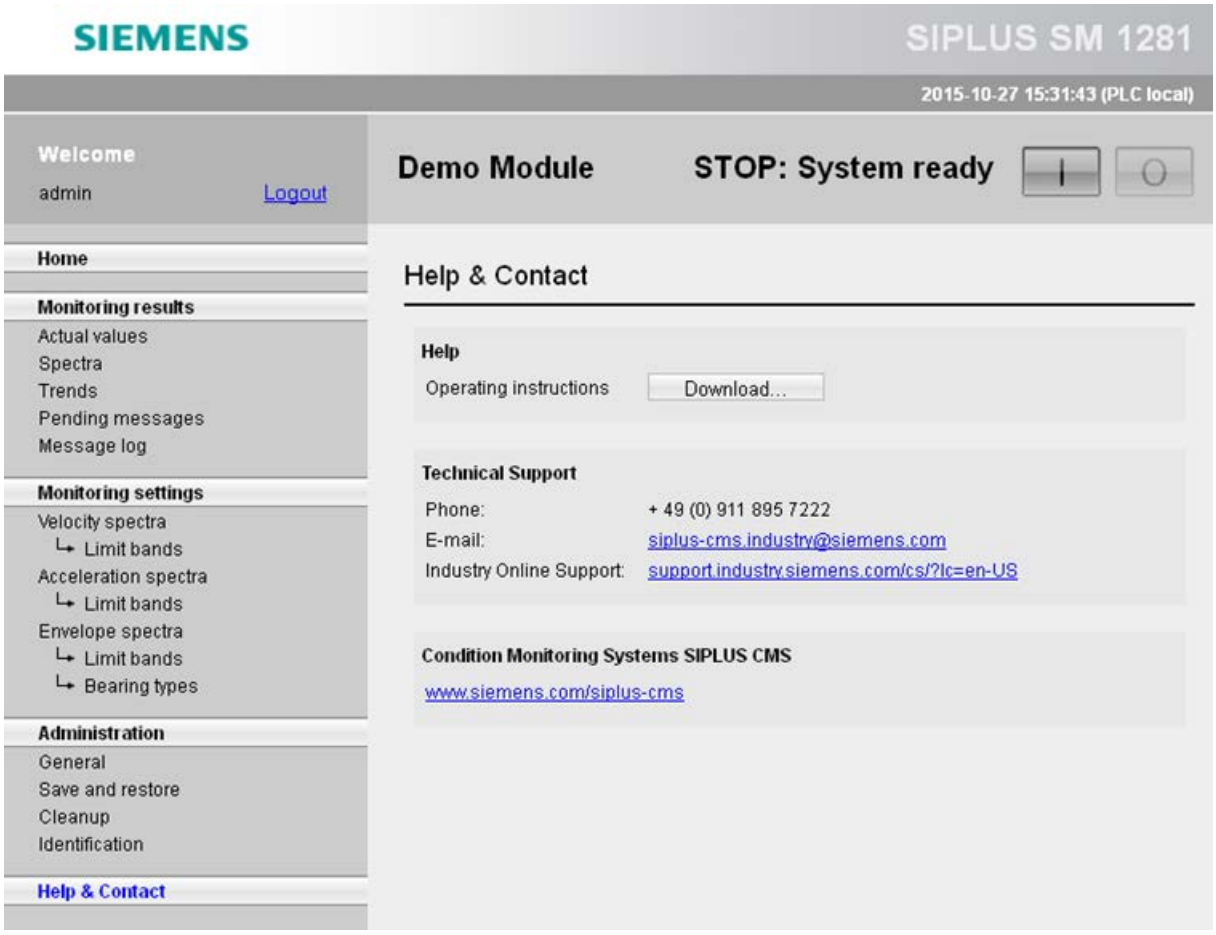

## Display parameters

| Display parameters | Description |
|---|---|
| **Device name** | |
| Name on the web interface | The name of the system as it is displayed in the title of every webpage.<br>This name can be changed on the General (Page 173) web page. |
| **Basic unit** | |
| Firmware version | Firmware version of the condition monitoring firmware SM 1281. |
| **Browsers** | |
| HTTP identification | Browser identification used with the Web server.<br>The identification depends on the compatibility settings of the browser |

## 12.3.7 Help and Contact

One this page, you can download the operating instructions for the SM 1281.

On this page, you will also find links to Support and the Condition Monitoring Systems for SIPLUS CMS.



## 12.3.8 Website for HMI panels

The SM 1281 has an integrated website for HMI panels. The site allows you

- to back up parameter databases of the SM 1281 on the HMI panel
- to transfer backed up parameter databases from the HMI panel to the SM 1281

### Characteristics

- The website is a stand-alone website. It is not linked to the "standard" pages.
- The websites are optimized for panels with at least 7 inches, e.g. for SIMATIC TP700 Comfort and larger panels from this series.
- The display requires the Pocket Internet Explorer 6.0, which is available outside of the Runtime environment.

### Mobile website

You call the mobile website as follows: <*IP address*>/hmi

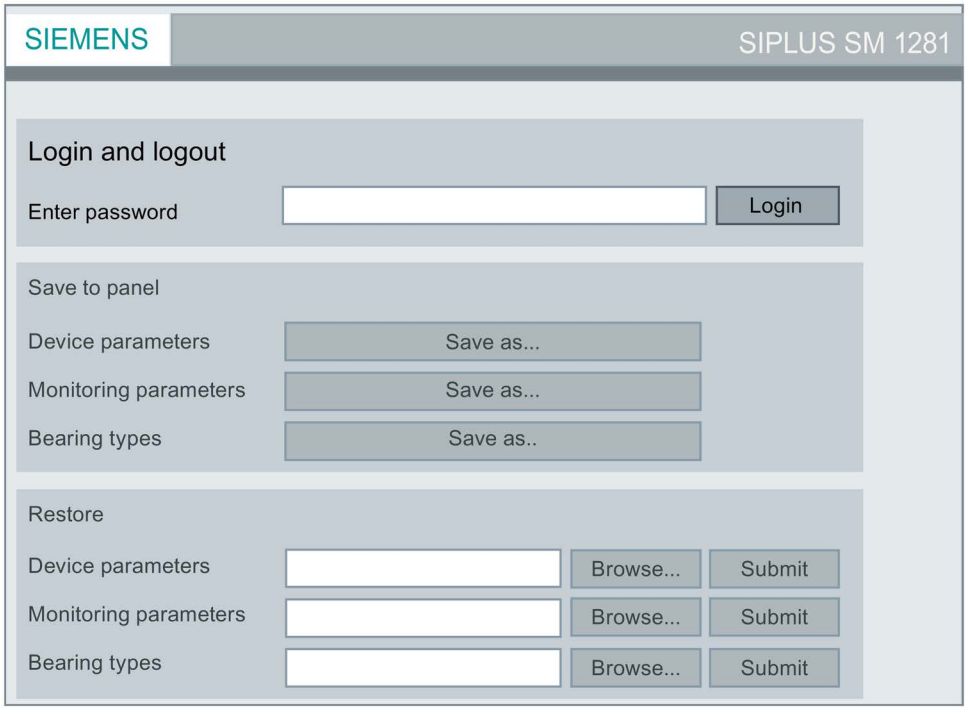



Figure 12-4 Mobile website SM 1281

## Backing up and restoring parameter databases

### Logging in and logging out

Enter the password which you have set on the regular web interface, confirm the entry with "Return", and click on the "Login" button. After the successful login, the input field is grayed out and the caption of the "Login" button changes to "Logout". Using this button, you can log off again.

### Saving to the panel

Click on the "Save as..." buttons to download the corresponding database files of the device parameters, of the monitoring parameters, and of the bearing data from the module to the panel.

### Restoring

Click on the "Browse..." buttons to select backed up database files via a file selection dialog. The text field shows the path and name of the selected file.

Click on the "Submit" buttons to upload the selected file to the module.

### Authentication

The save action is secured via an additional authentication.

The default login name "admin" must be entered as the user name. The password required is the one that was most recently set in the device administration on the appropriate web page. If the password was not changed here, the default password "0000" applies.

# Maintenance and servicing 13

## 13.1 Firmware installation

### 13.1.1 S7 firmware update

#### Carrying out a firmware update

Perform the update as described in the System Manual S7-1200 Automation System (https://support.industry.siemens.com/cs/document/36932465/simatic-s7-s7-1200-programmable-controller?dti=0&dl=en&lc=de-WW).

### 13.1.2 CM firmware update

The firmware for the device is supplied as the file "sm1281.cab" on request. Use the communciation channels specified under Service & support (Page 211) to do this.

#### Back up the data before installing a firmware update

Before updating the firmware, back up all the parameters for the device, monitoring, and bearing type via the export function, see Chapter Save and restore (Page 176). When backing up, you can restore the original condition of the firmware and device.

The raw data recordings ("Raw data", files *.wav) do not have to be backed up.

#### Update the firmware

To update the firmware, proceed as follows:

1. Copy the file "sm1281.cab" to the update directory of the device.
   To do this, use the upload options as described in the Chapters Data transfer over WebDAV (Page 64) or Data exchange via FTP (Page 67).
   This copying process can take several minutes.
2. Start the device via the "Restart" button on the website "Administration > General" or by switching the power supply of the SM 1281 off and back on.

   The new firmware will be automatically installed during the restart. This can also take several minutes.

**Note**

Make sure during the firmware update that the power supply is not interrupted since this could result in incomplete/inconsistent firmware in the device.

## Update successful

You can recognize a successfully completed update procedure if the following three conditions occur:

- The DIAG LED changes to a steady green.
- The device can be reached again via the IP address, which is transferred from the S7 user program to the SM 1281.
- The new firmware version is displayed on the home page.

**Note**

If the original firmware version is still shown on the home page, this may be due to the caching mechanisms of your browser.

Remedy: Clear the browser cache and reload the home page.

## Update unsuccessful

In the event of an error, the device goes to the operating mode "ERROR: System not ready (Page 199)".

In this case, perform the update procedure again.

### 13.1.3 Restarting SM 1281 via the website

#### Requirement

To restart the device via the website, the control priority must be passed on from the S7 to the websites (`OperatorControlS7` = false). Thus, during the restart, no commands are transferred from the S7-1200 to the SM 1281. The SM 1281 can no longer be controlled via the blocks.

#### Startup behavior

**Note**

**Restarting the device via web interface**

If you restart the device via the website, this never automatically leads to the RUN state.

Establish the operating mode "STOP: System ready" by restarting the device via the website.

1. Log onto the SM 1281 websites.
2. Switch to the operating mode "STOP: System ready".
3. On the "Administration > General" website, select "Restart SM 1281".

   ⇒ The SM 1281 restarts. It imports the device parameters currently present at the S7 blocks.

   ⇒ The SM 1281 automatically switches to the operating mode "STOP: System ready".

   ⇒ At the function block of the S7, the feedback message "Control priority S7 not active" is displayed (`OperatorControlS7` = false).

## 13.2 Replace SM 1281

The principle steps for replacing the SM 1281 are described below.

### Backing up initialization data

Before replacing the SM 1281, back up the CMS databases that are saved in the device. They are required for initializing the new device.

You can load the files onto your PC via the website "Save and restore" (Page 176).

### Replacing the device

1. De-energize the S7 assembly, including the SM 1281.
2. Remove terminal blocks from the device (see System Manual S7-1200 Automation System (https://support.industry.siemens.com/cs/document/36932465/simatic-s7-s7-1200-programmable-controller?dti=0&dl=en&lc=de-WW)).
3. Disassembling the device from the DIN rail. Proceed in the reverse order to that described in ChapterAssembly (Page 75).
4. Installing and connecting the new device.
5. Restore (Page 176) the CMS databases on the device.

### Replacement of modules with different firmware versions

If you replace the SM 1281 with a module with a different firmware version, you must adapt your user program and use the block library associated with the module.

You can find additional information in the overview. (Page 41)

### Additional information

Information that must be observed during repairs can be found in Chapter Safety instructions.

# 13.3 Transferring backed-up initialization data to the SM 1281

## Requirement

- The SM 1281 is connected to a PC via Ethernet.
- The back-up of the initialization data of the SM 1281 is available.

## Transferring initialization data to the SM 1281

You must transfer the following databases to the SM 1281:

- Device.CMSDB
- Parameters.CMSDB
- BearingTypes.CMSDB

| NOTICE |
| --- |
| **Malfunctions due to impermissible files**<br>The transfer of impermissible files can lead to a malfunction of the device.<br>Only transfer databases to the SM 1281 which have also been exported from an SM 1281 device. |

1. Transfer the backed-up databases on the SM 1281 to the directory "/config".

   To do this, use WebDAV (Page 64) or FTP (Page 67) or the Save and restore (Page 176) website.

2. After the data is successfully transferred, restart the SM 1281.

   You can initiate the restart by switching the supply voltage on/off or via the General (Page 173) website.

The SM 1281 can be recycled due to its environmentally compatible components.

| NOTICE |
| --- |
| • Disposal of the products described in this manual must be in accordance with the applicable statutory requirements.<br>• For ecologically compatible recycling and disposal of your old device, contact only a certified disposal service for electronic scrap. |

There is no provision for returning the device to Siemens.

For further questions regarding disposal and recycling, please contact your local Siemens contact. You will find the contact details in our database on the Internet at: http://www.automation.siemens.com/partner

# Process and system messages, error handling 14

## 14.1 LED status display

### LED display

The device has the following LEDs on the front:

| LED | Meaning | LED status | | Description |
|---|---|---|---|---|
| DIAG | S7 diagnostics display | Illuminated green | ■ | Correct operation |
| | | Flashes red | ☼ | Fault |
| | | Flashes green | ☼ | Initialization or firmware update |
| MON | Monitoring | Illuminated green | ■ | Operating mode RUN: Monitoring is active. |
| IEPE ERROR 1 to 4 | • Error state of the respective IEPE measurement channel (monitoring only in the RUN operating mode)<br>• Missing communication to the S7 CPU | Off | ■ | • Correct operation<br>• Channel deactivated |
| | | Illuminated red | ■ | • Vibration sensor of the respective channel faulted<br>• Short-circuit or interruption of the sensor line |

# 14.2 S7 diagnostics alarms

## Diagnostics alarms

The following diagnostics alarms are displayed in the diagnostic buffer of the S7 CPU:

Table 14- 1 S7 diagnostics alarms

| Diagnostic interrupt | Cause | Measure |
|---|---|---|
| No supply voltage | 24 V power supply at the SM 1281 module is not detected | Check the 24 V power supply. |
| High limit violated | Wire break in a sensor cable | Check the wiring of the connected sensor. |
| Lower limit violated | Short-circuit between the cores of a sensor cable | Check the wiring of the connected sensor. |
| Invalid/inconsistent firmware available | • Version conflict between the two firmware components "S7 Firmware" and "CM Firmware".<br>• The update of the "CMFirmware" was not successful.<br>• The blocks required from the SM 1281 library are not called in the user program. | • Check the S7 firmware and the Web server update for consistency.<br>• Repeat the CM firmware update.<br>• Use the blocks from the SM 1281 library and correct your user program. |

## Error messages

The following error message is displayed in the TIA Portal:

| Message | Meaning | Measure |
|---|---|---|
| SM1281_Invalid_Cpu_Fw | An SM 1281 module has been configured using an S7-1200 CPU with FW 4.0. | Use an S7-1200 CPU FW 4.1 or higher. |

# 14.3 SM 1281 Web server messages

## Error messages

The following error messages are displayed in the SM 1281 Web server:

Table 14- 2 Error messages

| Message text | Cause | Measure |
|---|---|---|
| Client command response timeout. | A client command could not be executed within a defined period. | The device is temporarily overloaded. Wait and see whether the command is nevertheless executed. Otherwise, repeat the command. |
| Client command not possible in current application state. | A client command cannot be performed in the current operating mode. Deletion of data (cleanup), for example, is only possible in STOP state. | Change to the operating mode in which the command is permitted and then execute the command. |
| Database file missing: ***.cmsdb | The required database file is missing from the device. | Reboot the device. The missing file will be generated automatically. Then check your parameter assignment. |
| Database file corrupt: ***.cmsdb | A database file that is required is damaged on the device and cannot be used. | Delete the specified file via WebDAV or FTP and reboot the device. |
| Wrong order of warning and alarm levels for / in ... | The limits for warning and alarm are not plausible for the specification monitoring function. | It is important to note when setting parameters that alarm limits must be higher than warning limits when upper limits are monitored. Conversely, when monitoring lower limits, the alarm limits must lie below the warning limits. |
| Absolute hysteresis for … greater than warning limit / alarm limit. | In the specified monitoring function, the value of a parameterized hysteresis is greater than the value of the associated limit. | When setting the parameters, ensure that the hysteresis values do not exceed the associated limits. |
| No limit band selected for velocity / acceleration / envelope spectrum monitoring. | No limit band has been selected for the specified spectrum monitoring function. | Select a limit band for each monitored vibration channel under "Velocity spectra / Acceleration spectra / Envelope curve spectra". |
| No bearing type selected for envelope spectrum monitoring. | No bearing type has been selected for bearing-related monitoring of the envelope curve spectrum. | Choose a bearing type under the limit band used. |
| Open driver <name> failed. | During device start-up, a driver could not be started. | Reboot the device. If the problem is not rectified, update the firmware. |
| System in STOP / no more raw data available for recording. | The system has been moved to the STOP state; an ongoing raw data recording could not be completed. The data recorded up to this point are rejected. | Change to the RUN state, if applicable, and carry out raw data recording via the Web page "Current Values". |
| Login failed | An incorrect password was entered. | Enter the correct password. |
| | The user is already logged in. | - |
| Firmware update failed. For details see update.log. | The last firmware update included errors, or was terminated prematurely by the system. Details can be found in "update.log". | Repeat the firmware update. |

## Message texts

**Note**

The messages below contain variable texts that are identified by pointed brackets (e.g. <Cause>). In the case of a fault, the cause is normally given; in the case of limit transgressions, the current measured value, limit, frequency (for vibration analyses) and the current speed is specified.

Table 14- 3 Message texts

| Message text | Description | Remarks |
|---|---|---|
| System startup. | Start-up message from the device. | - |
| Operating mode RUN-Monitoring <cause>. | Change to RUN-Monitoring mode | - |
| Operating mode RUN-Measuring <cause>. | Change to RUN-Measuring mode | - |
| Operating mode RUN-Monitoring: inhibit <On/Off>. | Changeover between RUN-Monitoring and RUN-Monitoring inhibited | - |
| Operating mode STOP <cause>. | Change to STOP mode. | - |
| System shutdown <cause>. | Shutdown message of the device (followed by a restart) | - |
| System initialization failed (system not ready): <cause>. | The device is in the ERROR state. System not ready. | See Chapter Operating mode: "ERROR: System not ready" (Page 199) |
| Transition in RUN-Monitoring failed: <Cause>. | Change to RUN-Monitoring mode has failed. | - |
| Transition in RUN-Measuring failed: <Cause>. | Change to RUN-Measuring mode has failed. | - |
| Disk space for historical data critical! Memory utilization: <Memory utilization> (Available memory: <available memory> / Free memory: <free memory>) | The memory space for historical data is almost full (more than 90%). | - |
| Message jitter on: <Message text> | The specified message is alternately incoming and outgoing at very short intervals ("message jitter"). Entry of the message in the message log is temporarily suppressed to reduce the load on the system. This will not have a negative impact on the monitoring functions of the device. | Use hysteresis for monitoring process values against limits, where appropriate, to prevent a message avalanche. |
| Message jitter off: <Message text> | The specified message is no longer changing at very short intervals and is therefore quire normally entered in the message log. | See previous message "Message jitter on: <Message text>" |
| SPEED: Acquisition failed (<cause>). | Acquisition of speed has failed. | - |

| Message text | Description | Remarks |
|---|---|---|
| VIB<number><channel name>: Acquisition failed (<cause>). | Acquisition of the vibration on vibration channel <number> <channel name> has failed. | The cause "Value suspect" indicates failure of the 24 V process supply voltage. |
| <VIB channel>: vRMS warning limit violated (<actual value> > <threshold value>). Speed: <speed>. | The vRMS warning limit has been violated on the specified vibration channel. | The current vRMS value, the overshot threshold value, and the current speed are specified. |
| <VIB channel>: vRMS alarm limit violated (<actual value> > <threshold value>). Speed: <speed>. | On the specified vibration channel, the vRMS alarm limit was violated. | The current vRMS value, the overshot threshold value, and the current speed are specified. |
| <VIB channel>: aRMS warning limit violated (<actual value> > <threshold value>). Speed: <speed>. | On the specified vibration channel, the aRMS warning limit was violated. | The current aRMS value, the overshot threshold value, and the current speed are specified. |
| <VIB channel>: aRMS alarm limit violated (<actual value> > <threshold value>). Speed: <speed>. | On the specified vibration channel, the aRMS alarm limit was violated. | The current aRMS value, the overshot threshold value, and the current speed are specified. |
| <VIB channel>: Warning <message text> on acceleration spectrum. Limit violated at <frequency> (<actual value> > <limit>). Speed: <speed>. | On the specified vibration channel, a warning limit was violated on the acceleration spectrum. | The parameterized message text, the position (frequency) in the spectrum, the amplitude (actual value), the overshot limit, and the current speed. |
| <VIB channel>: Alarm <message text> on acceleration spectrum. Limit violated at <frequency> (<actual value> > <limit>). Speed: <speed>. | On the specified vibration channel, an alarm limit was violated on the acceleration spectrum. | The parameterized message text, the position (frequency) in the spectrum, the amplitude (actual value), the overshot limit, and the current speed. |
| <VIB channel>: Warning <message text> on velocity spectrum. Limit violated at <frequency> (<actual value> > <limit>). Speed: <speed>. | On the specified vibration channel, a warning limit was violated on the velocity spectrum. | The parameterized message text, the position (frequency) in the spectrum, the amplitude (actual value), the overshot limit, and the current speed. |
| <VIB channel>: Alarm <message text> on velocity spectrum. Limit violated at <frequency> (<actual value> > <limit>). Speed: <speed>. | On the specified vibration channel, an alarm limit was violated on the acceleration spectrum. | The parameterized message text, the position (frequency) in the spectrum, the amplitude (actual value), the overshot limit, and the current speed. |
| <VIB channel>: Warning <message text> on envelope spectrum. Limit violated at <frequency> (<actual value> > <limit>). Speed: <speed>. | On the specified vibration channel, a warning limit was violated on the envelope curve spectrum. | The parameterized message text, the position (frequency) in the spectrum, the amplitude (actual value), the overshot limit, and the current speed. |
| <VIB channel>: Alarm <message text> on envelope spectrum. Limit violated at <frequency> (<actual value> > <limit>). Speed: <speed>. | On the specified vibration channel, an alarm limit was violated on the envelope curve spectrum. | The parameterized message text, the position (frequency) in the spectrum, the amplitude (actual value), the overshot limit, and the current speed. |
| <VIB channel>: aRMS monitoring failed. | It was not possible to perform aRMS monitoring successfully on the specified vibration channel; monitoring is no longer performed. | Possible causes:<br>- Speed not acquired<br>- Speed unstable<br>- Speed not in the range 120 - 16000 rpm (does not apply to reduced scan rate)<br>- Vibration acquisition disturbed |

| Message text | Description | Remarks |
|---|---|---|
| <VIB channel>: vRMS monitoring failed. | It was not possible to perform vRMS monitoring successfully on the specified vibration channel; monitoring is no longer performed. | Possible causes:<br>- Speed not acquired<br>- Speed unstable<br>- Speed not in the range 120 - 16000 rpm (does not apply to reduced scan rate)<br>- Vibration acquisition disturbed |
| <VIB channel>: Monitoring of acceleration spectrum failed. | It was not possible to perform monitoring of the acceleration spectrum successfully on the specified vibration channel; monitoring is no longer performed. | Possible causes:<br>- Speed not acquired<br>- Speed unstable<br>- Speed not in the range 120 - 16000 rpm<br>- Vibration acquisition disturbed |
| <VIB channel>: Monitoring of velocity spectrum failed. | It was not possible to perform monitoring of the velocity spectrum successfully on the specified vibration channel; monitoring is no longer performed. | Possible causes:<br>- Speed not acquired<br>- Speed unstable<br>- Speed not in the range 120 - 16000 rpm<br>- Vibration acquisition disturbed |
| <VIB channel>: Monitoring of envelope spectrum failed. | It was not possible to perform monitoring of the envelope spectrum successfully on the specified vibration channel; monitoring is no longer performed. | Possible causes:<br>- Speed not acquired<br>- Speed unstable<br>- Speed not in the range 120 - 16000 rpm<br>- Vibration acquisition disturbed |
| Recording of raw data <Operation> <Further information> | Raw data recording was started, has failed, etc. | - |
| Recording of raw data started: trigger = <trigger>, duration = <recording duration>, file = <file name> | Recording of raw data in progress. The file name, recording duration [s], and trigger for recording are also stated. | This message shows whether raw data is being recorded or has already been completed. |
| The system will restart due to serious internal errors: <Cause> | The system will restart due to internal errors. | - |
| No or not enough raw data available to be recorded. Error code: 151. | After a switch of the operating mode from "STOP: System ready" to "RUN: Monitoring" an attempt to record raw data was made too quickly. | - |

## 14.4 Operating mode: "ERROR: System not ready"

If the self-monitoring detects an error in the system, the device switches to the operating mode "ERROR: System not ready".

### Remedy

You have the following options:

- If the SM 1281 webserver is available, call the page"Pending messages" (Page 149). The current error situation is explained in more detail here.
- In some instances, a firmware update may have to be performed, see Chapter CM firmware update (Page 187).
- The device can be restarted by a voltage reset.

**Note**

If the operating mode "ERROR: System not ready" is no longer exited after a manual restart of the SM 1281 module, including the S7 controller, contact Support (https://support.industry.siemens.com/cs/?lc=en-DE).

# Technical data

# 15

## 15.1 Technical specifications of SM1281

### Technical specifications SM 1281

| | |
|---|---|
| product brand name | SIPLUS |
| Product designation | CMS1200 SM 1281 Condition Monitoring |
| **General technical data:** | |
| Browser software required | Web browser Mozilla Firefox (ESR31) or Microsoft Internet Explorer (10/11) |
| Storage capacity total | 1 Gbyte |
| Scanning frequency maximum | 46 875 Hz |
| Material of the enclosure | Plastic: polycarbonate, abbreviation: PC- GF 10 FR |
| Material of the enclosure on the front plastic | Yes |
| Connector type on the front required | Yes |
| Hardware configuration | Modular, up to 7 modules per CPU |
| Vibration frequency measuring range | |
| • initial value | 0.05 Hz |
| • Full-scale value | 10 000 Hz |
| Power loss [W] total typical | 4.8 W |
| Consumed current from backplane bus at DC at 5 V typical | 80 mA |
| Consumed current from backplane bus at DC at 5 V maximum | 85 mA |
| Equipment marking acc. to DIN EN 81346-2 | P |
| Weight | 260 g |
| **Supply voltage:** | |
| Supply voltage 1 at DC rated value | 24 V |
| Supply voltage at DC Rated value 24 V | Yes |
| Type of voltage of the supply voltage | DC |
| Supply voltage at DC rated value | |
| • minimum | 20.4 V |
| • maximum | 28.8 V |
| Consumed current typical | 200 mA |
| Consumed current maximum | 250 mA |
| **Installation/ mounting/ dimensions:** | |
| Mounting position | Horizontal, vertical |
| Mounting position recommended | Horizontal |
| Mounting type | Rail or wall mounting |

| | |
|---|---|
| Width | 70 mm |
| Height | 112 mm |
| Depth | 75 mm |
| **Inputs/ Outputs:** | |
| Number of sensor inputs for IEPE sensors | 4 |
| Number of speed inputs | 1 |
| Product function Bus communication | Yes |
| Product function monitoring of sensor inputs | Yes |
| Product function monitoring of sensor inputs Note | Cable break and short-circuit |
| Input voltage at speed input DC 24 V digital | Yes |
| **Display:** | |
| Display version for diagnostic function: status display digital input LED green | No |
| Display version as status display by LED for status of Inputs | Yes |
| Display version as status display by LED for maintenance | Yes |
| **Communication:** | |
| Type of data transmission | Exporting of raw data as WAV file for further analyses (e.g. using CMS X-Tools) can be downloaded via browser |
| Design of the interface Ethernet interface | Yes |
| Service as web server HTTP | Yes |
| **Ambient conditions:** | |
| Environment Degree of protection IP 20 | Yes |
| Ambient temperature | |
| • in horizontal mounting position during operation | -20 ... +60 °C |
| • in vertical mounting position during operation | -20 ... +45 °C |
| Air pressure | |
| • during storage and transport | 660 ... 1 080 hPa |
| • during operation | 795 ... 1 080 hPa |
| Height of fall maximum | 0.3 m |
| Height of fall maximum Note | five times, in product package |
| **Options:** | |
| Alert function Diagnostics alarm | Yes |
| Type of electrical connection | Screw connection |

# 15.2 Measuring inputs

## Technical specifications of the measuring inputs

All specifications apply for the entire operating temperature range Tu = -20 °C to +60 °C and nominal voltage U = 24 V DC

| Measuring inputs | Value |
|---|---|
| Input voltage (AC)<br>• Nominal range | <br>-3.0 V ... +3.0 V |
| Operating point voltage (DC) of the sensors<br>• Raw data<br>• aRMS calculation | <br>+9.0 V ... 12.0 V<br>+9.5 V ... 11.5 V |
| Constant current supply (DC)<br>• Nominal range<br>• Typical | <br>+4.1 mA ... 4.55 mA<br>+4.35 mA |
| Input resistance | > 10 MΩ |
| Input frequency range<br>• Raw data<br>• aRMS value | <br>0.5 Hz ...10 kHz<br>0.5 Hz ...1 kHz |
| Resolution | 0.1526 mV (= 5V / $2^{15}$) |
| coupling | AC |
| Crosstalk attenuation (CTA)<br>• Channel to channel with f = 1 khz | <br>-66 dB |
| Signal noise | < 4 $mV_{rms}$ |
| Sampling frequency per channel | 46875 Hz |
| Limit frequency analog section (hardware filtering) | 23 kHz |
| DC accuracy | 0.5% |
| AC accuracy raw data<br>• 0.5 Hz to 2 kHz<br>• 1 kHz to 10 kHz | <br>±2 % (typ. ±1 %)<br>±3 % (typ. ±2 %) |
| AC accuracy acceleration RMS value<br>• 5 Hz to 1 kHz | <br>±2 % (typ. ±1 %) |
| Temperature-based DC and AC measurement | ±50 ppm/K |
| Linearity errors<br>• DC measurement<br>• AC measurement | <br>±0.1 %<br>±1 % (typ. ±0.5 %) |
| Galvanic isolation | No; specified by individual sensors at the process end |
| Cable break detection: | Yes |

| Measuring inputs | Value |
|---|---|
| Cable short-circuit detection | Yes |
| Common-mode rejection (working voltage)<br>• Raw data<br>• Acceleration RMS value: | <br>> 68 dB<br>> 56 dB |

## Filter characteristic curve analog inputs

The following diagram shows the amplitude frequency response (with antialiasing) for the analog inputs of the SM1281.

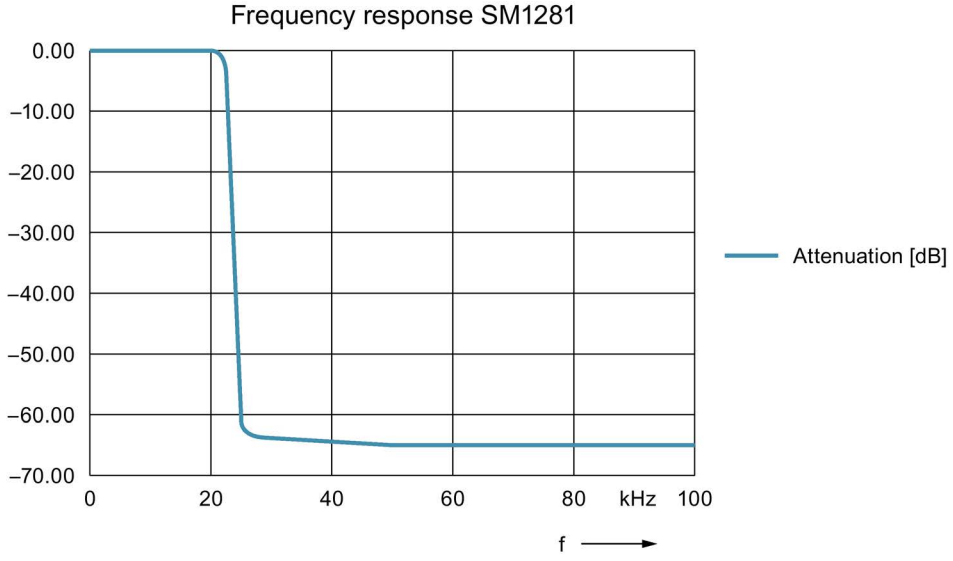



Figure 15-1 Filter characteristic curve analog inputs SM1281

# 15.3 Dimensional drawing

## Dimensional drawings of the SM 1281 Condition Monitoring

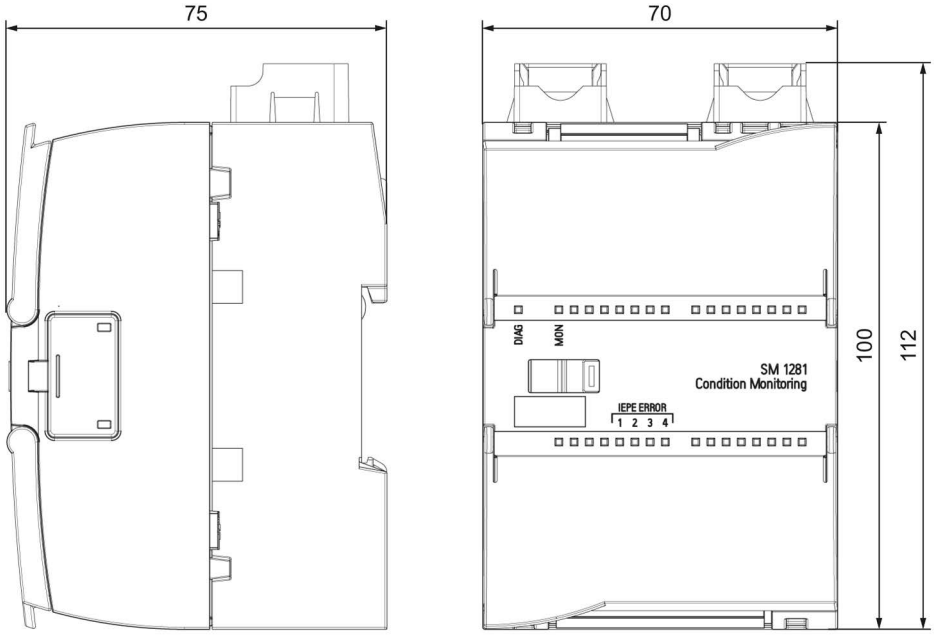



Figure 15-2 Dimensional drawings SM 1281

# Appendix

# A

## A.1 Certificates and approvals

**Note**

**Approvals are only valid when marked on the product**

The specified approvals apply only when the corresponding mark is printed on the product. You can check which of the following approvals have been granted for your product by the markings on the type plate.

### CE marking

The SM 1281 Condition Monitoring device fulfills the requirements and safety objectives of the EC directives below.

### Industrial environments

The product is designed for use in an industrial environment.

EMC requirements:

| Field of application | Noise emission requirements | Interference immunity requirements |
|---|---|---|
| Industrial area | EN 61000-6-4 | EN 61000-6-2 |

The product meets these requirements if you adhere to the installation guidelines and safety instructions described in these operating instructions and in the System Manual for the S7-1200 Automation System.

### Declaration of Conformity

The EC Declaration of Conformity is kept available for the responsible authorities in accordance with the above-mentioned EC Directive at the following address:

SIEMENS AG
DF FA SE R&D
BRESLAUER STR. 5
90766 FUERTH
GERMANY

### Approvals

- UL 508
- CSA C22.2 No. 14

## Further applied standards

- IEC 61131-2 / 2007
- IEC 61010-1 / 2010 + C1 (2011) + C2 (2013)

# A.2 Contact address

## Contact address

SIEMENS AG
DF FA SE
Breslauer Strasse 5
90766 FÜRTH
GERMANY

# A.3 Licenses

## Use of open source software (OSS)

The SM 1281 Condition Monitoring product uses open source software modified by us or in its unmodified form. Mandatory licensing information and sources to be published are saved in the "SM1281_Readme_OSS.pdf" file. This file can be read out on the website "Save and restore" in the section "Downloading software licensing information" (Page 176).

Sources under the GNU General Public License are provided to you free of charge on request. Use the communication channels specified under Service & support (Page 211) to do this.

# A.4 Service & support

## Technical Support

You can access Technical Assistance as follows:

- Phone: + 49 (0) 911 895 7222
- E-mail (mailto:siplus-cms.industry@siemens.com)

## Siemens Industry Online Support

You can find various services on the Support homepage (http://support.automation.siemens.com) on the Internet.

There you will find the following information, for example:

- The correct documents for you via product-related search functions
- Online support request form
- You local representative
- Information about on-site service, repairs, and spare parts.
- A forum for global information exchange by users and specialists.
- Our newsletter containing up-to-date information on your products.

## Online catalog and ordering system

The online catalog and the online ordering system can be found on the Industry Mall homepage (https://mall.industry.siemens.com).

## SIPLUS CMS Condition Monitoring Systems on the Internet

Current information on SIPLUS CMS Condition Monitoring Systems are provided as part of our online presence (http://www.siemens.com/siplus-cms).

# Glossary

### Alarm limit

A threshold value can be set for each of the measured or calculated variables, e.g. vRMS, aRMS, speed. If this threshold value is exceeded, the device will trigger an alarm.

### BPFI

Ball Passing Frequency Inner race

### BPFO

Ball Passing Frequency Outer race

### BSF

Ball Spin Frequency

### CMS

Condition monitoring system for monitoring mechanical components as part of preventive maintenance.

### Fault frequency

The fault frequency is the rate at which the ball of the bearing passes a damage location. The fault frequencies can either be determined from the bearing geometry and the speed, or they can be directly entered on the basis of a reference speed.

### FE (functional grounding)

Low-impedance connection to ground potential

### Fingerprint

A "Fingerprint" is created for the purpose of recording the current status of a monitored bearing. Characteristic values are either measured using configurable measuring procedures or calculated by averaging the measured values over a definable period, and saving them in the device.

### FTF

Fundamental Train Frequency

### FTP

File Transfer Protocol

### High/low limit

Some measured values are monitored for overshooting a high limit (for both warning and alarm) as well as for undershooting a low limit (for both warning and alarm).

### IEPE sensor

IEPE sensors are piezo-electric sensors with integrated electronics.

### ISO 10816-3

Title: Mechanical vibration - Evaluation of machine vibration by measurements on non-rotating parts - Part 3: Industrial machines with nominal power above 15 kW and nominal speeds between 120 rpm and 15000 rpm when measured in situ (ISO 10816-3:2009)

### Limit band

A limit band is a dataset that contains frequencies or frequency ranges (depending on the analysis technique selected) and the limits to be monitored in each case.

### Raw data

The measured values acquired on the input channels of the device for further processing.

### RMS

Root Mean Square

### SIPLUS CMS

SIPLUS CMS is the name for the condition monitoring product family from Siemens. Mechanical wear, imbalance, damage to rolling contact bearings and other damage in machines can cause an unplanned plant stoppage. SIPLUS CMS detects such damage early and therefore ensures plant availability.

### SM 1282 Condition Monitoring

Parameterizable condition monitoring system from the SIPLUS CMS product family from Siemens. With the SM 1282, visualization and parameterization is performed via a web browser or via the TIA Portal. Handling has therefore been considerably simplified for the service personnel, both locally as well as in remote operation.

## SMTP

Simple Mail Transfer Protocol

## Warning limit

A threshold value can be set for each of the measured or calculated variables, e.g. vRMS, aRMS. If this threshold value is exceeded, the device will trigger a warning.

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