SIEMENS

Edition 08/2023

OPERATING INSTRUCTIONS

SIMATIC

SIPLUS CMS 1200

SM 1281 Condition Monitoring

www.siemens.com

SIEMENS

SIPLUS

Condition Monitoring System SM 1281 Condition Monitoring

Operating Instructions

08/2023

A5E36912951-AI

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.

Siemens AG
Digital Industries
Postfach 48 48
90026 NÜRNBERG
GERMANY

A5E36912951-AI
Ⓟ 09/2023 Subject to change

Table of contents

Introduction

1

1.1 About SIMATIC SIPLUS CMS 1200

SIMATIC SIPLUS CMS 1200

The SM 1281 is a condition monitoring system for preventive monitoring of machines and plants.

1.2 About this manual

1.2.1 Contents

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.

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".

To illustrate possible application areas for our products, typical use cases are listed in this product documentation and in the online help. These are purely exemplary and do not constitute a statement on the suitability of the respective product for applications in specific individual cases. Unless explicitly contractually agreed, Siemens assumes no liability for such suitability. Suitability for a particular application in specific individual cases must be assessed by the user, taking into account all technical, legal, and other requirements on a case-by-case basis. Always observe the descriptions of the technical properties and the relevant constraints of the respective product contained in the product documentation.

This documentation should be kept in a location where it can be easily accessed and made available to the personnel responsible.

Information regarding third-party products

Note

Recommendation relating to third-party products

This document contains recommendations relating to third-party products. Siemens accepts the fundamental suitability of these third-party products.

You can use equivalent products from other manufacturers.

Siemens does not accept any warranty for the properties of third-party products.

1.2.2 What's new?

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.x
10/2017	Update for SM 1281 modules with firmware version V3.0
04/2018	Update for SM 1281 modules with firmware version V3.0 *(The specification of version 3.5 in earlier editions of this manual is a printing error)*
09/2018	Update for SM 1281 modules with firmware version V3.1
03/2020	Update for SM 1281 modules with firmware version V3.2
04/2021	Update for SM 1281 modules with firmware version V3.3
02/2023	Update for SM 1281 modules with firmware version V3.4

1.2.3 Target group

Description

These operating instructions are intended for:

- Fitters
- Commissioning engineers
- Machine operators
- Service and maintenance personnel
- Warehouse personnel
- I&C personnel (optional)
- Network administrator (optional)

1.2.4 Standard scope

Description

This documentation describes the functionality of the standard scope. This scope may differ from the scope of the functionality of the system that is actually supplied. Please refer to the ordering documentation only for the functionality of the supplied drive system.

Further functions may be executable in the system, which are not explained in this documentation. However, there is no entitlement to these functions in the case of a new delivery or service.

This documentation does not contain all detailed information on all types of the product. Furthermore, this documentation cannot take into consideration every conceivable type of installation, operation and service/maintenance.

The machine manufacturer must document any additions or modifications they make to the product themselves.

1.2.5 Use of third-party products in this documentation

Description

This documentation contains recommendations relating to third-party products. Siemens accepts the fundamental suitability of these third-party products. You can use equivalent products from other manufacturers.

Siemens does not accept any warranty for the use of third-party products.

1.2.6 Websites of third-party companies

Description

This document may contain hyperlinks to third-party websites. Siemens is not responsible for and shall not be liable for these websites and their content. Siemens has no control over the information which appears on these websites and is not responsible for the content and information provided there. The user bears the risk for their use.

1.3 SIMATIC Documentation

1.3.1 Documentation guide

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 1- 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/ww/en/view/36932465)	• Application planning • Assembly • Connection • Commissioning
Designing interference-free controllers	Function Manual Designing interference-free controllers (https://support.industry.siemens.com/cs/ww/en/view/59193566)	• Basics • Electromagnetic compatibility • Lightning protection

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

1.4 Service & Support

1.4.1 Siemens Industry Online Support on the Web

Important product information is available through Siemens Industry Online Support using the following options:

- Website: SIOS (https://support.industry.siemens.com/cs/ww/en/)
- App Industry Online Support (for Apple iOS and Android)

Content of Siemens Online Support

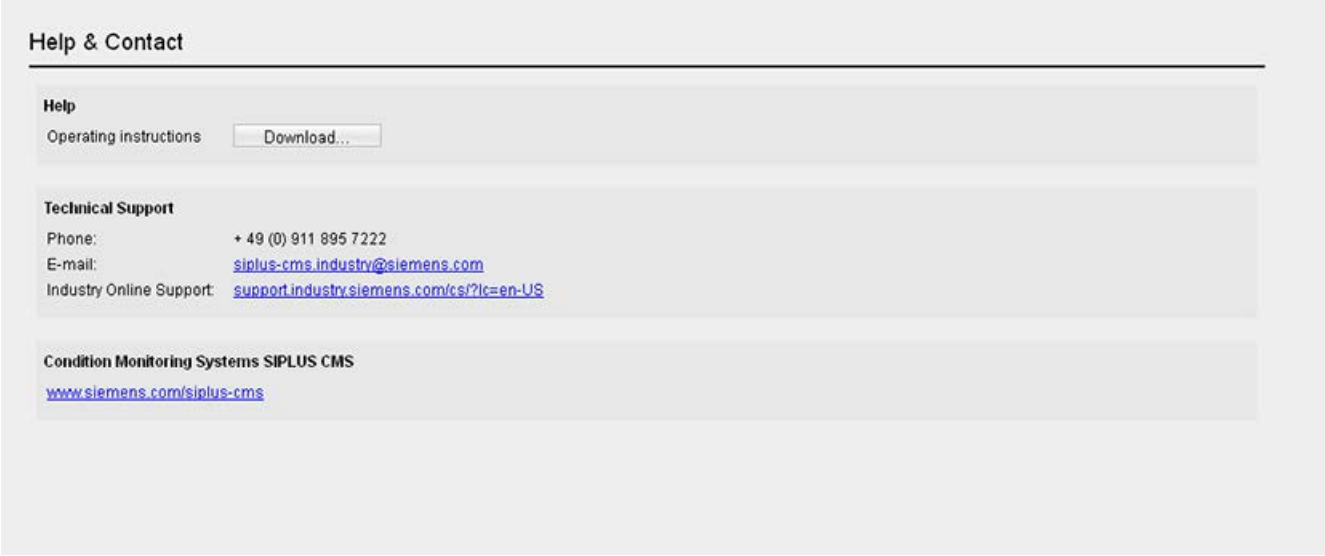
- Product support
- Global forum for information and best practice sharing between users and specialists
- Local contact persons via the contact person database (→ Contact)
- Product information
- FAQs (frequently asked questions)
- Application examples
- Manuals
- Downloads
- Compatibility tool
- Newsletter with product selection
- Catalogs/brochures
- Certificates

For products with QR code, the manual and certificate can be directly called.

1.4.2 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.



1.4.3 Spare parts services

Description

The online spare part service "Spares on Web" offers certain spare parts for the product:

- Website: SOW address (https://www.sow.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 (https://www.siemens.com/siplus-cms).

1.5 Important product information

1.5.1 Intended use

SM 1281 devices comply with the approvals printed on the nameplate. Contact Technical Support in case of any questions about the acceptability of the installation in the intended environment.

NOTICE
Property damage due to improper use SM 1281 is not a machine protection solution. Do not use the status displays provided by SM 1281 in the form of LEDs and web pages for control purposes (e.g. shutting down the machine).

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

Fundamental safety instructions 2

2.1 General safety instructions

⚠WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules.

Generally, the following steps apply when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Isolate the drive system from the power supply and take measures to prevent it being switched back on again.
3. Wait until the discharge time specified on the warning labels has elapsed.
4. Check that there is no voltage between any of the power connections, and between any of the power connections and the protective conductor connection.
5. Check whether the existing auxiliary supply circuits are de-energized.
6. Ensure that the motors cannot move.
7. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water. Switch the energy sources to a safe state.
8. Check that the correct drive system is completely locked.

After you have completed the work, restore the operational readiness in the inverse sequence.

⚠WARNING

Risk of electric shock and fire from supply networks with an excessively high impedance

Excessively low short-circuit currents can lead to the protective devices not tripping or tripping too late, and thus causing electric shock or a fire.

- In the case of a conductor-conductor or conductor-ground short-circuit, ensure that the short-circuit current at the point where the converter is connected to the line supply at least meets the minimum requirements for the response of the protective device used.
- You must use an additional residual-current device (RCD) if a conductor-ground short circuit does not reach the short-circuit current required for the protective device to respond. The required short-circuit current can be too low, especially for TT supply systems.

⚠WARNING

Risk of electric shock and fire from supply networks with an excessively low impedance

Excessively high short-circuit currents can lead to the protective devices not being able to interrupt these short-circuit currents and being destroyed, and thus causing electric shock or a fire.

- Ensure that the prospective short-circuit current at the line terminal of the converter does not exceed the breaking capacity (SCCR or Icc) of the protective device used.

⚠WARNING

Electric shock if there is no ground connection

For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.

- Ground the device in compliance with the applicable regulations.

⚠WARNING

Electric shock due to connection to an unsuitable power supply

When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage. Contact with hazardous voltage can result in severe injury or death.

- Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV-(Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.

⚠WARNING

Electric shock due to equipment damage

Improper handling may cause damage to equipment. For damaged devices, hazardous voltages can be present at the enclosure or at exposed components; if touched, this can result in death or severe injury.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged devices.

⚠WARNING

Electric shock due to unconnected cable shield

Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.

- As a minimum, connect cable shields and the conductors of power cables that are not used (e.g. brake cores) at one end at the grounded housing potential.

⚠WARNING

Arcing when a plug connection is opened during operation

Opening a plug connection when a system is in operation can result in arcing that may cause serious injury or death.

- Only open plug connections when the equipment is in a voltage-free state, unless it has been explicitly stated that they can be opened in operation.

⚠WARNING

Electric shock due to residual charges in power components

Because of the capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.

- Wait for 5 minutes before you check that the unit really is in a no-voltage condition and start work.

NOTICE

Damage to equipment due to unsuitable tightening tools.

Unsuitable tightening tools or fastening methods can damage the screws of the equipment.

- Only use screw inserts that exactly match the screw head.
- Tighten the screws with the torque specified in the technical documentation.
- Use a torque wrench or a mechanical precision nut runner with a dynamic torque sensor and speed limitation system.
- Adjust the tools used regularly.

NOTICE

Property damage due to loose power connections

Insufficient tightening torques or vibration can result in loose power connections. This can result in damage due to fire, device defects or malfunctions.

- Tighten all power connections to the prescribed torque.
- Check all power connections at regular intervals, particularly after equipment has been transported.

⚠ WARNING

Spread of fire from built-in devices

Built-in devices can cause a fire and a pressure wave in the event of a fault. Fire and smoke can escape from the control cabinet and cause serious personal injury and property damage.

- Install built-in appliances in a robust metal control cabinet that is suitable for protecting people from fire and smoke.
- Only operate built-in devices with the control cabinet doors closed.
- Ensure that smoke can only escape via controlled and monitored paths.

⚠ WARNING

Active implant malfunctions due to electromagnetic fields

Converters generate electromagnetic fields (EMF) in operation. Electromagnetic fields may interfere with active implants, e.g. pacemakers. People with active implants in the immediate vicinity of an converter are at risk.

- As the operator of an EMF-emitting installation, assess the individual risks of persons with active implants.
- Observe the data on EMF emission provided in the product documentation.

⚠ CAUTION

Symptomatic respiratory and skin reaction to chemicals

A newly purchased product might contain traces of substances that are identified as sensitizers.

Sensitizers are substances which can cause sensitization in the lungs and skin after exposure to them.

Once sensitized, individuals can have severe reactions to further exposure, even in small amounts. In the most extreme cases, individuals might develop asthma or dermatitis respectively.

- If the product has a strong smell, keep it in a well-ventilated area for 14 days.

⚠WARNING

Unexpected machine movement caused by radio devices or mobile phones

Using radio devices, cellphones, or mobile WLAN devices in the immediate vicinity of the components can result in equipment malfunction. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- Therefore, if you move closer than 20 cm to the components, be sure to switch off radio devices, cellphones or WLAN devices.
- Use the "SIEMENS Industry Online Support App" or a QR code scanner only on equipment that has already been switched off.

NOTICE

Damage to motor insulation due to excessive voltages

When operated on systems with grounded line conductors or in the event of a ground fault in the IT system, the motor insulation can be damaged by the higher voltage against ground. If you use motors that have insulation that is not designed for operation with grounded line conductors, you must perform the following measures:

- IT system: Use a ground fault monitor and eliminate the fault as quickly as possible.
- TN or TT systems with grounded line conductor: Use an isolating transformer on the line side.

⚠WARNING

Fire due to inadequate ventilation clearances

Inadequate ventilation clearances can cause overheating of components with subsequent fire and smoke. This can cause severe injury or even death. This can also result in increased downtime and reduced service lives for devices/systems.

- Ensure compliance with the specified minimum clearance as ventilation clearance for the respective component.

NOTICE

Overheating due to inadmissible mounting position

The device may overheat and therefore be damaged if mounted in an inadmissible position.

- Only operate the device in admissible mounting positions.

⚠WARNING

Unrecognized dangers due to missing or illegible warning labels

Dangers might not be recognized if warning labels are missing or illegible. Unrecognized dangers may cause accidents resulting in serious injury or death.

- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, where necessary in the national language.
- Replace illegible warning labels.

NOTICE

Device damage caused by incorrect voltage/insulation tests

Incorrect voltage/insulation tests can damage the device.

- Before carrying out a voltage/insulation check of the system/machine, disconnect the devices as all converters and motors have been subject to a high voltage test by the manufacturer, and therefore it is not necessary to perform an additional test within the system/machine.

⚠WARNING

Unexpected movement of machines caused by inactive safety functions

Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death.

- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

Note

Important Safety instructions for Safety Integrated

If you want to use Safety Integrated functions, you must observe the Safety instructions in the Safety Integrated documentation.

⚠WARNING

Malfunctions of the machine as a result of incorrect or changed parameter settings

As a result of incorrect or changed parameterization, machines can malfunction, which in turn can lead to injuries or death.

- Protect the parameterization against unauthorized access.
- Handle possible malfunctions by taking suitable measures, e.g. emergency stop or emergency off.

2.2 Equipment damage due to electric fields or electrostatic discharge

Electrostatic sensitive devices (ESD) are individual components, integrated circuits, modules or devices that may be damaged by either electric fields or electrostatic discharge.

NOTICE

Equipment damage due to electric fields or electrostatic discharge

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g conductive foam rubber of aluminum foil.
- Only touch components, modules and devices when you are grounded by one of the following methods:
  - Wearing an ESD wrist strap
  - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring
- Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).

2.3 Warranty and liability for application examples

Application examples are not binding and do not claim to be complete regarding configuration, equipment or any eventuality which may arise. Application examples do not represent specific customer solutions, but are only intended to provide support for typical tasks.

As the user you yourself are responsible for ensuring that the products described are operated correctly. Application examples do not relieve you of your responsibility for safe handling when using, installing, operating and maintaining the equipment.

2.4 Cybersecurity information

Siemens provides products and solutions with industrial cybersecurity 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 cybersecurity concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial cybersecurity measures that may be implemented, please visit
https://www.siemens.com/global/en/products/automation/topic-areas/industrial-cybersecurity.html.

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

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under
https://new.siemens.com/global/en/products/services/cert.html.

Further information is provided on the Internet:

Industrial Security Configuration Manual
(https://support.industry.siemens.com/cs/ww/en/view/108862708)

⚠ WARNING

Unsafe operating states resulting from software manipulation

Software manipulations, e.g. viruses, Trojans, or worms, can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Keep the software up to date.
- Incorporate the automation and drive components into a state-of-the-art, integrated industrial cybersecurity concept for the installation or machine.
- Make sure that you include all installed products in the integrated industrial cybersecurity concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.
- Carefully check all cybersecurity-related settings once commissioning has been completed.

2.5 Residual risks of power drive systems

When assessing the machine or system-related risk in accordance with the respective local regulations (e.g. EC Machinery Directive), the machine manufacturer or system integrator must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example,
   - Hardware faults and/or software errors in the sensors, control system, actuators, and connections
   - Response times of the control system and of the drive
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive contamination
   - Parameterization, programming, cabling, and installation errors
   - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
   - External influences/damage
   - X-ray, ionizing radiation and cosmic radiation
2. Unusually high temperatures inside and outside the components, including open flames, as well as emissions of light, noise, particles, gases, etc. due to fault conditions, e.g.:
   - Component failure
   - Software errors
   - Operation and/or environmental conditions outside the specification

   - External influences/damage
   - Short circuits or ground faults in the intermediate DC circuit of the converter
3. Hazardous shock voltages caused by, for example:
   - Component failure
   - Influence during electrostatic charging
   - Induction of voltages in moving motors
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive contamination
   - External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly
6. Influence of network-connected and wireless communications systems, e.g. ripple-control transmitters or data communication via the network or mobile radio, WLAN or Bluetooth.
7. Motors for use in potentially explosive areas:

   When moving components such as bearings become worn, this can cause enclosure components to exhibit unexpectedly high temperatures during operation, creating a hazard in areas with a potentially explosive atmosphere.

For more information about the residual risks of the drive system components, see the relevant sections in the technical user documentation.

2.6 Safety instructions

Connection of sensors

⚠WARNING

Voltage hazards

The inputs of the SM 1281 have a functional galvanic isolation up to 500 V. Touching live components can result in death or serious injury.

- Only use sensors that ensure safe electrical separation up to the maximum level of the potentials involved in the system constellation.
- Mount sensors only on electrically non-conductive or grounded surfaces.
- To ensure safe electrical separation, follow the isolation characteristics of the sensors used and take additional measures.

Repairs

⚠WARNING

Electric shock and danger to life during repairs

Unauthorized opening and improper repairs can result in death or serious injury to the user or considerable damage to property.

- For repairs, send the device to the Return Center in Fürth.
- Have the device repaired by authorized specialists only.

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:

From the 24 V output of the power supply, connect the terminal for GND 24 V to the potential equalization for a uniform reference potential. Select a connection point that is as central as possible.

⚠ CAUTION

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.

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.

- Change the preset password of the SM 1281 ("0000") to an individual password during initial configuration. (Section General (Page 187))
- Keep your password safe.
- Data transfer, including passwords, between a client PC and the SM 1281 via a network is carried out unsecured, i.e. without encryption.
  This concerns the data exchange with SM 1281 via the following interfaces:
  - Access via the SM 1281 web interface (section Parameterizing via the SM 1281 web user interface (Page 146))
  - Access via WebDAV (section Data exchange via WebDAV (Page 74))
  - Access via FTP (section Data exchange via FTP (Page 76))
  - Access via OPC-UA (section Data exchange via OPC-UA (Page 77))
  - Data exchange with CMS X-Tools (section Operation with activated X-Tools interface (Page 82))

  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.
- When using the raw data transmission to FTP server function (section Request raw data send (Page 140)) the transmission of the password is unencrypted. Because of this, the FTP server password can be easily seen by an attacker. Siemens recommends access protection for the utilized network.

Network settings

The following table shows the network settings of the SM 1281 for communication via the Ethernet interface:

Name	Port number	Transport protocol	Direction	Function
HTTP	80	TCP	Inbound	This service is used for the web interface, as well as for transferring files (initiated by the user) with WebDAV.
HTTPS	443	TCP	Inbound	Not used

Name	Port number	Transport protocol	Direction	Function
FTP	20, 21	TCP	Inbound, Outbound	This service is used for transferring files. This includes transfer initiated by the user and automatic transfer of raw data.
NetBIOS	137, 139	UDP	Inbound	Not used
OPC UA	4840	TCP	Inbound	This service is used for data transfer via OPC UA.
CMS X-Tools	User-defined	TCP	Inbound	This service is used for streaming raw data to the X-Tools software package.

Fundamentals of vibration monitoring and diagnostics

3

3.1 Introduction to vibration monitoring

You need to record certain variables to ensure that a machine is effectively monitored during operation. The most important measured variables are those that best describe the state of the machine. Vibrations provide particularly important information.

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

3.2 Mechanical vibration

3.2.1 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

Vibration diagnostics is the basis for monitoring the mechanical condition of a machine.

Using vibration diagnostics, you can

- Detect changes in airborne noise.
- Detect movements in machine components.
- Detect changes in vibration.
- Detect wear at an early stage.
- Plan maintenance intervals individually.
- Increase the availability of machines.
- Increase productivity.

3.2.2 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

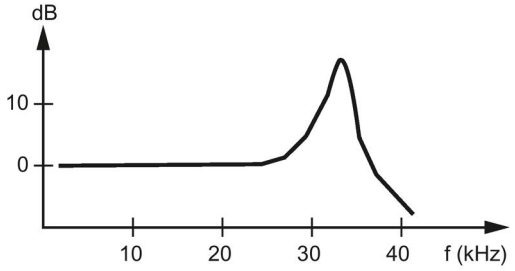
3.3 Measuring vibration

3.3.1 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).

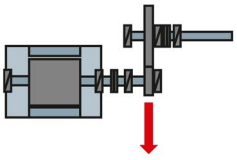
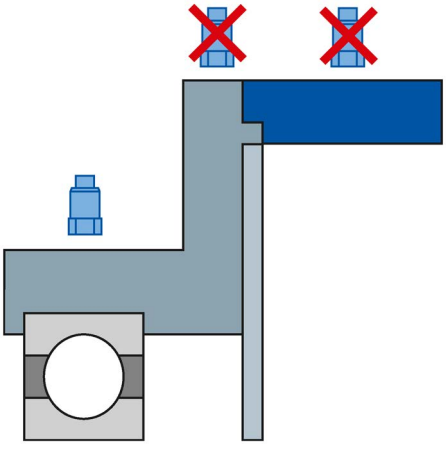
The following figure shows an example of a frequency sensor with the typical frequency response.

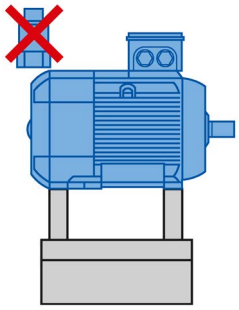
Acceleration sensor	**Typical frequency response (resonance at 34 to 36 kHz)**
	

3.3.2 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.	 Example: Direction of load, tooth drive side
The measurement path between the machine bearing and the measuring point should be as short and direct as possible • The longer the signal path, the weaker vibration signals become. • 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.	 Fan cover as measuring point

3.3.3 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 fastening or mounting acceleration sensors:

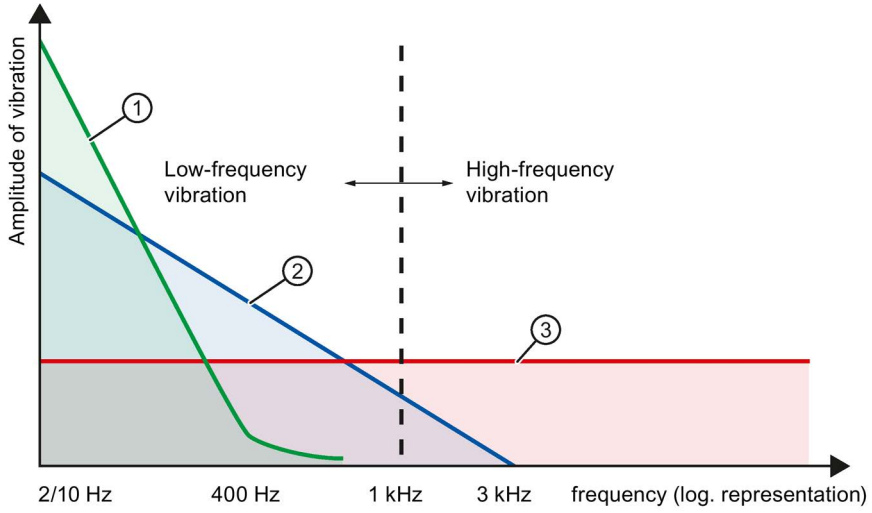
Fastening methods		**Suitability / special aspects**	**Frequency band**
	Direct screw fastening with threaded bolts	For flat, smooth surface	Upper frequency limit 10 to 20 kHz
	Screw fastening via adapter	For non-flat and/or coated surfaces	Upper frequency limit 10 to 20 kHz

Fastening methods		Suitability / special aspects	Frequency band
	Adhesive bond, e.g. with superglue or epoxy resin	Depending on the temperature properties of the adhesive used	Upper frequency limit 10 to 18 kHz
	Fastening with permanent magnets	For fast and flexible mounting Suitability depends on adhesive force, falls of at higher frequencies	Upper frequency limit typically approx. 5 to 15 kHz

3.3.4 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

3.4 Method of fault detection and diagnostics

3.4.1 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
- Characteristic value formation through vibration acceleration (DKW) for the rolling contact 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 frequency 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

3.4.2 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 Double rotation frequency f_n	-	-
Mounting defect	RMS	Single rotation frequency f_n Double rotation frequency f_n 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	-	-
Bearing wear	DKW	-	3 kHz ≤ f_{LE} ≤ 10 kHz	
Bearing damage frequency	DKW	-	-	Geometry-dependent for: Outer ring, inner ring, cage and rolling element
Electrical stator faults	RMS	Double line frequency f_{line}	-	-
Electrical rotor faults	RMS	$f_{bar} \leq 1$ kHz	$f_{bar} > 1$ kHz	-
Rotor bar break	RMS	Double line frequency f_{line} Modulation with slip frequency f_{slip}	--	-

3.5 Vibration diagnostics by characteristic value formation in the time range

3.5.1 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 frequencies from 2 Hz or 10 Hz to 1000 Hz.
  Depending on the speed, the measuring range starts at 2 Hz (speeds from 120 to 600 rpm) or at 10 Hz (speeds greater than or equal to 600 rpm) according to ISO 10816-3.

3.5.2 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 20816-1	Mechanical vibration - Measurement and evaluation of machine vibration Part 1: General guidelines
	ISO 10816-3	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 r/min and 15000 r/min when measured in situ
Guidelines	VDI 3832	Rolling element bearing condition, various procedures

3.5.3 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.

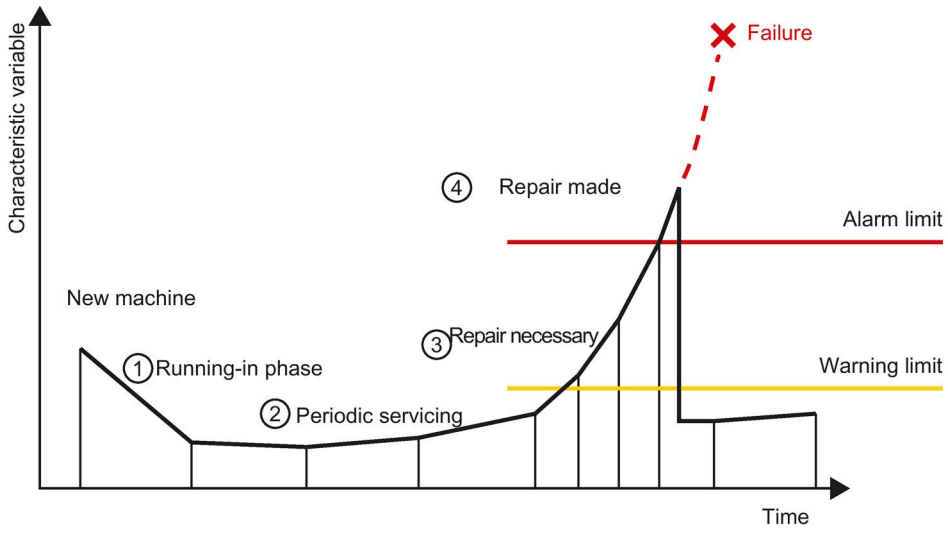


Figure 3-1 Characteristic value trend

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.

3.5.4 Evaluation of machine condition on basis of RMS value for vibration level

3.5.4.1 Description of the diagnostic method (RMS)

Characteristics SM 1281

Characteristic value	Frequency band	Monitorable
vRMS Root mean square - speed	Configurable from 0.1 Hz to 2 kHz [1]	Speed-dependent damage
aRMS Root mean square - acceleration	Configurable from 0.1 Hz to 23 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 (for example 10 Hz to 1 kHz).

The SM 1281 is set up for use in machines and wind power plants. Please note the following settings:

Parameter	Machine	Wind power plant
Duration	3 revolutions to 10 sec.	11 sec. to 10 min.
Analysis mode	Standard	Moving
High-pass filter aRMS / vRMS	From 2 Hz	From 0.1 Hz

For more information, see table 10-10

Relation between vibrations channels and analysis mode:

Only two channels can be operating in moving analysis mode per module. The other channels operate unchanged in standard analysis mode.

Only ONE RMS value can be calculated per channel in moving analysis mode, i.e. either vRMS OR aRMS.

3.5.4.2 Application example machine analysis: Unbalance (RMS)

Application example

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

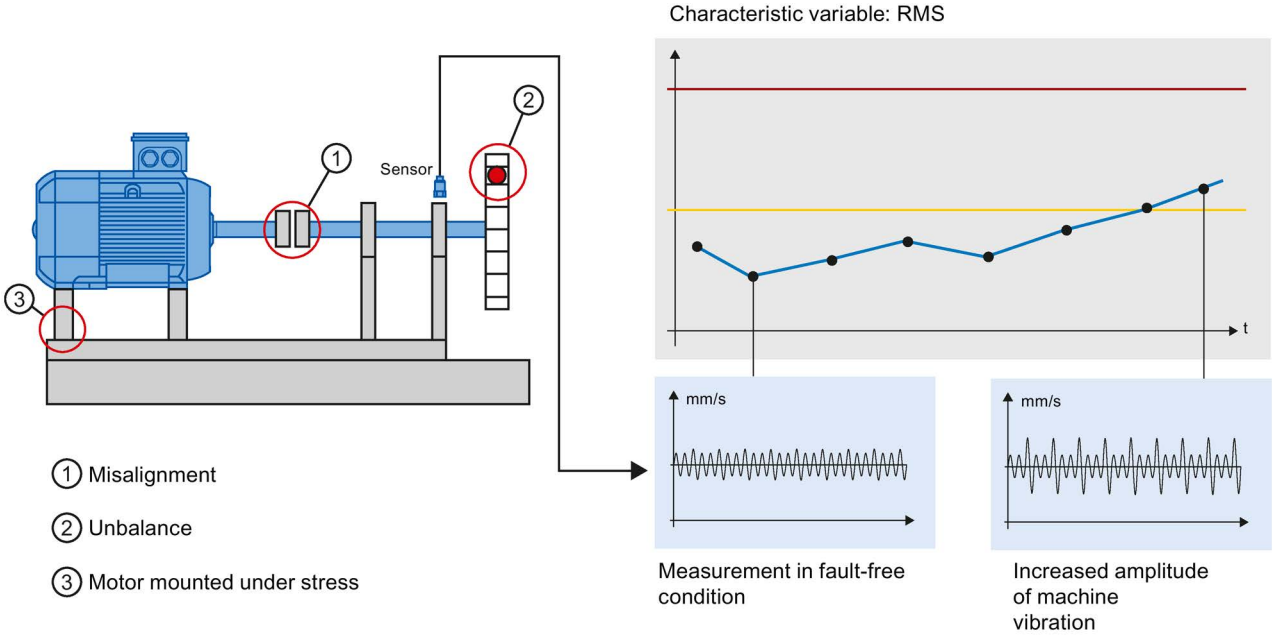


Figure 3-2 Example of RMS

3.5.5 Characteristic value formation through vibration acceleration (DKW)

3.5.5.1 Description of the diagnostic method (DKW)

Diagnostic characteristic value (DKW) parameters for SM 1281

Characteristic value	Frequency band	Monitorable
DKW (diagnostic characteristic value)	> 1 kHz	Rolling element bearing condition

- The characteristic value formation through the diagnostic characteristic value (DKW) allows for qualitative diagnosis of the overall state of the rolling contact bearing.
- The measured rms values and peak values of vibration acceleration at the initial condition of the bearing are compared relative to the current condition to calculate the DKW value.
- The diagnostic characteristic value DKW exhibits a high correlation with the damage condition of rolling element bearings and is therefore very meaningful.

Calculation of the DKW value

The diagnostic characteristic value (DKW) is calculated by following formula:

$$DKW\,(t) = \frac{a_{max}(t) \cdot a_{eff}\,(t)}{a_{max}(0) \cdot a_{eff}\,(0)}$$

$a_{max}(t)$	Current peak value for vibration acceleration
$a_{RMS}(t)$	Current RMS value for vibration acceleration
$a_{max}(0)$	Initial peak value for vibration acceleration
$a_{RMS}(0)$	Initial RMS value for vibration acceleration

Note

DKW is the reciprocal value of the diagnostic characteristic value K(t) according to VDI 3832

According to the K(t) method, the characteristic value would reduce as the damage increases. The SM 1281 therefore forms the reciprocal value of K(t) for better representation.

Peak value for vibration acceleration

The peak value of SM 1281 used for calculation is output as accompanying information alongside the calculated DKW.

Notes on the parameter assignment in SM 1281

The term $a_{max}(0) * a_{RMS}(0)$ represents the reference value for the DKW calculation. This reference value can be parameterized in SM 1281 depending on speed.

If the reference value is parameterized correctly, the DKW is typically close to 1 and increases as the vibration values increase.

3.5.5.2 Application example: Rolling element bearing damage (DKW)

Application example damaged rolling element bearing

The following example shows application of the DKW characteristic value to determine the condition of the rolling element bearing.

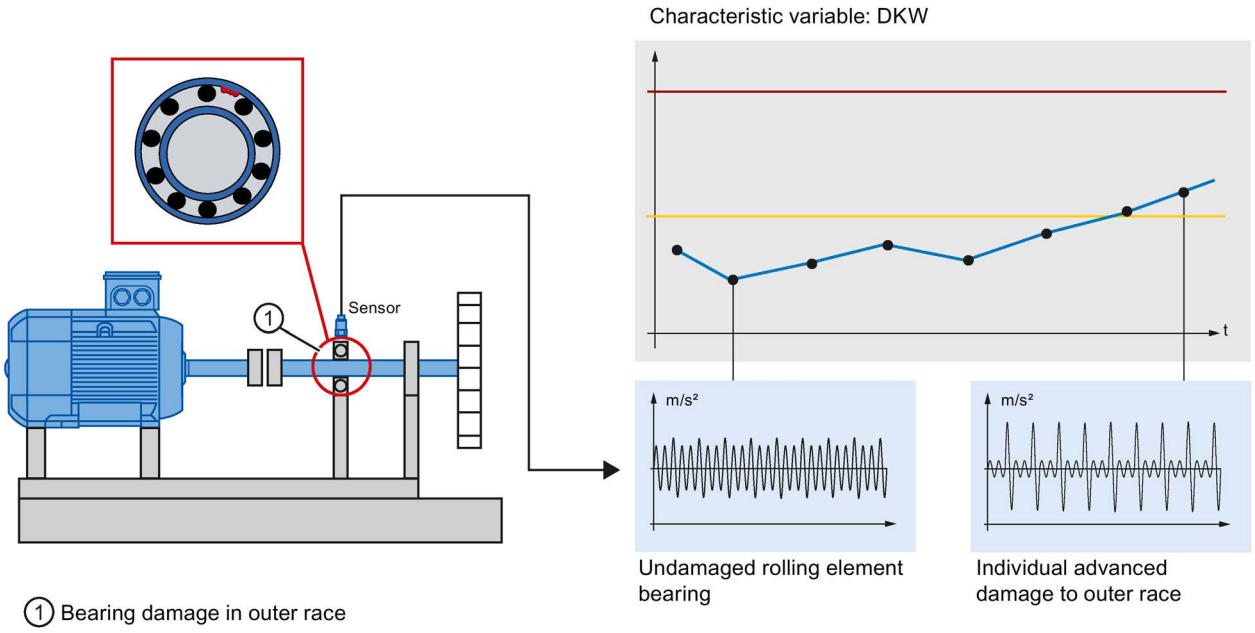


Figure 3-3 Example of a DKW characteristic value

The DKW is in itself not sufficient to examine and determine the cause of damage precisely. Additional analysis methods such as envelope curve analysis is used here (see section Envelope spectrum (Page 50)).

The SM 1281 also derives the peak value of the vibration acceleration (PEAK) from the DKW calculation. No limit monitoring by the SM 1281 takes place. The PEAK value is made available to users who want to calculate the CREST factor. The calculation and monitoring must be performed in the Simatic CPU. In this case, ensure that DKW and aRMS are calculated within the same filter limits.

3.6 Vibration diagnostics by frequency analysis

3.6.1 Overview

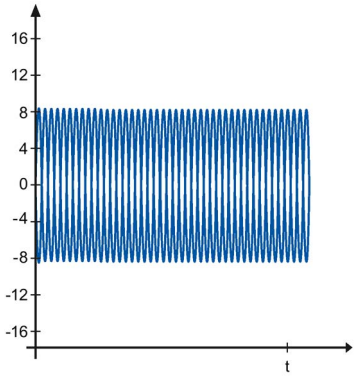
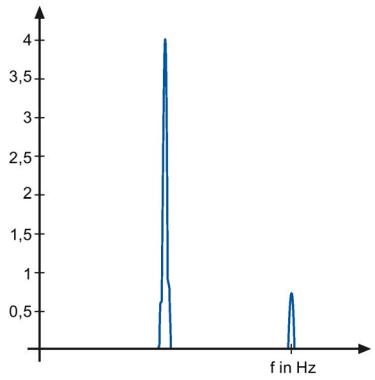
The vibration diagnostics in the time range reaches its limits when it comes to examining the causes of wear more precisely. Frequency analysis is used as the diagnostic method for more detailed examination of vibrations.

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
	

3.6.2 Vibration velocity spectrum

3.6.2.1 Description of the diagnostic method

Characteristics SM 1281

Spectrum	Speed	Frequency band	Resolution	Monitorable
Vibration velocity	<= 6000 rpm	2 Hz to 1 kHz	0.204 Hz	Any combination of speed-dependent and speed-independent monitoring functions.
	> 6000 rpm	10 Hz to 2 kHz	0.408 Hz	

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.

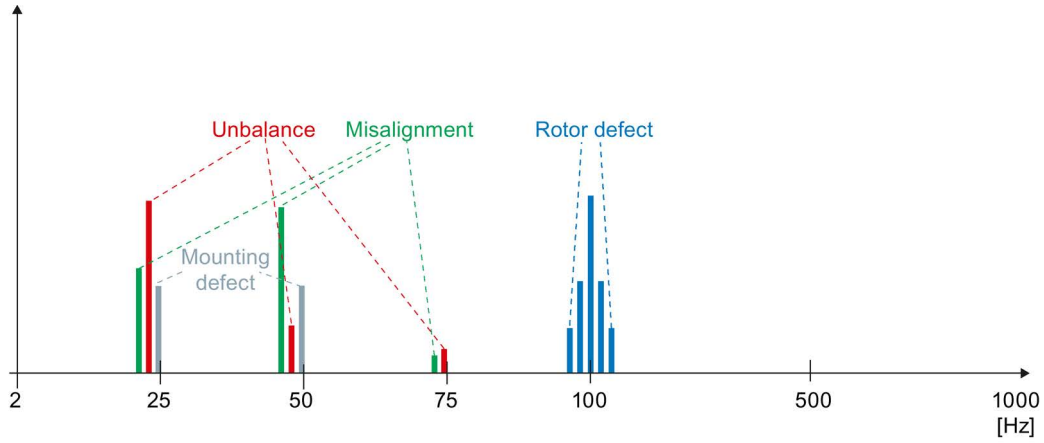


Figure 3-4 Overall spectrum of vibration velocity

3.6.2.2 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 measuring directions.

The spectrum is calculated on the basis of the input signals from the accelerometer.

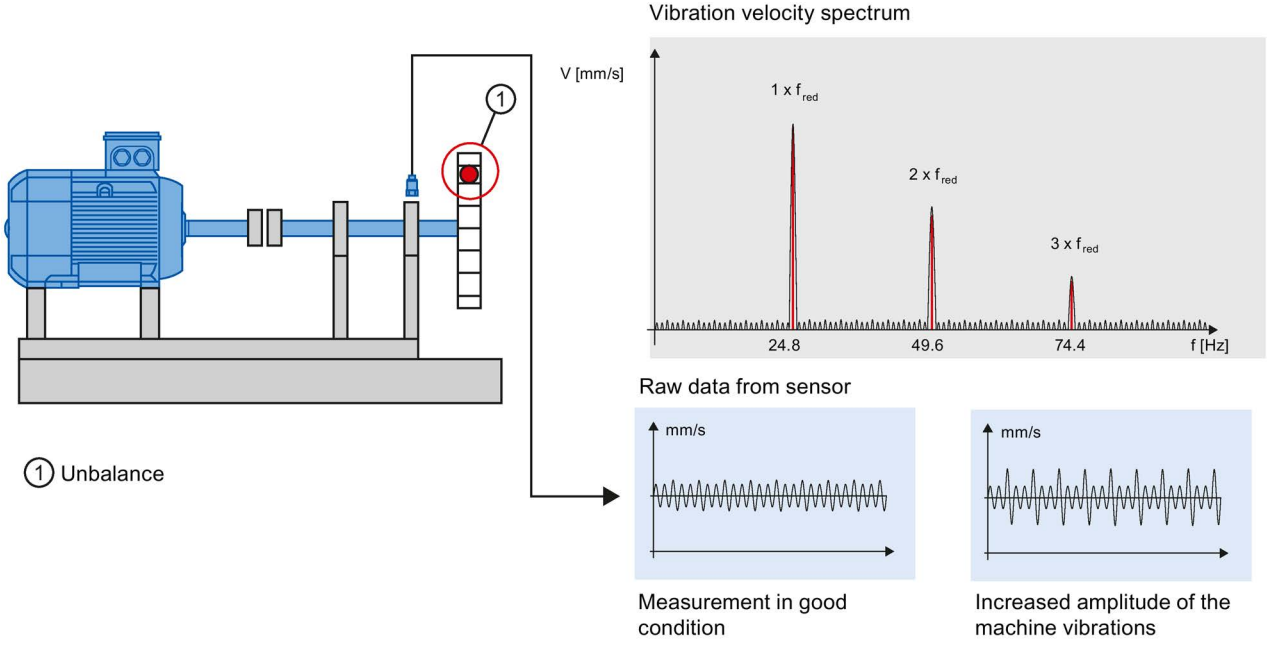


Figure 3-5 Example of a spectrum of vibration velocity (unbalance)

3.6.3 Vibration acceleration spectrum

3.6.3.1 Description of the diagnostic method

Characteristics SM 1281

Spectrum	Frequency band	Resolution	Monitorable
Vibration acceleration	2 Hz to 23 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.

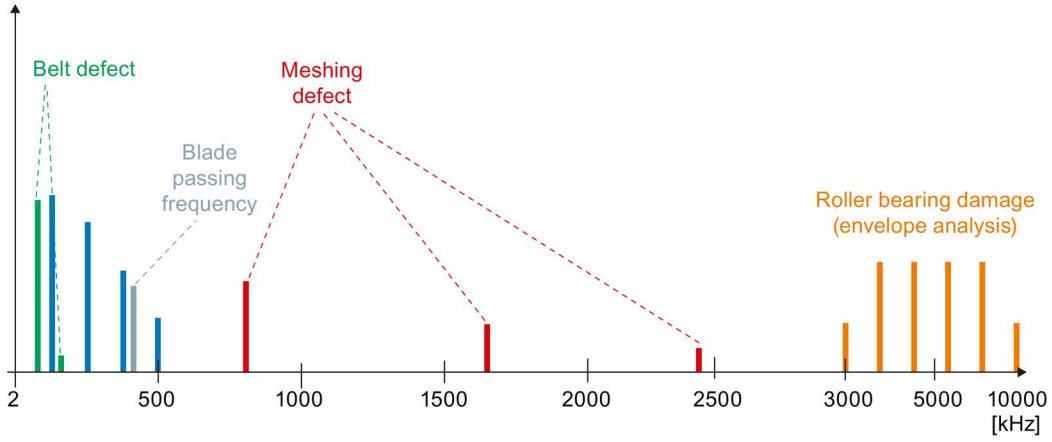


Figure 3-6 Overall spectrum of vibration acceleration

3.6.3.2 Application example (rotor field fault)

Example rotor field fault

Possible causes of a defective rotor include a rotor bar break.

Signs of this fault include:

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

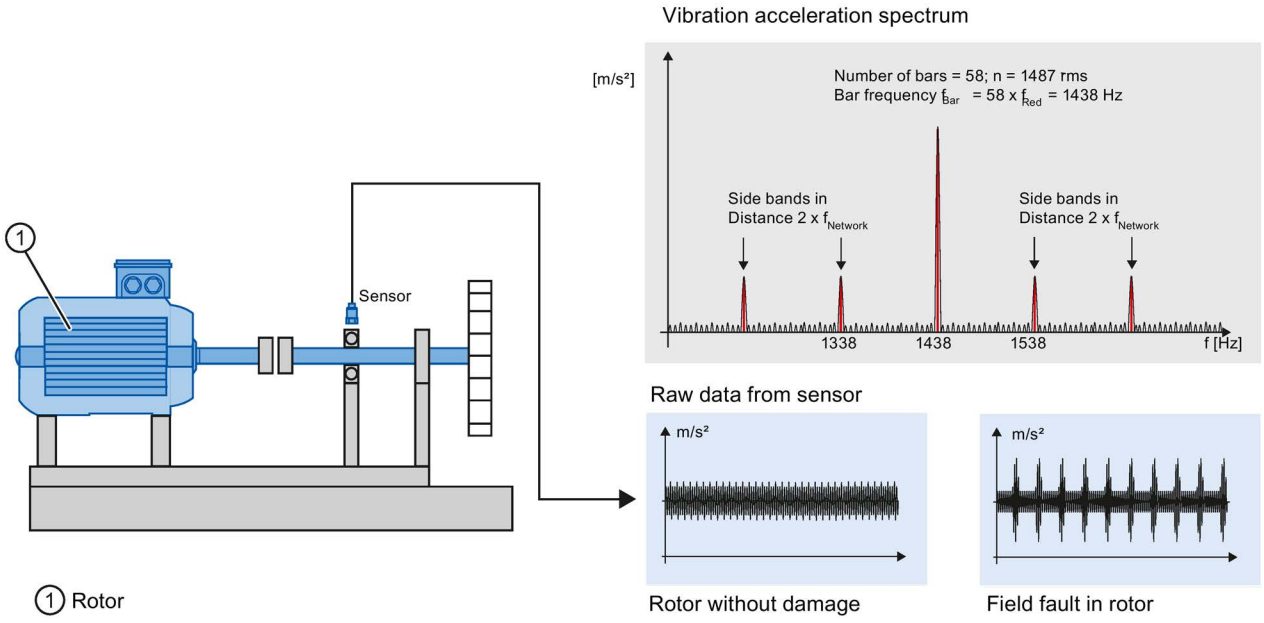


Figure 3-7 Example: Spectrum of the vibration acceleration (rotor field fault)

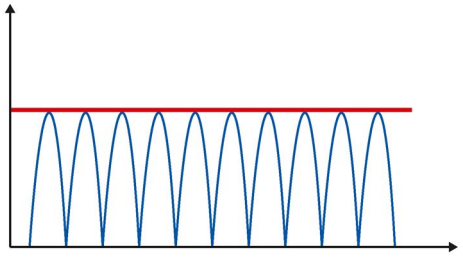
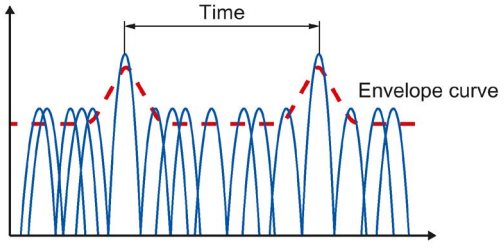
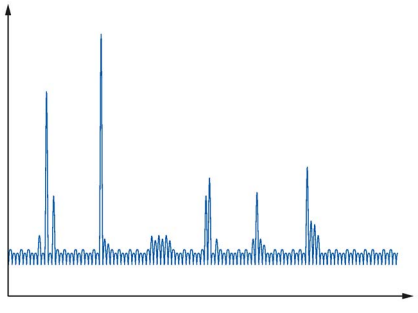
3.6.4 Envelope spectrum

3.6.4.1 Description of the diagnostic method (envelope curve)

Characteristics SM 1281

Spectrum	Speed	Frequency band	Resolution	Monitorable
Envelope curve analysis	<= 2400 rpm	2 Hz to 1 kHz	0.2 Hz	Bearing damage frequencies
	<= 4800 rpm	10 Hz to 2 kHz	0.4 Hz	
	<= 12000 rpm	10 Hz to 5 kHz	1.0 Hz	
	> 12000 rpm	10 Hz to 10 kHz	1.4 Hz	

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. 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. 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.	

3.6.4.2 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.

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

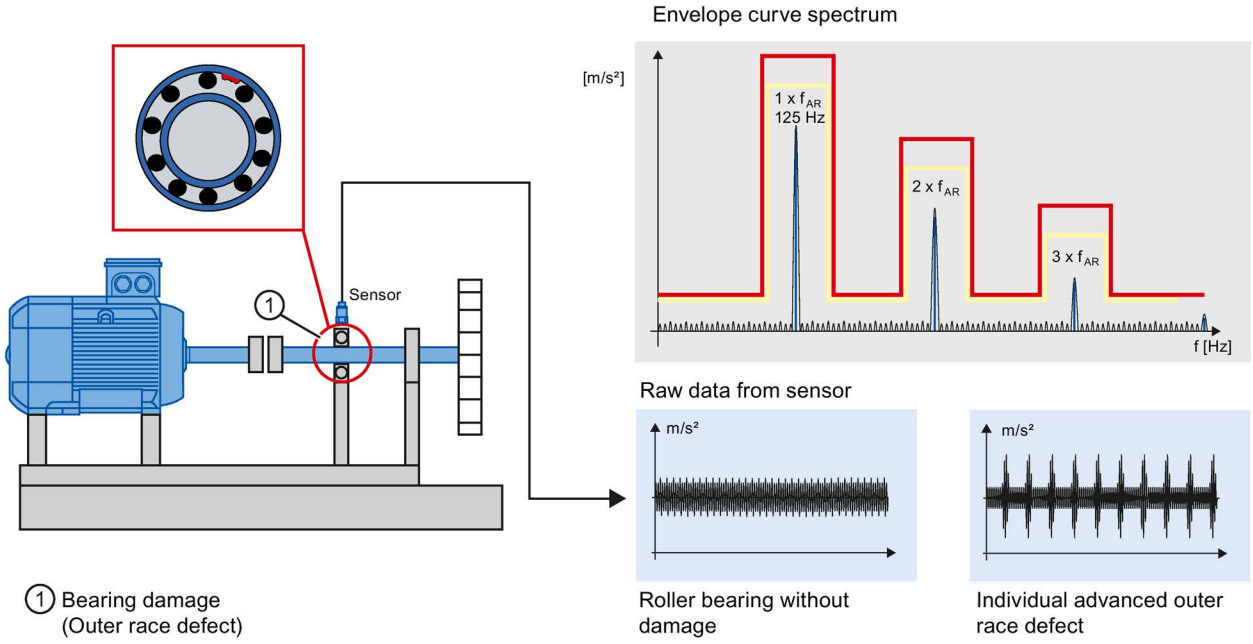


Figure 3-8 Example of envelope curve analysis

3.6.5 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.

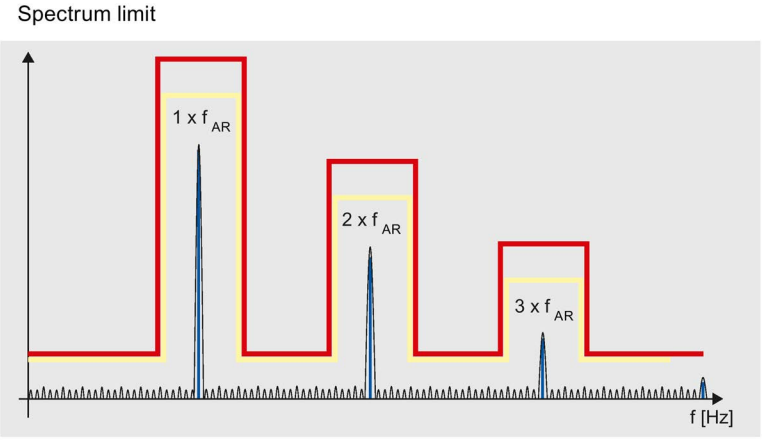


Figure 3-9 Spectrum limit band, speed-dependent

Speed-independent monitoring allows add-on units (for example fans on machines) to be included in the calculations.

System overview

4

4.1 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 acquisition (optionally usable)
- 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 SM 1281 and the library blocks are matched to each other. Make sure that you use the matched system components listed in the table below.

Table 4- 1 System components for use of the SM 1281

Module	Firmware version of the module	Required library in the TIA Portal	Configuration software STEP 7 (TIA Portal)
SM 1281	V1.x	LSM 1281 V1.x	as of V13 SP1 Update 9 and HSP 0113
SM 1281	V2.x	LSM 1281 V2.1	as of V13 SP1 Update 9 and HSP 0113
SM 1281	V3.0	LSM 1281 V3.0	as of V13 SP1 Update 9
SM 1281	V3.0	LSM 1281 V3.5	V14 and V15
SM 1281	V3.1	LSM 1281 V3.6	V14 and V15
SM 1281	V3.2	LSM 1281 V3.7	V14, V15 and V16
SM 1281	V3.3	LSM 1281 V3.7	V16, V17 and V18
SM 1281	V3.4	LSM 1281 V3.8	V16, V17 and V18

4.2 Configuration (integration into networks)

Configuration

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

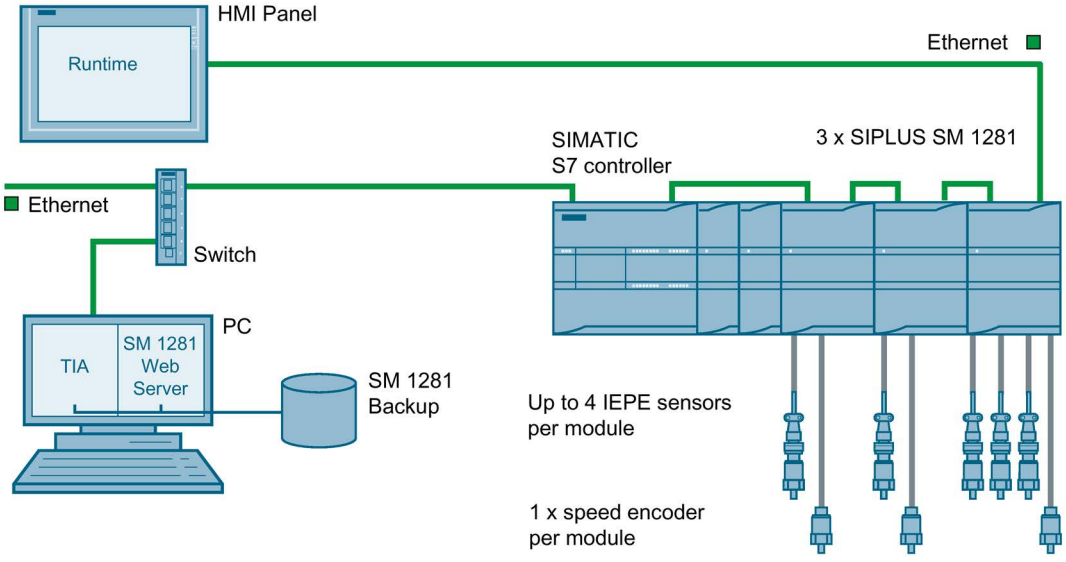
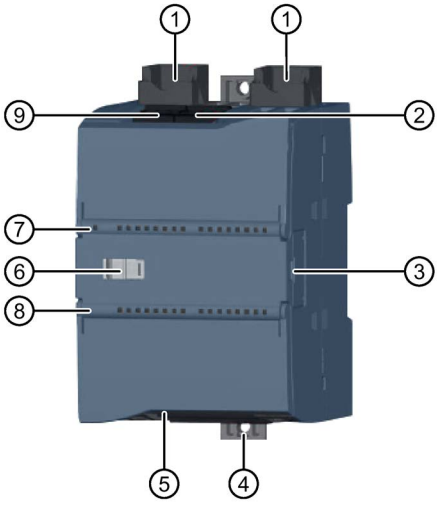


Figure 4-1 Configuration

4.3 SM 1281 structure

SM 1281 structure

Table 4- 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 • DIAG (red/green): S7 diagnostics display • 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

4.4 Ordering data

Table 4- 3 Ordering data

Product	Article number
SIPLUS CMS1200 SM 1281 Condition Monitoring	6AT8007-1AA10-0AA0
SM 1281 shield clamp set, comprised of 2 shield clamps and 5 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 CMS connecting cable for connecting VIB sensors to MIL plugs; length 30 m	6AT8008-2BA12-0AA0
SIPLUS CMS2000 VIB sensor S01 (vibration sensor IEPE, 100 mV/g, 0.5 Hz ... 15 kHz)	6AT8002-4AB00
SIPLUS CMS VIB sensor S02 (vibration sensor IEPE, 10 mV/g, 1 Hz ... 15 kHz)	6AT8008-2AA00-0AA0
SIPLUS CMS VIB sensor S03 (vibration sensor IEPE, 500 mV/g, 0.2 Hz ... 3 kHz)	6AT8008-2AA02-0AA0

For easy configuration and without the use of TIA Portal, we offer this special package:

Product	Article number
CMS1200 Ready to use Bundle	6AT8007-1AA30-0AA0

See also

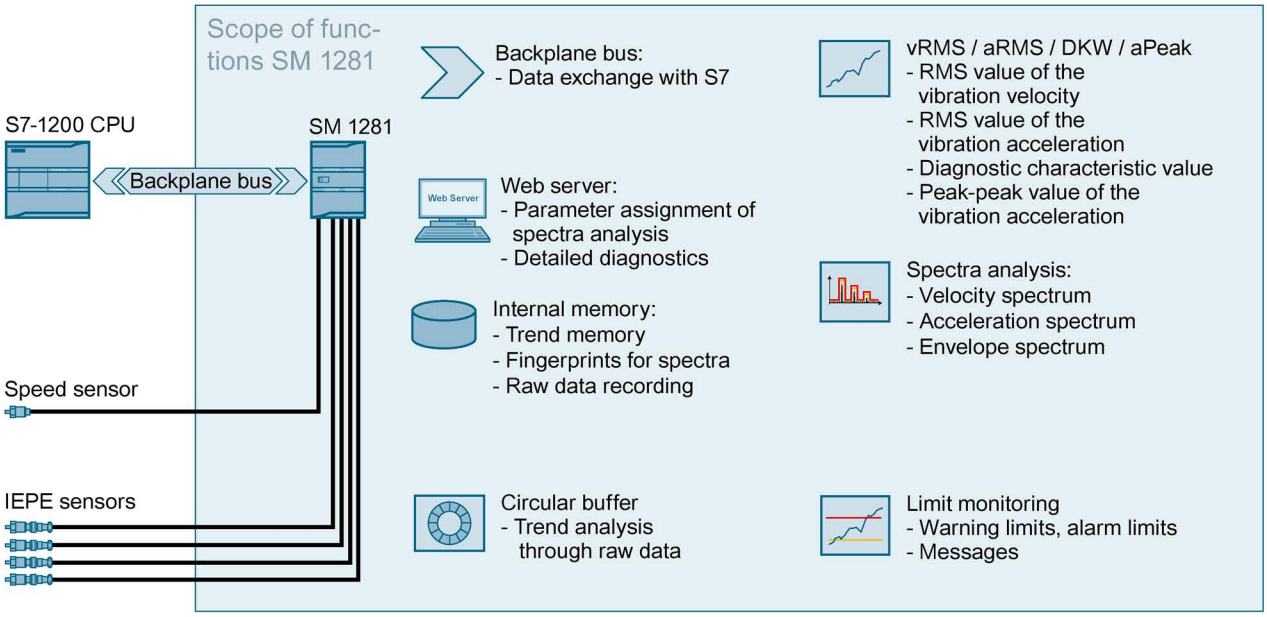
Ready to use Bundle (https://support.industry.siemens.com/cs/ww/en/view/109794341)

Functions

5

5.1 Overview

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

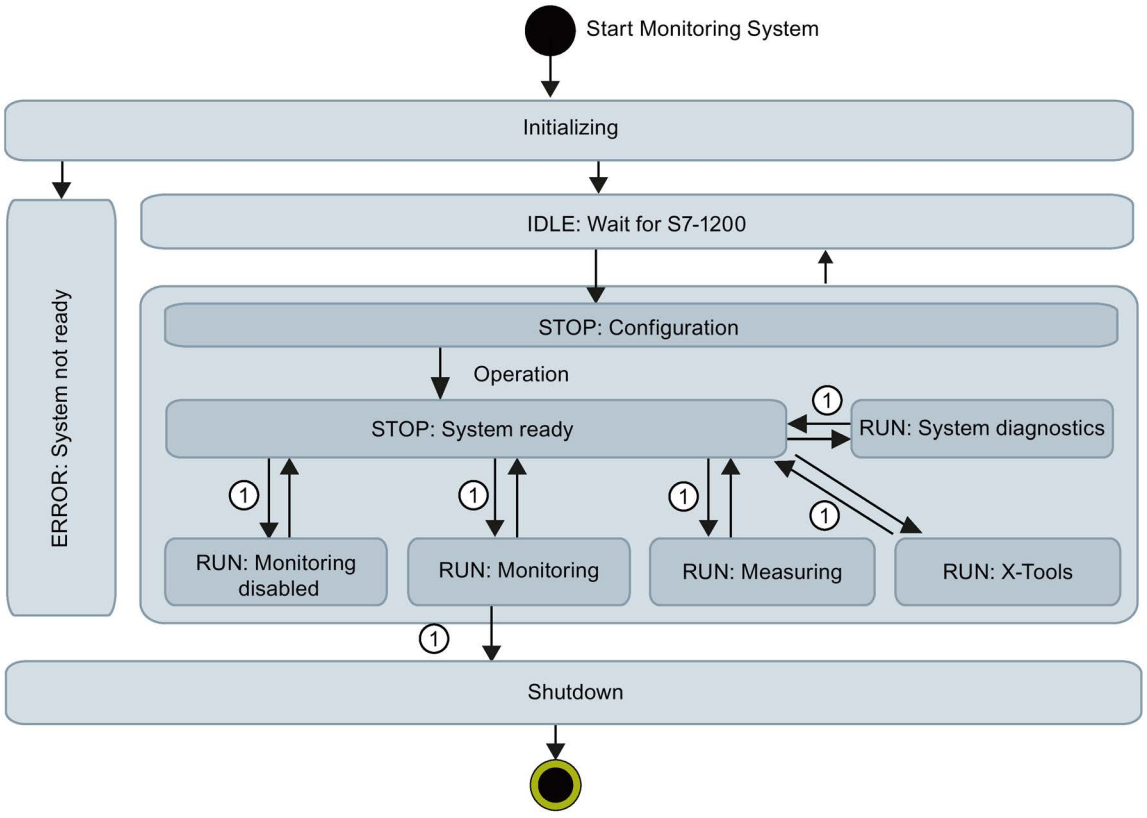


Information on the individual functions can be found in the following sections.

5.2 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 3 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 152) page. The fault is displayed on the "Home" (Page 152) 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
- Assign parameters for monitoring settings in the spectra
- 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 checking the vibration acceleration sensors (Page 100). 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.

The results are available in the global data block "SM1281_Status" (Page 125) 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.

If the voltage that is output lies outside the specifications on the sensor data sheet, the cause for this must be checked (cable break, short-circuit, sensor defect, etc.).

Note

For deactivated channels of the SM 1281, a default value of 10.5V is output.

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 (section Changing the operating mode (Page 149)) or via the S7 (Select operating mode/CPU restart (Page 135)).

RUN: Measuring

In the mode "RUN: Measuring", the SM 1281 functions purely as a measuring device. The measured variables of the configured channels are acquired, 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 measuring mode, the characteristics vRMS, aRMS and DKW on the vibration channels are calculated, extrapolated and saved as trends.

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 154) page on the SM 1281 websites and in the S7. However, the trend is no longer saved and there is no monitoring (the actual values have a corresponding blue background on the SM 1281 web pages). 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. This means 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.

RUN: X-Tools

In "RUN: X-Tools" mode, the vibration data for all configured channels is recorded and the streaming interface for X-Tools is activated. If SM 1281 is in this operating mode, X-Tools can establish a streaming connection. The RMS and DKW characteristic values are calculated but no spectra are calculated. No monitoring takes place. The calculated characteristic values are also provided via the streaming interface and saved as a trend.

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 (section General (Page 187))
- The "Reset device to factory settings" function is called (section Cleanup (Page 195))

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 214).

5.3 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 70).

See "RUN: Measuring" in Section Operating modes (Page 57) and Changing the operating mode (Page 149).

5.4 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 57) and Changing the operating mode (Page 149).

Frequency bands and speed ranges

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

Table 5- 1 Monitoring method

Monitoring method	Frequency band	
	High-pass filter **(HighpassFilter_...)**	**Low-pass filter** **(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 / 23 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)
DKW	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 / 23 kHz (adjustable)

[1] The standard values from ISO 10816-3 for vRMS:
- from 2 Hz to 1 kHz for speeds from 120 to 600 r/min
- from 10 Hz to 1 kHz for speeds > 600 r/min

Table 5- 2 Spectra

Spectra	Frequency band	Speed range
Velocity	2 Hz to 1 kHz	120...6000 r/min
	10 Hz ... 2 kHz	> 6000 r/min
Acceleration	10 Hz to 23 kHz	>120 r/min
Envelope curve	2 Hz ... 1 kHz	120... 2400 r/min
	10 Hz ... 2 kHz	2400... 4800 r/min
	10 Hz ... 5 kHz	4800... 12000 r/min
	10 Hz ... 10 kHz	>12000 r/min

5.4.1 Vibration/bearing monitoring (characteristic RMS values)

RMS monitoring

The SM 1281 enables the calculation of the characteristic values vRMS, aRMS and DKW:

- 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.
- The DKW is calculated based on the interval rms value of the vibration acceleration.

For each vibration channel, it is possible to set warning and alarm limits and a hysteresis for vRMS, aRMS and DKW.

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.

5.4.2 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.

5.4.3 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.

5.4.4 Hysteresis

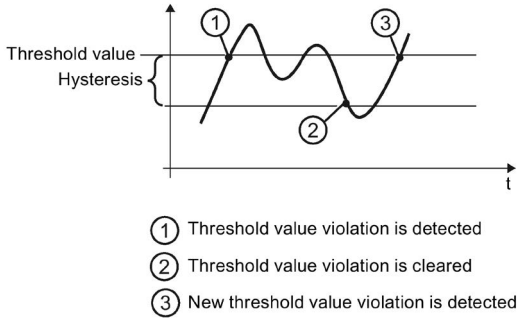
Hysteresis

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 a percentage value for vRMS, aRMS and DKW.

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. The monitored value and the limit are directly compared to detect a violation ①. 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

During monitoring of vRMS, aRMS, DKW and spectra, three consecutive violations of the threshold value must be present for a warning or alarm to be triggered. Similarly, three consecutive limit undershoots must occur (including the absolute value hysteresis), before the warning or alarm is canceled again.

5.5 Speed acquisition

The SM 1281 has 3 options for speed acquisition:

- 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)`
- Via a PLL algorithm from the vibration data `(SpeedSource = 3)`

Note

When `SpeedSource = 2`, the speed is only calculated in RUN.

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 acquisition 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 acquisition.

To obtain more accurate measurement results, use a speed sensor with more than 1 pulse/revolution for speeds < 100 rpm.

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 acquisition:

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

If an error occurs during speed acquisition, 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.

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 an unstable speed or a speed that is too low (lowest permissible speed: 120 r/min) repeatedly prevents vibration analysis, a system message is output.

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

Measurement using PLL

If the speed is measured using PLL, it is determined directly from the processed vibration data. Therefore, in this case, the entire vibration analysis (characteristic values and spectra) is performed on the basis of the same vibration data, so that the speed calculation does not have to be performed unnecessarily frequently. This changes the time behavior of the vibration analysis somewhat: The characteristic value calculation occurs less often and the spectra calculation more often. All results are then always available and updated simultaneously.

The speed is always based on the first configured vibration channel (lowest channel number), but is scaled proportionally to the speed ratio depending on the channel.

5.6 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. 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 165) web page.

Viewing the message log

The process and system messages are stored in a message log and displayed on the "Message log" (Page 165) 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.

Note

If error status 255 appears at block FC SM1281_Channel (Table 11-5), check the message entries in SM 1281 immediately. These provide further information about the error.

5.7 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 Status LEDs (Page 209).

S7 diagnostics alarms

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

You can find information on this in the section S7 diagnostics alarms (Page 209).

SM 1281 web pages

On the "Home page (Page 152)" and on the page "Pending messages (Page 165)", 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 154)". 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 125).

5.8 Recording data

5.8.1 Recording data: Trends

Trend charts

Valid characteristic values (vRMS, aRMS, DKW, apeak, AUX) and the speed values are automatically saved as trend curves in the RUN state. In addition, monitored amplitude values of the spectra can be recorded as a trend chart. For this, a trend name for each amplitude value to be recorded must be specified in the corresponding limit band (see section 12.3.5.2 (Page 170) to 12.3.5.7 (Page 181))

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.

5.8.2 Recording data: Fingerprints

This function allows you to take a snapshot of the state 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 consists of:

- All frequency spectra currently calculated
- Associated speed
- RMS characteristic values calculated at the same time on the same IEPE channel (if present)

5.8.3 Teach values

In measuring mode, teach values for configured DKW calculations are automatically determined and updated. These teach values can be used as reference values for the initial state of the machine and therefore support the determination of suitable monitoring limit values.

The values calculated during the teaching process are updated cyclically:

DKW: Maximum value of the reference value (see the section DKW (Page 167))

Up to 1000 teach values per characteristic value are saved

5.8.4 Recording raw data

For extended offline analysis, e.g. with CMS X-Tools, the signals of the sensor inputs can be recorded as a raw data file on request and stored in the internal memory of the device as a WAV file (see section Raw data recording (Page 189)).

The recording contains the data of the last seconds before the triggering event and the time stamp is always in UTC time without localization information.

Note

The internal drive of the SM 1281 is a flash memory and has a limited write cycle.
To protect the flash memory, raw data may only be recorded a few times per day.
For continuous analysis of raw data, the use of CMS X-Tools is recommended.

The UTC time stamp on the web page contains localization information because the computer with browser knows the location and time zone.

The duration of the recording can be set.

The recorded WAV file contains the speed as well as the raw data from the vibration sensors.

The DC offset (direct component) is entered in the 'cms' chunk of the WAV file. The WAV file can be opened with any standard audio data processing program.

Raw data recording can be triggered by the following events:

- A limit value violation
- By the S7 user program
- User command

There are two possible types of recording in line with the OpClass RawData input of function block SM1281_Module (see Blocks (Page 106)):

Version 1: Without operating class

The raw data is saved in the raw data directory of SM 1281 recording by recording. The file name consists of the date, time and abbreviated channel name. Multiple recordings can be made each day. The number of records is limited by the internal memory available. If the internal memory is full and another raw data recording operation is launched, the oldest record is deleted.

Version 2: Operating class-based

This version allows the user to save raw data in different directories on the basis of various different machine states called operating classes. The operating classes are not managed by SM 1281 and it is the task of the S7 user program to set the correct operating class for a recording.

You can differentiate between a maximum of five operating classes. Operating classes are only effective for raw data recording.

The raw data can be recorded daily for the five operating classes. After triggering of a recording, the raw data file is stored in a subdirectory "/op_class_n" (n = operating class). If a raw data file is already available for this day, it is deleted. Raw data files are retained for up to three days. If three raw data files are available when a new file is to be stored, the oldest file will be deleted. The file name of storage belonging to an operating class consists of date, time, abbreviated channel name and the operating class abbreviation ("_OCn"). The duration of raw data recording can be configured 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 "Raw data recording (Page 189)" web page.

Note

Delayed raw data recording

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.

The SM 1281 operating class concept is not comparable with the CMS2000 operating class concept.

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 154)", 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**

  You can start the recording of raw data using the S7 user program. This recording can be assigned to one of five operating classes. The resulting raw data recording is then stored by specific operating class in a numbered subfolder "oc_1" to "oc_5" in the raw data directory. You can send raw data recordings for specific operating classes automatically per FTP.

  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 Save and restore (Page 191) web page
- Via WebDAV (see Section Data transfer over WebDAV (Page 74))
- Via FTP (see section Data exchange via FTP (Page 76))
- Via active raw data transmission via FTP (see section Data exchange via FTP (Page 76))

See also

General (Page 187)

5.9 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 214).

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 restarts.

The Ethernet switch functionality is unavailable for the duration of the system restart.

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 an unstable speed or a speed that is too low (lowest permissible speed: 120 r/min) repeatedly prevents vibration analysis, a system message is output.

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

5.10 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/ww/en/view/36932465).

5.11 Data transfer over WebDAV

Functions

Exchanging data

Via WebDAV, files can be transferred to the device or downloaded from the device. Typical use cases are

- 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 191).

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 5- 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 5- 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 187) web page. 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

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.

5.12 Data exchange via FTP

Instead of the WebDAV access (Page 74), 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 5- 5 Access via FTP

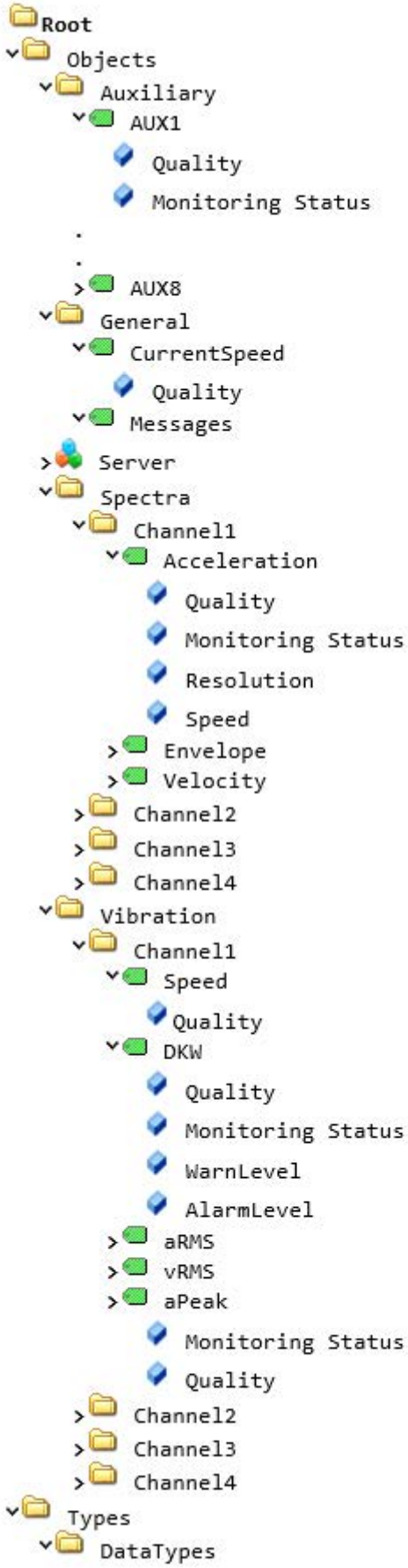
Content	Path	Description
Parameter	/config	All the parameter databases for the device are located here.
Historical data	/history	The databases for historical data and messages are located here.
Directory for firmware update files	/update	Firmware update files are copied to this location.
Directory for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

5.13 Data exchange using OPC UA

As of version V3.2, the SM1281 comes equipped with an OPC UA data server that is available in addition to the web server on the device.

The OPC UA server can serve up to 5 OPC UA clients and is always active. All interface values can only be read.

The OPC UA interface is structured as follows:


Root
Objects
Auxiliary
AUX1
Quality
Monitoring Status
AUX8
General
CurrentSpeed
Quality
Messages
Server
Spectra
Channel1
Acceleration
Quality
Monitoring Status
Resolution
Speed
Envelope
Velocity
Channel2
Channel3
Channel4
Vibration
Channel1
Speed
Quality
DKW
Quality
Monitoring Status
WarnLevel
AlarmLevel
aRMS
vRMS
aPeak
Monitoring Status
Quality
Channel2
Channel3
Channel4
Types
DataTypes

The nodes have the following functionality:

	Nodes with system information regarding the SM1218 OPC UA server
	Structuring nodes without functionality
	Nodes with process data
	Nodes with property values of the process data nodes

The value of the "CurrentSpeed" node is output at the DI. Only used if `SpeedSource=2`, otherwise 0 is displayed.

The format of the message texts of the "Messages" property node is structured as follows:

"Date <Tab> Time <Tab> Message type <Tab> Message text"

The TCP port in use is the standard OPC UA port: 4840. This port cannot be configured on the SM1281.

The monitoring status of the characteristic values and the spectra is output as in the TIA Portal.

Bit	Value	Description
0	NotValid	Do not evaluate (status unknown)
1	Good	Good (green)
2	Warning	Warning (yellow)
3	Alarm	Alarm (red)

Behavior in "RUN-Monitoring" operating mode

A connection is set up from an OPC UA client (e.g. IoT2050) to the SM 1281. If data is to be saved to a cloud via the OPC UA client to monitor trends, for example, the MIN, MAX, AVG values must be calculated on the OPC UA client.

Pending messages of the device can be read via the "Messages" attribute.

Behavior in "RUN-Measuring" operating mode

Users use the SM1281 to generate pre-calculated values that the device has generated from the measured vibration data (e.g. aRMS). An OPC UA client reads these values cyclically and independently monitors limits for excessive values. Users must parameterize or program all warning and alarm limits on the OPC UA client.

All attributes in the OPC UA interface that are part of the monitoring tasks are set to zero in this case (e.g. MonitoringState, WarnLevel, AlarmLevel).

The "Messages" attribute only contains system messages.

5.14 Data export

You can export the following data as a file.

Data	Export type	Exported file
Messages	CSV file with all messages from the message archive.	Messages.csv
Trends	CSV file with minimum, maximum and average values of all characteristic values as well as the speed from a trend buffer.	Trends_1d.csv Trends_1w.csv Trends_1m.csv Trends_6m.csv Trends_10y.csv
Spectra trends	CSV file with minimum, maximum and average values of all spectrum trends from a trend buffer.	SpectrumTrends_1d.csv SpectrumTrends_1w.csv SpectrumTrends_1m.csv SpectrumTrends_6m.csv SpectrumTrends_10y.csv
Fingerprints	CSV file with all spectra values of a fingerprint. Fingerprints are individually exported.	<FingerprintName>.csv
Configuration	Text file with the current configuration.	Configuration.txt

Export of trend data

Time stamp	VIB1: aRMS min	VIB1: aRMS avg	VIB1: aRMS max	VIB1: aRMS qual	VIB1: vRMS min	VIB1: vRMS avg	VIB1: vRMS max	VIB1: vRMS qual	VIB1: DKW min	VIB1: DKW avg	VIB1: DKW max	VIB1: DKW qual	VIB1: aPeak min	VIB1: aPeak avg	VIB1: aPeak max	VIB1: aPeak qual	...
<first time stamp>	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	
...																	
<last time stamp>	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	< Value >	

Time stamp	Speed1 min	Speed1 avg	Speed1 max	Speed1 qual	...	Aux1 min	Aux1 avg	Aux1 max	Aux1 qual	...
<first time stamp>	< Value >	< Value >	< Value >	< Value >		< Value >	< Value >	< Value >	< Value >	
...										
<last time stamp>	< Value >	< Value >	< Value >	< Value >		< Value >	< Value >	< Value >	< Value >	

Export of spectra trends

The spectra trends are largely exported in the same format as the trend data. Due to the fact that the number of spectrum trends is not fixed but configuration-dependent, the CSV file accordingly also has a dynamic number of columns. The columns are arranged as follows:

- The first column contains the time stamp
- This is followed by 4 columns (minimum, average, maximum and quality) for each spectrum trend.
- Spectra trends are exported in the following order:
  - By ascending channel number
  - Acceleration spectrum -> Velocity spectrum -> Envelope spectrum

Export of fingerprints

Spectrum	Resolution in Hz	Frequency 0	Frequency 1	Frequency 2	...	Frequency 7999
a(f)	<Resolution>	<Value>	< Value >	< Value >		< Value >
v(f)	< Resolution >	< Value >	< Value >	< Value >		< Value >
e(f)	< Resolution >	< Value >	< Value >	< Value >		< Value >

Each frequency corresponds to its index (0 for "Frequency 0", 1 for "Frequency 1" etc.) multiplied by the corresponding resolution ("Resolution in Hz"). A total of 8000 frequencies are available, but not all of them have to be used. Unused values remain empty.

Export of messages

Timestamp	Type	Action	Message text	ID
<first time stamp>	<Value>	<Value>	<Value>	<Value>
...				
<last time stamp>	<Value>	<Value>	<Value>	<Value>

Note

All CSV files use the semicolon (";") as the separator for the columns and "Carriage Return" + "Line Feed" ("\r\n") as the separator for the rows. Character coding is UTF-8.

Export of configuration

The configuration is exported as a text file. It contains the following data:

- Device name
- For each vibration channel:
  - Monitoring settings of the characteristic values
  - Monitoring settings of the spectra

5.15 Operation with activated X-Tools interface

SM 1281 offers an interface for the "CMS X-Tools" analysis software.

CMS X-Tools is powerful analysis software with an extensive library of standard function blocks such as FFT, envelope analysis, and input filters, and it enables the graphical creation of diagnostics models. The software runs on standard PCs and industrial PCs (e.g., Microbox PC).

The interface enables the online transmission (data streaming) of recorded vibration acceleration values and the speed value from SM 1281 to X-Tools.

The application options of SM 1281 can be expanded using the X-Tools analysis software:

- Analyses such as gearbox diagnostics, or monitoring below a speed of 120 r/min, that cannot be covered by SM 1281, can be carried out in X-Tools.

Requirements for using the X-Tools interface

- SM 1281 as of firmware version V3.0
- CMS X-Tools as of version 04.04. SP1

Note

No AUX channels are displayed in X-Tools.

System configuration

The following figure shows the configuration of the Ethernet ports for the data transmission between SM 1281 and X-Tools.

Figure 5-1 X-Tools settings

For operation in RUN: X-Tools, make the following settings on the function blocks:

Module:

The module block must be configured in the S7 project in such a way that the project can be compiled error-free, In particular, this is the speed configuration.

Channel:

Set the sensor sensitivity type of the channels at the input parameters of the FC_Channel so that the SM 1281 module can change from STOP to RUN. As of FW V3.1, the characteristic values are also calculated in RUN: X-Tools also calculates the characteristic values. Therefore, it is necessary to set the parameters for the characteristic values correctly (but the threshold values are not required).

The other channel parameters do not have any impact for operation RUN: X-Tools.

Things like the speed ratio or alarm and warning limits have no effect and have to be "rebuilt" in X-Tools.

Features of the X-Tools interface

- Data is transferred between SM 1281 and X-Tools over Ethernet (TCP/IP).
- The X-Tools interface can be used as alternative to the existing functionality of the SM 1281.
- The connection is established using X-Tools. In the case of communication errors or the absence of the X-Tools sign of life, the SM 1281 terminates the connection. SM 1281 is again ready for re-establishment of the connection.

Data streaming

The following raw and process data can be transferred from SM 1281 to X-Tools:

- Raw data of vibration channels VIB1 to VIB4
- Calculate characteristic values (vRMS, aRMS, DKW)
- Speed values as calculated speed values

In addition, the following data is transferred to X-Tools:

- Active Process Alarms
- Active Process Warnings
- Active System Alarms
- Active System Warnings
- Operating Mode

The following applies to the operating mode: 12 = RUN: X-Tools.

For the warning and alarm values, the number of currently pending warnings or alarms is transmitted as a numerical value.

The messages can be viewed via the alarm view of the CMS web pages.

Adjustable sampling rate

An individual sampling rate can be set in X-Tools for all high-resolution transferred sensor signals. In principle, the use of a lower sampling rate permits a reduction in the volume of data to be processed and thus lowers the performance demands made on the X-Tools processor.

The maximum sampling rate is 46.875 kHz. Vibration data which is transferred with a lower sampling rate is subjected to a downsampling including anti-aliasing-type low-pass filtering in SM 1281 before the transmission.

The adjustable sampling rates and the characteristics of the filters used for the vibration data are summarized in the following table. Explanations:

- Filter passband = frequency range that can be analyzed in X-Tools
- Filter passband: The ripple is <= 0.02 dB; slight attenuation of max. -0.5 dB at the end
- Filter intermediate range: The attenuation increases from -0.5 dB to -80 dB
- Filter blocking range: The attenuation is continuously >= -80 dB (prevent aliasing effects)

Down-sampling factor	Sampling rate adjustable in X-Tools	Filter passband	Filter intermediate range	Filter blocking range
1	46.875 kHz	0 – approx. 19 kHz	> 19 kHz	> 23 kHz
2	23.438 kHz	0 – 9.55 kHz	9.55 – 11.70 kHz	> 11.70 kHz
3	15.625 kHz	0 – 6.20 kHz	6.20 – 7.80 kHz	> 7.80 kHz
4	11.719 kHz	0 – 4.55 kHz	4.55 – 5.85 kHz	> 5.85 kHz
5	9.375 kHz	0 – 3.55 kHz	3.55 – 4.65 kHz	> 4.65 kHz
6	7.813 kHz	0 – 2.85 kHz	2.85 – 3.90 kHz	> 3.90 kHz
7	6.696 kHz	0 – 2.35 kHz	2.35 – 3.35 kHz	> 3.35 kHz
8	5.859 kHz	0 – 2.00 kHz	2.00 – 2.90 kHz	> 2.90 kHz
9	5.208 kHz	0 – 1.75 kHz	1.75 – 2.60 kHz	> 2.60 kHz
10	4.688 kHz	0 – 1.55 kHz	1.55 – 2.35 kHz	> 2.35 kHz
11	4.261 kHz	0 – 1.35 kHz	1.35 – 2.10 kHz	> 2.10 kHz
12	3.906 kHz	0 – 1.20 kHz	1.20 – 1.95 kHz	> 1.95 kHz

Activating the interface

You activate the X-Tools interface by switching the SM 1281 to "RUN: X-Tools" mode. X-Tools can then establish a connection to the SM 1281.

The SM 1281 device remains operable via the Web pages or the S7-CPU. The transition from RUN ⇒ STOP terminates the connection to X-Tools.

Information on the status of the connection

You can view the current status of the connection (active / inactive) under Pending messages (Page 165).

Information on building up and clearing down the connection is to be found in the Message log (Page 165).

See also

X-Tools settings (Page 190)

Changing operating mode (Page 149)

Application planning

6

6.1 Shipping

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

6.2 Storage

It is absolutely essential that the SM 1281 is stored in compliance with the storage conditions as described in section Technical data (Page 215). 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.

6.3 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 delivery and be ordered (Page 55) separately.

NOTICE
Damage to the system Damaged parts can result in damage to the system. Do not use any parts that show evidence of damage!

6.4 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/ww/en/view/36932465).

Electromagnetic compatibility (EMC)

NOTICE
Damage to the device Inadequately dimensioned overvoltage protection can result in severe damage to the device. Therefore ensure that the overvoltage protection is adequate (see section Technical data (Page 215)). To do this, use the shield clamp set (see Order data (Page 55)) 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 60 °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

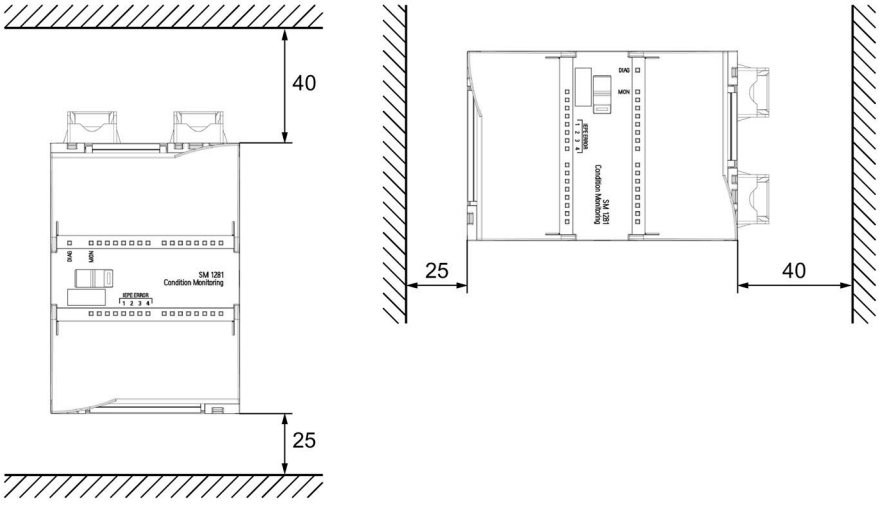


Figure 6-1 Minimum clearances with horizontal and vertical installation

Note the following device dimensions in this regard:

Table 6- 1 Device dimensions

Dimensions	
Width	70 mm
Height	112 mm
Depth	75 mm

NOTICE
Damage due to overheating 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 7

7.1 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/ww/en/view/36932465).

Note

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

7.2 Mounting the shield clamps

SM 1281 shield clamp set

The shield clamp set is used to connect signal and encoder lines to the SM 1281 in accordance with EMC requirements.

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

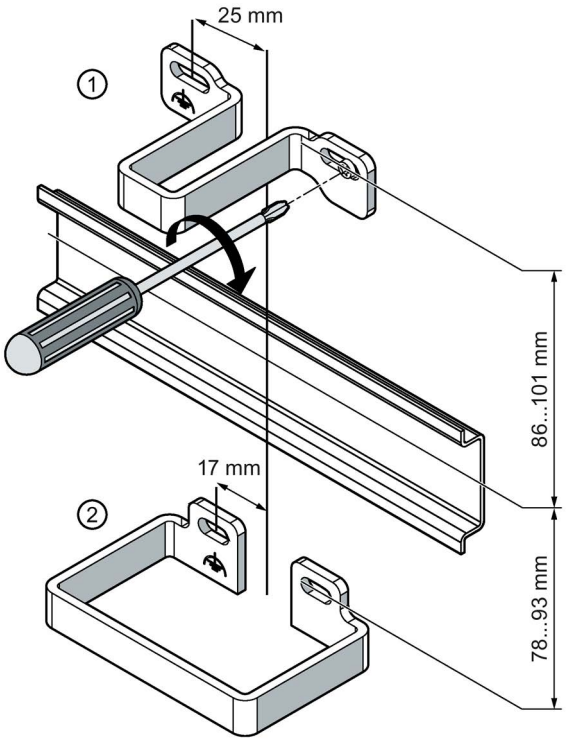
Note

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 101)

Connection

8

8.1 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.

8.2 Terminal assignment

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

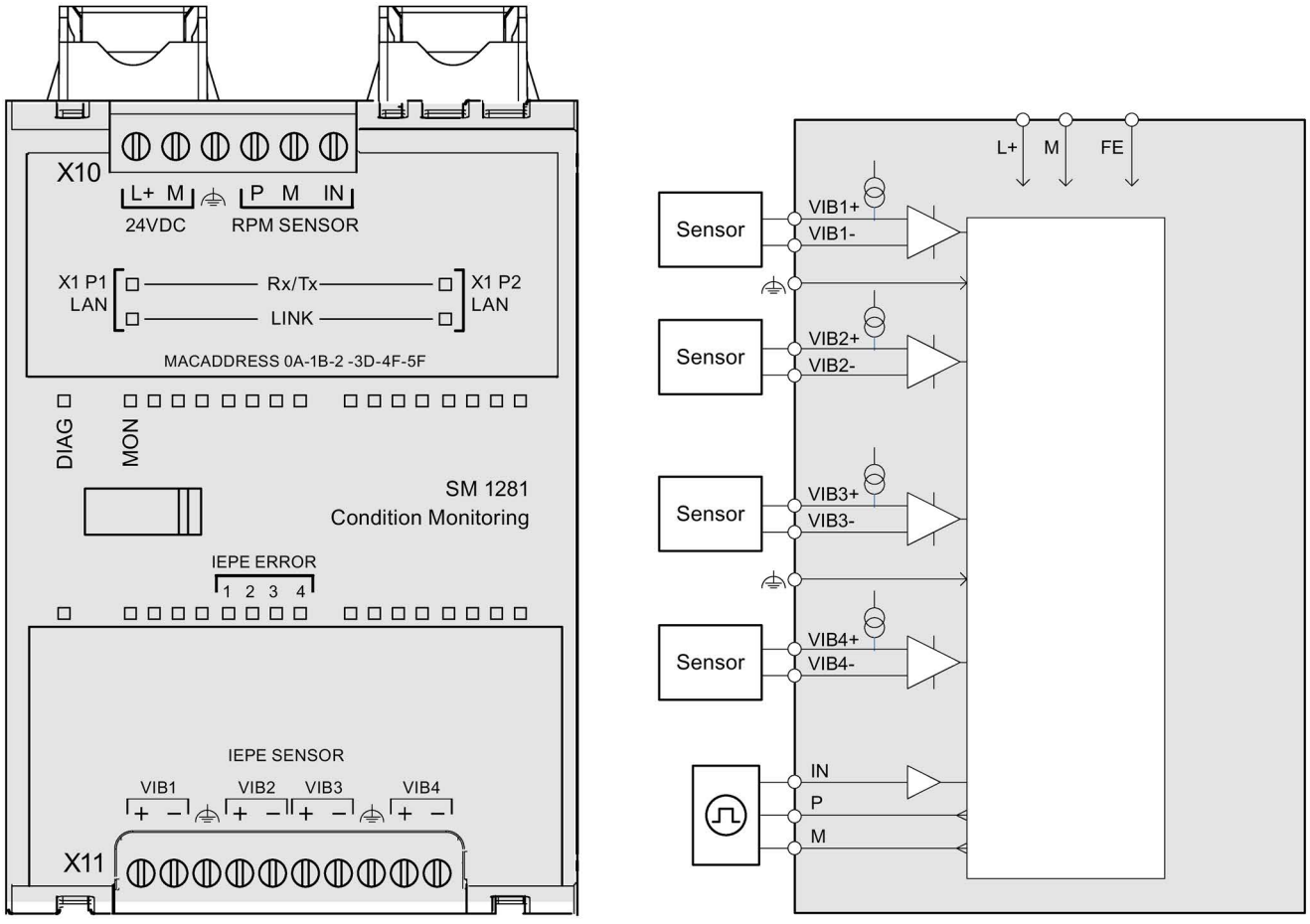


Figure 8-1 Connection diagram and block diagram

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

8.3 Attaching the cable shield

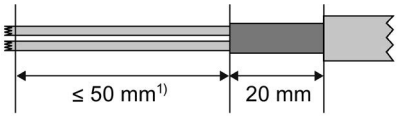
The following SM 1281 process signals must be connected via shielded cables:

- 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 shielding bracket set can be ordered as an accessory (see section Ordering data (Page 55)).

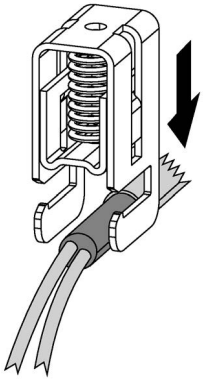
Proceed as follows:

1. Strip the cable.

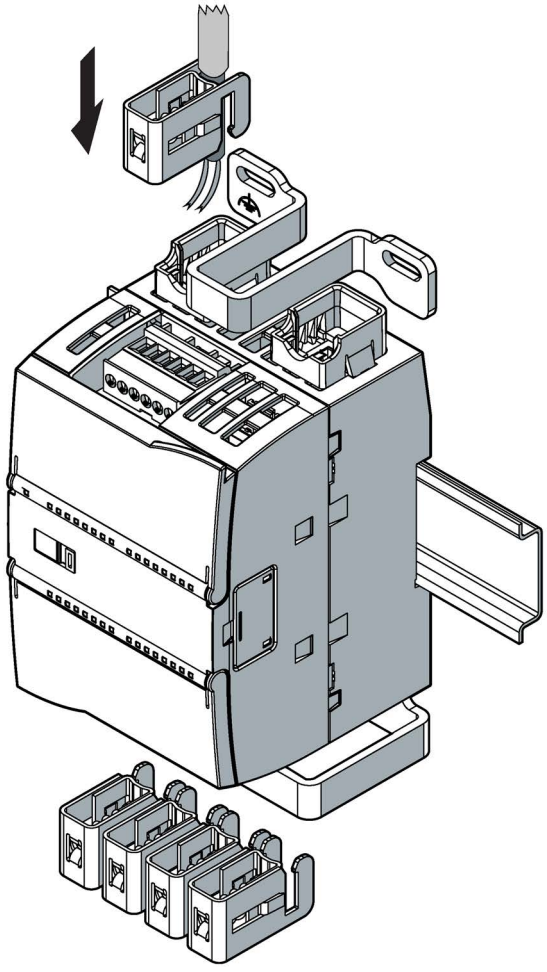


1) The length depends on the distance between the shield clamp and the device.

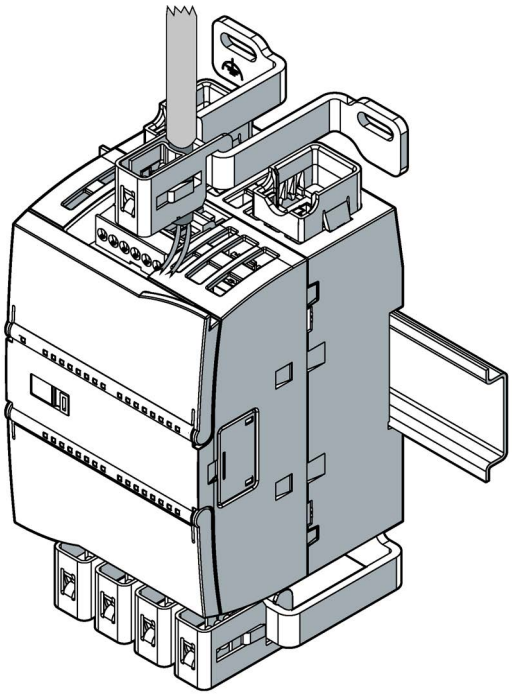
2. Press the terminal clamps onto the protective braided shield of the cable.



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 more than one SM 1281 module in your configuration, an equivalent grounding of the cable shields is also permitted, e.g. via a ground bus.

8.4 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.

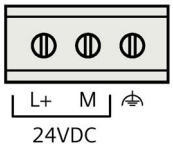
Applies to non-isolated system design:

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 8- 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

8.5 Connecting sensors

⚠ WARNING

Voltage hazards

May cause death or serious injury

The inputs of the SM 1281 have a 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.

8.5.1 IEPE sensors

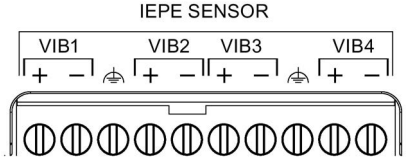
You can use all IEPE sensors (Integrated Electronics Piezo-Electric) that fulfill the specification for the relevant sensor inputs VIB1 to VIB4. We recommend that you use sensors from the Siemens portfolio (see Section Ordering data (Page 55)).

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 8- 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. For values < 6.2 V and values > 15.0 V, the calculation result is output as poor quality and not stored in the trend. The gap in the trend curve is displayed in color.

You can check the operation point of the IEPE sensors you used with the aid of the operating mode "RUN: System diagnostics" (Page 57).

8.5.2 Speed sensors

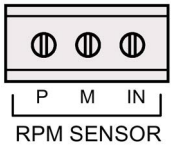
Speed sensor

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 8- 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

8.6 Connecting to functional ground

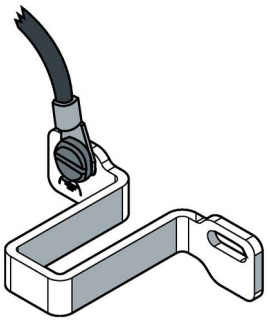
Prerequisites

- 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 94)) to the screw connections of the shield clamps.

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



8.7 Connecting Ethernet

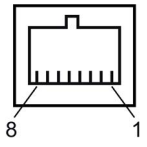
The SM 1281 is equipped with an integrated Ethernet switch with 2 ports. The connections are designed as RJ45 sockets.

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.

The Ethernet switch of the SM1281 remains active, even if the module has no valid IP address.

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

9

9.1 Commissioning the 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 (https://support.industry.siemens.com/cs/ww/en/view/36932465)).
- The shield clamps are fitted (see Section Mounting the shield clamps (Page 91)).
- 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 installing the hardware, carry out the additional steps required for commissioning in the TIA Portal, in the S7 user program and on the SM 1281.

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 105) 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, assign parameters for the module and for characteristic monitoring, and launch 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

You can now access the SM 1281 Web pages from a supported browser with the IP address set in the S7 project:

1. Make (Page 166) 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 106).
2. Back up the CMS databases of the module, e.g. via download on the SM 1281 website "Save and restore" (Page 191).

See also

SIMATIC manuals (https://w3.siemens.com/mcms/industrial-automation-systems-simatic/en/manual-overview/Pages/Default.aspx)

Integrating functions with the SM 1281 library 10

Note

The following description of the blocks represents the Version from the V3.x.x libraries only.

10.1 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.

10.2 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 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 V14	6ES7822-0A.04-..	1	SIMATIC STEP 7 Professional V14 SP1, SIMATIC STEP 7 Professional V15, SIMATIC STEP 7 Professional V16

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

10.3 Blocks

The "SM1281_Library" contains the following blocks:

Type	Symbol	Description
Function block	SM1281_Module (Page 107)	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 118)	The FC SM1281_Channel can be assigned to a channel of the SM 1281. This permits the parameter assignment and monitoring of the corresponding vibration channel.
Function block	SM1281_AUX	The FB SM1281_AUX allows the assignment of parameters and the monitoring of the corresponding AUX values.
Global data block	SM1281_Status (Page 125)	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 128)	The DB SM1281_Backup serves as memory for the automatic backup of valid parameter sets.

Library resources

If you use exactly one module, the blocks occupy approx. 20 KB of work memory. For each additional module, the blocks occupy an additional approx. 1.7 KB in the work memory.

Description

The blocks "SM1281_Module" and "SM1281_Channel" are 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 4 vibration channels of the SM 1281, to which acceleration sensors for machine monitoring can be connected, are channel-specific.

10.3.1 FB SM1281_Module

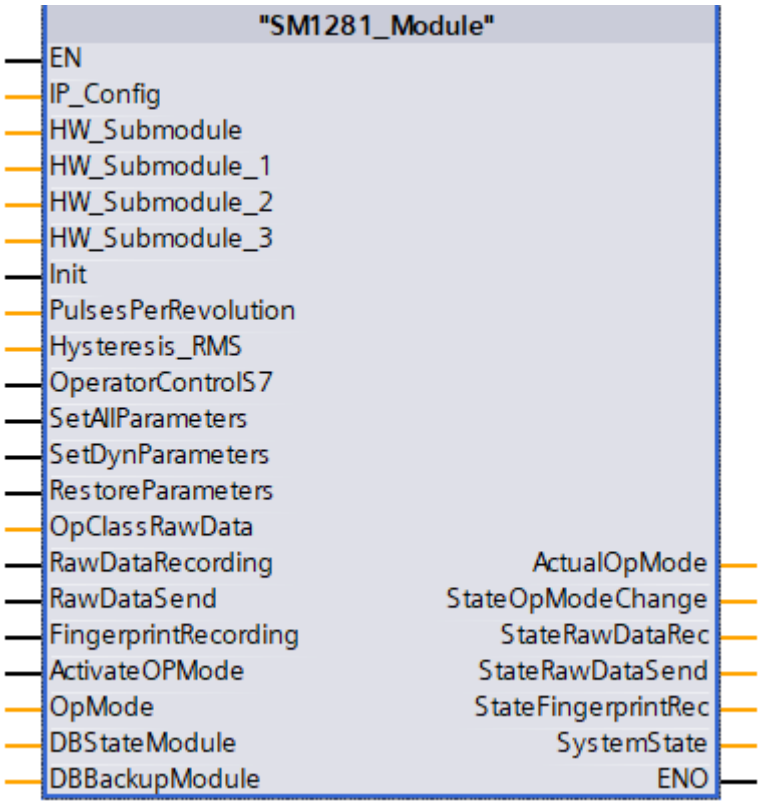


Figure 10-1 FB SM1281_Module

Function

The "SM1281_Module" block offers the following functions:

- IP configuration of the SM 1281 module
- Transfer module and channel parameters to the SM 1281
- Request (raw data and) fingerprint recording
- Execute raw data transmission
- 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 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. Therefore, only execute one command at a time via the FB "SM1281_Module"!

References

The operation of the block is explained in section Using blocks (Page 135) 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.

10.3.1.1 FB SM1281_Module - Parameters

Input parameters

Table 10- 1 FB SM1281_Module - input parameters

Parameters	Data type	Description
IP_CONFIG	typeSM1281IPConfig	IPConfig SM1281_IP_Config IP configuration of the SM 1281 IPAddress Array [1..4] of Byte IP address of the SM 1281 SubnetMask Array [1..4] of Byte Subnet mask of the SM 1281 DefaultGateway Array [1..4] of Byte Standard Gateway of the SM 1281 DNS Array [1..4] of Byte DNS setting DHCP Bool Use of a DHCP server (automatic assignment of the IP address and subnet mask) **Example IP address 192.168.0.1:** ⇒ `IP_Config.IPAddress[1]` = 192, `IP_Config.IPAddress [2]` = 168, `IP_Config.IPAddress[3]` = 0, `IP_Config.IPAddress [4]` = 1.
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.
PulsesPerRevolution	UInt	Pulses per revolution must be specified if the DI of the SM 1281 is used as the speed source. Valid values: Integers between 1 and 100.

Parameters	Data type	Description
Hysteresis_RMS	USint	Hysteresis RMS in % (related to the respective set threshold value for the vibration channels). The value is only relevant for the channel where the speed source = 2. Valid for vRMS, aRMS and DKW.
OperatorControlS7	Bool	Write protection web interface of the SM 1281. **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. However, the Web pages can still be used. Spectra and trends and the parameter assignment can still be viewed as before. **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. 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
OpClassRawData	USint	Selection of the operating class for raw data recording: 0: Without operating class 1-5: Operating class 1 - 5
RawDataRecording	Bool	Request for raw data recording of all channels activated for the recording
RawDataSend	Bool	Request sending of raw data (via FTP connection)
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 according to ActualOpMode. 6: STOP: System ready 7: RUN: System diagnostics 8: RUN: Measuring 9: RUN: Monitoring disabled 10: RUN: Monitoring 12: RUN: X-Tools 253: RESET: Restart 254: RESET: Factory Settings 255: RESET: Password Values outside these modes are interpreted as 6 (STOP: System ready)

Input/output parameters

Table 10- 2 FB SM1281_Module - input/output parameters

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

Output parameters

Table 10- 3 FB SM1281_Module - output parameters

Parameters	Data type	Description
ActualOpMode	USInt	Current operating mode of the SM 1281
StateOpModeChange	USInt	Status of operating mode change
StateRawDataRec	USInt	Status of raw data recording
StateRawDataSend	USInt	Raw data transmission status
StateFingerprintRec	USInt	Status of fingerprint recording
SystemState	DWord	System state

Status and error displays ActualOpMode

Table 10- 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
11	Firmware update running
12	RUN: X-Tools

Status and error displays StateOpModeChange

Table 10- 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`
5	Error VIB2: Sensitivity of sensor	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`

Status	Meaning	Remedy / notes
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	Error VIB1: Limit value DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
21	Error VIB2: Limit value DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
22	Error VIB3: Limit value DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
23	Error VIB4: Limit value DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
24 ... 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`

Status	Meaning	Remedy / notes
35	Error VIB3: Filter combination aRMS	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
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	Analysis mode error	Invalid combination of analysis modes
47	Error VIB1: Filter combination DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
48	Error VIB2: Filter combination DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
49	Error VIB3: Filter combination DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
50	Error VIB4: Filter combination DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
51	Error VIB1: Evaluation duration DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
52	Error VIB2: Evaluation duration DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
53	Error VIB3: Evaluation duration DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
54	Error VIB4: Evaluation duration DKW	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
55 ... 243	Not assigned	-
244	Invalid X-Tools configuration	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
245	Velocity spectrum: No limit band defined	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
246	Velocity spectrum: Hysteresis too high (> threshold value)	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
247	Velocity spectrum: Warning and alarm limits interchanged	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
248	Acceleration spectrum: No limit band defined	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`

Status	Meaning	Remedy / notes
249	Acceleration spectrum: Hysteresis too high (> threshold value)	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
250	Acceleration spectrum: Warning and alarm limits interchanged	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
251	Envelope spectrum: Incomplete bearing type definition (no monitored damage type)	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
252	Envelope spectrum: No limit band defined	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
253	Envelope spectrum: Hysteresis too high (> threshold value)	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
254	Envelope spectrum: Warning and alarm limits interchanged	Invalid parameter assignment - check parameters and load in SM 1281 with `SetAllParameters`
255	Unknown error	Other error CMS internal

Status and error displays StateFingerprintRec

Table 10- 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, for example, when control priority is not with the S7-1200 CPU or the device is in an operating mode other than RUN: Monitoring or RUN: Measuring.

Status and error displays StateRawDataRec

Table 10- 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 operator control is not with the S7-1200 CPU, for example, or if the device is in an operating mode other than RUN: Monitoring or RUN: Measuring.

Status and error displays StateRawDataSend

Table 10- 8 FB SM1281_Module - Status and error displays StateRawDataSend

Status	Meaning	Remedy / notes
0	IDLE	Status at startup
1	Transmission is running	-

Status	Meaning	Remedy / notes
2	Last transmission was successful	-
3	Error during last transmission	This error occurs if the control priority is not with the S7-1200 CPU, for example.

Status and error displays SystemState

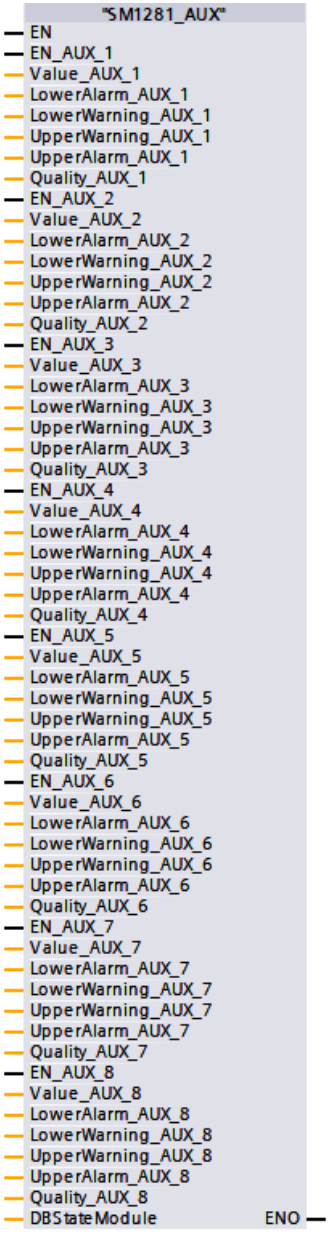
Table 10- 9 FB SM1281_Module - Status and error displays SystemState

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 acquisition failed	The speed acquisition has failed.
21	Memory space critical	The memory space on the internal Flash is >90% full.
29	Version error: SM 1281 FW newer than SM 1281 Lib	Incompatible version of FB and FW
30	Version error: SM 1281 Lib newer than SM 1281 FW	Incompatible version of FB and FW
31	Internal error	-

See also

FC SM1281_Channel - Parameters (Page 119)

10.3.2 FC SM1281_AUX



Function

The "SM1281_AUX" block offers the following functions:

- Assignment of additional channels
- Settings for warning and alarm limits

Call of the function block "SM1281_AUX" is only required for additional channel usage. Only one call of the function block is possible per module and offers up to 8 additional channels within one call.

10.3.2.1 FC SM1281_AUX - Parameter

Input parameters

Parameters	Data type	Description
EN_AUX_1	Bool	Enables activation and deactivation of the AUX channel.
Value_AUX_1	Real	Analog value of the additional channel.
LowerAlarm_AUX_1	Real	Alarm of the lower limit value of the AUX channel.
LowerWarning_AUX_1	Real	Lower limit warning of the AUX channel.
UpperWarning_AUX_1	Real	Upper limit warning of the AUX channel.
UpperAlarm_AUX_1	Real	Upper limit warning of the AUX channel.
Quality_AUX_1	USInt	Qualifier AUX (see table Status and error displays Quality_AUX)
EN_AUX_2	Bool	Enables activation and deactivation of the AUX channel.
Value_AUX_2	Real	Analog value of the additional channel.
LowerAlarm_AUX_2	Real	Alarm of the lower limit value of the AUX channel.
LowerWarning_AUX_2	Real	Lower limit warning of the AUX channel.
UpperWarning_AUX_2	Real	Upper limit warning of the AUX channel.
UpperAlarm_AUX_2	Real	Upper limit alarm of the AUX channel.
Quality_AUX_2	USInt	Qualifier AUX (see table Status and error displays Quality_AUX)
EN_AUX_3	Bool	Enables activation and deactivation of the AUX channel.
Value_AUX_3	Real	Analog value of the additional channel.
LowerAlarm_AUX_3	Real	Alarm of the lower limit value of the AUX channel.
LowerWarning_AUX_3	Real	Lower limit warning of the AUX channel.
UpperWarning_AUX_3	Real	Upper limit warning of the AUX channel.
UpperAlarm_AUX_3	Real	Upper limit alarm of the AUX channel.
Quality_AUX_3	USInt	Qualifier AUX (see table Status and error displays Quality_AUX)
EN_AUX_4	Bool	Enables activation and deactivation of the AUX channel.
Value_AUX_4	Real	Analog value of the additional channel.
LowerAlarm_AUX_4	Real	Alarm of the lower limit value of the AUX channel.
LowerWarning_AUX_4	Real	Lower limit warning of the AUX channel.
UpperWarning_AUX_4	Real	Upper limit warning of the AUX channel.
UpperAlarm_AUX_4	Real	Upper limit alarm of the AUX channel.
Quality_AUX_4	USInt	Qualifier AUX (see table Status and error displays Quality_AUX)
EN_AUX_5	Bool	Enables activation and deactivation of the AUX channel.
Value_AUX_5	Real	Analog value of the additional channel.
LowerAlarm_AUX_5	Real	Alarm of the lower limit value of the AUX channel.

Parameters	Data type	Description
LowerWarning_AUX_5	Real	Lower limit warning of the AUX channel.
UpperWarning_AUX_5	Real	Upper limit warning of the AUX channel.
UpperAlarm_AUX_5	Real	Upper limit alarm of the AUX channel.
Quality_AUX_5	USInt	Qualifier AUX (see table Status and error displays Quality_AUX)
EN_AUX_6	Bool	Enables activation and deactivation of the AUX channel.
Value_AUX_6	Real	Analog value of the additional channel.
LowerAlarm_AUX_6	Real	Alarm of the lower limit value of the AUX channel.
LowerWarning_AUX_6	Real	Lower limit warning of the AUX channel.
UpperWarning_AUX_6	Real	Upper limit warning of the AUX channel.
UpperAlarm_AUX_6	Real	Upper limit alarm of the AUX channel.
Quality_AUX_6	USInt	Qualifier AUX (see table Status and error displays Quality_AUX)
EN_AUX_7	Bool	Enables activation and deactivation of the AUX channel.
Value_AUX_7	Real	Analog value of the additional channel.
LowerAlarm_AUX_7	Real	Alarm of the lower limit value of the AUX channel.
LowerWarning_AUX_7	Real	Lower limit warning of the AUX channel.
UpperWarning_AUX_7	Real	Upper limit warning of the AUX channel.
UpperAlarm_AUX_7	Real	Upper limit alarm of the AUX channel.
Quality_AUX_7	USInt	Qualifier AUX (see table Status and error displays Quality_AUX)
EN_AUX_8	Bool	Enables activation and deactivation of the AUX channel.
Value_AUX_8	Real	Analog value of the additional channel.
LowerAlarm_AUX_8	Real	Alarm of the lower limit value of the AUX channel.
LowerWarning_AUX_8	Real	Lower limit warning of the AUX channel.
UpperWarning_AUX_8	Real	Upper limit warning of the AUX channel.
UpperAlarm_AUX_8	Real	Upper limit alarm of the AUX channel.
Quality_AUX_8	USInt	Qualifier AUX (see table Status and error displays Quality_AUX)

Status and error displays Quality_AUX

Status	Meaning
0	Unknown
1	Good
2	Bad

Explanation of input parameters

Any analog value can be assigned to this input, which is then updated in the process image of the S7-1200 CPU. SM 1281 then monitors the value and visualizes it in the trend diagram.

Input/output parameters

Parameter	Data type	Description
DBStateModule	Structure	Reference to the module structure in the DB "SM1281_Status - Parameter (Page 125)". The assignment to the FB "SM1281_Module" or to the SM 1281 in the device configuration also takes place at this point.

10.3.3 FC SM1281_Channel

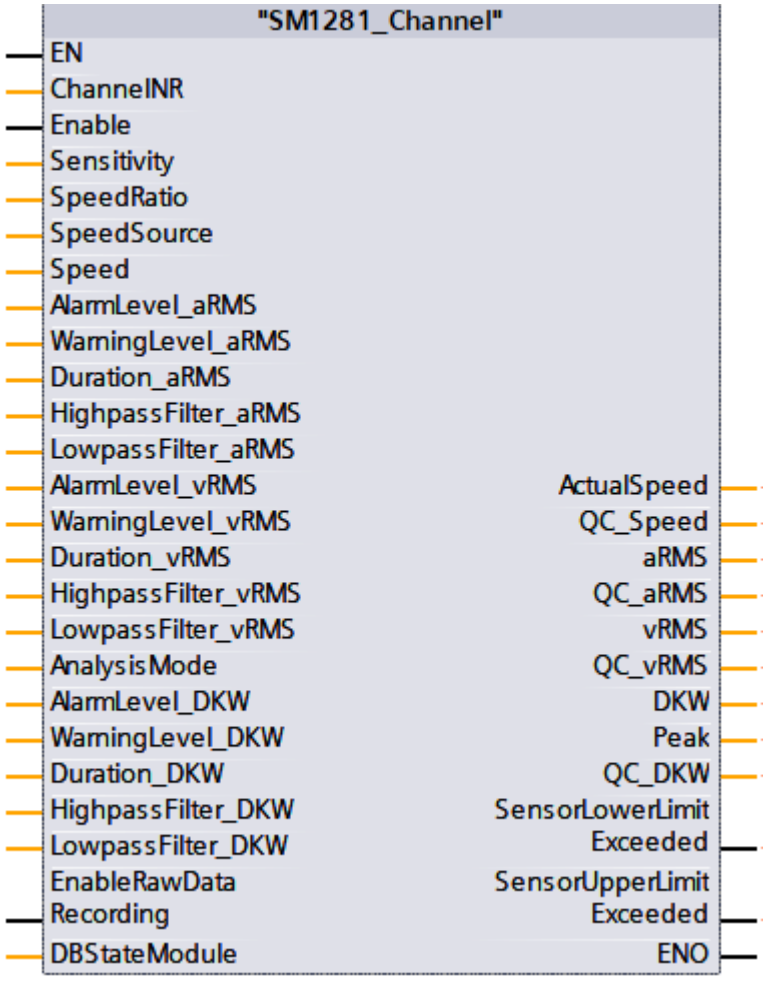


Figure 10-2 FC SM1281_Channel

Function

The "SM1281_Channel" block offers the following functions:

- Channel-specific parameter settings
- Request channel-specific raw data recording

- Speed configuration
- 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` (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 section Using blocks (Page 135) 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.

10.3.3.1 FC SM1281_Channel - Parameters

Input parameters

Table 10- 10 FC SM1281_Channel - input parameters

Parameters	Data type	Description	
ChannelNR	USInt	Assignment to the channel of the SM 1281: Channel number 1-4 With channel number < 1 or > 4, the function is not executed.	
Enable	Bool	Permits enabling and disabling of the channel.	
Sensitivity	Real	Sensor sensitivity in mV/g (>0.001)	
SpeedRatio	Real	Speed ratio (>0)	
		Speed ratio	**Speed of the monitored shaft**
		= 1	The shaft speed corresponds to the value at the speed output of the module block.
		> 1	The shaft speed is greater than the value at the speed output of the module block.
		< 1	The shaft speed is less than the value at the speed output of the module block.
SpeedSource	Byte	Selection of the speed source: 1: S7-1200 2: DI - Digital input of the SM 1281 3: PLL	
Speed	Real	Speed value (r/min) from S7-1200 (only used if `SpeedSource`=1)	

Parameters	Data type	Description
AlarmLevel_aRMS	Real	Limit value alarm aRMS in m/s² The value range is limited to 0.0...255.99609375 by an internal conversion to a 16-bit fixed point number! Values <0 are interpreted as 0, values >255.99609375 are interpreted as 255.99609375. 0: The limit value is not monitored.
WarningLevel_aRMS	Real	Limit value warning aRMS in m/s² The value range is limited to 0.0...255.99609375 by an internal conversion to a 16-bit fixed point number! Values <0 are interpreted as 0, values >255.99609375 are interpreted as 255.99609375. 0: The limit value is not monitored. WarningLevel_aRMS must be less than the associated AlarmLevel_aRMS.
Duration_aRMS	USInt	Duration for characteristic values aRMS: 0: 3 revolutions 1-60: 1-60 seconds 61: 2 minutes 62: 3 minutes 63: 4 minutes 64: 5 minutes 65: 6 minutes 66: 7 minutes 67: 8 minutes 68: 9 minutes 69: 10 minutes
HighpassFilter_aRMS	USInt	Preset limit frequency high-pass filter aRMS: 0: 0.1 Hz (not allowed with AnalysisMode = 0. Default) 1: 2 Hz 2: 10 Hz 3: 100 Hz 4: 1000 Hz 5: 2000 Hz
LowpassFilter_aRMS	USInt	Preset limit frequency low-pass filter aRMS: 0: 2 Hz 1: 10 Hz 2: 100 Hz 3: 1000 Hz 4: 2000 Hz 5: 5000 Hz 6: 10000 Hz 254: 23000 Hz
AlarmLevel_vRMS	Real	Limit value alarm vRMS in mm/s The value range is limited to 0.0...255.99609375 by an internal conversion to a 16-bit fixed point number! Values <0 are interpreted as 0, values >255.99609375 are interpreted as 255.99609375. 0: The limit value is not monitored.

Parameters	Data type	Description
WarningLevel_vRMS	Real	Limit value warning vRMS in mm/s The value range is limited to 0.0...255.99609375 by an internal conversion to a 16-bit fixed point number! Values <0 are interpreted as 0, values >255.99609375 are interpreted as 255.99609375. 0: The limit value is not monitored. WarningLevel_vRMS must be less than the associated AlarmLevel_vRMS.
Duration_vRMS	USInt	Duration for characteristic values vRMS: 0: 3 revolutions 1-60: 1-60 seconds 61: 2 minutes 62: 3 minutes 63: 4 minutes 64: 5 minutes 65: 6 minutes 66: 7 minutes 67: 8 minutes 68: 9 minutes 69: 10 minutes
HighpassFilter_vRMS	USInt	Preset limit frequency high-pass filter vRMS: 0: 0.1 Hz (not allowed with AnalysisMode = 0. Default) 1: 2 Hz 2: 10 Hz 3: 100 Hz
LowpassFilter_vRMS	USInt	Preset limit frequency low-pass filter vRMS: 0: 2 Hz 1: 10 Hz 2: 100 Hz 3: 1000 Hz 4: 2000 Hz
AnalysisMode	USInt	Analysis mode: 0: Standard 1: Moving aRMS 2: Moving vRMS
AlarmLevel_DKW	Real	Limit value alarm DKW (diagnostic characteristic value) as ratio of current (aRMS * aPeak) value to an initial value The value range is limited to 0.0...255.99609375 by an internal conversion to a 16-bit fixed point number! Values <0 are interpreted as 0, values >255.99609375 are interpreted as 255.99609375. 0: The limit value is not monitored.

Parameters	Data type	Description
WarningLevel_DKW	Real	Limit value warning DKW (diagnostic characteristic value) as ratio of current (aRMS * aPeak) value to an initial value The value range is limited to 0.0...255.99609375 by an internal conversion to a 16-bit fixed point number! Values <0 are interpreted as 0, values >255.99609375 are interpreted as 255.99609375. 0: The limit value is not monitored. `WarningLevel_aRMS` must be less than the associated `AlarmLevel_aRMS`.
Duration_DKW	USInt	Duration for diagnostic characteristic value DKW: 0: 3 revolutions 1-10: 1-10 seconds
HighpassFilter_DKW	USInt	Preselection high-pass filter limit frequency DKW: 0: 0.1 Hz (not allowed with AnalysisMode = 0. Default) 1: 2 Hz 2: 10 Hz 3: 100 Hz 4: 1000 Hz 5: 2000 Hz
LowpassFilter_DKW	USInt	Preselection low-pass filter limit frequency DKW: 0: 2 Hz 1: 10 Hz 2: 100 Hz 3: 1000 Hz 4: 2000 Hz 5: 5000 Hz 6: 10000 Hz 254: 23000 Hz
EnableRawDataRecording	Bool	Enable for request to record raw data of the channel A pending request to record raw data (RawDataRecording) is only sent to the device if EnableRawDataRecording = 1.

Explanation of input parameters

Parameters for duration

The module calculates the characteristic values for aRMS, vRMS and DKW via a configurable time interval. Specify the duration individually for each channel and separately for both aRMS, vRMS and DKW using the "SM1281_Channel" function. The adjustable value range for the duration is 0 ... 600 s (DKW: 0 ... 10 s).

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. The module also 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 characteristic value for aRMS with an incremental, block-by-block analysis of the raw data (16k samples). Spectra and characteristic value for vRMS are not 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", "HighpassFilter_DKW" or "LowpassFilter_DKW", 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 10- 11 FC SM1281_Channel - Input/output parameters

Parameters	Data type	Description
DBStateModule	Struct	Reference to the module structure in the DB "SM1281_Status - Parameter (Page 125)". The assignment to the FB "SM1281_Module" or to the SM 1281 in the device configuration also takes place at this point.

Output parameters

Table 10- 12 FC SM1281_Channel - Output parameters

Parameters	Data type	Description
ActualSpeed	Real	Current speed in revolutions per minute (only used if `SpeedSource`=2)
QC_Speed	USInt	Qualifier for speed (see table"Status and error displays QC_Speed, QC_vRMS, QC_aRMS, QC_DKW (Page 125)")
aRMS	Real	Interval rms value of vibration acceleration aRMS in m/s^2
QC_aRMS	USInt	Qualifier interval rms value of vibration acceleration aRMS (see table "Status and error displays QC_Speed, QC_vRMS, QC_aRMS, QC_DKW (Page 125)")
vRMS	Real	Speed vRMS in mm/s
QC_vRMS	USInt	Qualifier speed vRMS (see table "Status and error displays QC_Speed, QC_vRMS, QC_aRMS, QC_DKW (Page 125)")
DKW	Real	Diagnostic characteristic value formed as ratio of (aRMS * Peak) to an initial value
Peak	Real	Interval peak value of the vibration acceleration a in m/s^2
QC_DKW	USInt	Qualifier Diagnostic parameter (see table"Status and error displays QC_Speed, QC_vRMS, QC_aRMS, QC_DKW (Page 125)")
SensorLowerLimitExceeded	Bool	Sensor measuring range undershot
SensorUpperLimitExceeded	Bool	Sensor measuring range exceeded

Status and error displays QC_Speed, QC_vRMS, QC_aRMS, QC_DKW

Table 10- 13 FC SM1281_Channel - Status and error displays QC_Speed, QC_vRMS, QC_aRMS, QC_DKW

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

See also

Status and actual displays (Page 68)

10.3.4 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 "Module_1" structure can be copied and pasted as "Module_2". The names of the structure elements "Module", "Channel_1", "Channel_2", "Channel_3", "Channel_4" can be renamed as desired.

See also

Status and actual displays (Page 68)

10.3.4.1 DB SM1281_Status - Parameter

Parameters

Table 10- 14 DB SM1281_Status - Parameter

Parameters	Data type	Description
Module_1	**Struct**	All status and actual values of the SM 1281 are stored in this PLC data type. When there are multiple SM 1281 modules, the `Module1` parameter can be coped and inserted as `Module2`, etc. in the DB "SM1281_Status".
Module	**typeSM1281ModuleStatus**	This structure contains module-specific status and actual values.
ActualOpMode	USInt	Current operating mode of the SM 1281
StateOpModeChange	USInt	Status of operating mode change
StateFingerprintRec	USInt	Status of fingerprint recording
StateRawDataRec	USInt	Status of raw data recording
StateRawDataSend	USInt	Raw data transmission status
SystemState	DWord	System state
Channel_1	**typeSM1281ChannelStatus**	All status and actual values of the 1st channel of the SM 1281 are stored in this structure.
ActualSpeed	Real	Current speed in revolutions per minute (only used if `SpeedSource`=2)
QC_Speed	USIntUSInt	Qualifier for speed (see table QC_Speed (Page 124))
vRMS	Real	Interval rms value of the vibration velocity vRMS in mm/s
aRMS	Real	Interval rms value of vibration acceleration aRMS in m/s^2
DKW	Real	Diagnostic characteristic value formed as ratio of (aRMS * Peak) to an initial value
Peak	Real	Interval peak value of the vibration acceleration a in m/s^2
QC_vRMS	USInt	Qualifier interval rms value of vibration velocity vRMS (see table QC_vRMS, QC_aRMS, QC_DKW (Page 124))

Parameters	Data type	Description
QC_aRMS	USInt	Qualifier interval rms value of vibration acceleration aRMS (see table QC_vRMS, QC_aRMS, QC_DKW (Page 124))
QC_DKW	USInt	Qualifier of diagnostic characteristic value DKW (see table QC_vRMS, QC_aRMS, QC_DKW (Page 124))
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_DKW	**Struct**	Monitoring status of the diagnostic characteristic value DKW
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)

Parameters	Data type	Description
MonState_e(f)_FTF	**Struct**	Monitoring status envelope spectrum FTF (fundamental train frequency)
NotValid	Bool	Do not evaluate (status unknown)
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
SensorFaultType	**Struct**	Sensor connection
NoFault	Bool	No error
ShortCircuit	Bool	Short circuit
WireBreak	Bool	Wire break
Sensor offset	**Real**	Sensor operating point
Channel_2	**typeSM1281ChannelStatus**	All status and actual values of the 2nd channel of the SM 1281 are stored in this structure.
Channel_3	**typeSM1281ChannelStatus**	All status and actual values of the 3rd channel of the SM 1281 are stored in this structure.
Channel_4	**typeSM1281ChannelStatus**	All status and actual values of the 4th channel of the SM 1281 are stored in this structure.
AUX_1	**typeSM1281AUXChannelStatus**	All status values of the 1st AUX channel are stored in this structure.
NotValid	Bool	Status not known
Good	Bool	Good (green)
Warning	Bool	Warning (yellow)
Alarm	Bool	Alarm (red)
AUX_2	**typeSM1281AUXChannelStatus**	All status values of the 2nd AUX channel are stored in this structure.
AUX_3	**typeSM1281AUXChannelStatus**	All status values of the 3rd AUX channel are stored in this structure.
AUX_4	**typeSM1281AUXChannelStatus**	All status values of the 4th AUX channel are stored in this structure.
AUX_5	**typeSM1281AUXChannelStatus**	All status values of the 5th AUX channel are stored in this structure.
AUX_6	**typeSM1281AUXChannelStatus**	All status values of the 6th AUX channel are stored in this structure.
AUX_7	**typeSM1281AUXChannelStatus**	All status values of the 7th AUX channel are stored in this structure.
AUX_8	**typeSM1281AUXChannelStatus**	All status values of the 8th AUX channel are stored in this structure.

Parameters	Data type	Description
Parameters	**typeSM1281Parameters**	All module-specific and channel-specific parameters of the SM 1281 are stored in this structure. It corresponds mainly to the structure of the data block "SM 1281_Backup (Page 128)". However, the four individual structures "Parameters_Channel_1" to "Parameters_Channel_4" are replaced by a "Channels" field of type Array [1..4] of "SM1281_Type_Channelparameters" to make processing easier.
InternalData	**typeSM1281Values**	Internal data, not relevant for user

10.3.5 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.

10.3.5.1 DB SM1281_Backup - Parameter

Parameters

Table 10- 15 DB SM1281_Backup - Parameter

Parameters	Data type	Description
Module_1	**Struct**	
Module parameters	**typeSM1281Moduleparameters**	This structure contains the automatically backed up module parameters.
SpeedSource	Byte	Selection of the speed source: 1: S7-1200 2: DI - Digital input of the SM 1281 3: PLL
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)
IPConfig	**SM1281_IP_Config**	IP configuration of the SM 1281
IPAddress	Array [1..4] of Byte	IP address of the SM 1281
SubnetMask	Array [1..4] of Byte	Subnet mask of the SM 1281
DefaultGateway	Array [1..4] of Byte	Default gateway of the SM 1281
DNS	Array [1..4] of Byte	DNS setting
DHCP	Bool	Use of a DHCP server (automatic assignment of the IP address and subnet mask)
Parameters_Channel_1	**typeSM1281Channelparameters**	This structure contains the automatically backed up parameters of channel 1.
ChannelNr	USInt	Channel number, actually superfluous

Parameters	Data type	Description
Enable	Bool	Specifies whether the channel is enabled or disabled.
Sensitivity	Real	Sensitivity of sensor
SpeedRatio	Real	Speed ratio
AlarmLevel_aRMS	Real	Limit value alarm aRMS in m/s²
WarningLevel_aRMS	Real	Limit value warning aRMS in m/s²
Duration_aRMS	USInt	Duration for characteristic values aRMS
HighpassFilter_aRMS	USInt	Preset limit frequency high-pass filter aRMS: [1]
LowpassFilter_aRMS	USInt	Preset limit frequency low-pass filter aRMS: [1]
AlarmLevel_vRMS	Real	Limit value alarm vRMS in mm/s
WarningLevel_vRMS	Real	Limit value warning vRMS in mm/s
Duration_vRMS	USInt	Duration for characteristic values vRMS
HighpassFilter_vRMS	USInt	Preset limit frequency high-pass filter vRMS: [1]
LowpassFilter_vRMS	USInt	Preset limit frequency low-pass filter vRMS: [1]
AnalysisMode	USInt	Analysis mode
AlarmLevel_DKW	Real	Limit alarm DKW (ratio, without dimension)
WarningLevel_DKW	Real	Limit value warning vRMS (ratio, without dimension)
Duration_DKW	USInt	Duration for characteristic values DKW
HighpassFilter_DKW	USInt	Preselection high-pass filter limit frequency DKW: [1]
LowpassFilter_DKW	USInt	Preselection low-pass filter limit frequency DKW: [1]
EnableRawDataRecording	Bool	Enable for raw data recordings of this channel.[2]
Parameters_Channel_2	**typeSM1281Channelparameters**	This structure contains the automatically backed up parameters of channel 2.
Parameters_Channel_3	**typeSM1281Channelparameters**	This structure contains the automatically backed up parameters of channel 3.
Parameters_Channel_4	**typeSM1281Channelparameters**	This structure contains the automatically backed up parameters of channel 4.
Parameters_AUX_Channel_1	**typeSM1281AUXChannelparameters**	All parameters of the 1st AUX channel are stored in this structure.
ChannelNo	USInt	Channel number
Enable	Bool	Permits enabling and disabling of the channel.
LowerAlarm	Real	Lower alarm limit of the AUX channel
LowerWarning	Real	Lower warning limit of the AUX channel
UpperWarning	Real	Upper warning limit of the AUX channel
UpperAlarm	Real	Upper alarm limit of the AUX channel
Parameters_AUX_Channel_2	**typeSM1281AUXChannelparameters**	All parameters of the 2nd AUX channel are stored in this structure.
Parameters_AUX_Channel_3	**typeSM1281AUXChannelparameters**	All parameters of the 3rd AUX channel are stored in this structure.
Parameters_AUX_Channel_4	**typeSM1281AUXChannelparameters**	All parameters of the 4th AUX channel are stored in this structure.
Parameters_AUX_Channel_5	**typeSM1281AUXChannelparameters**	All parameters of the 5th AUX channel are stored in this structure.
Parameters_AUX_Channel_6	**typeSM1281AUXChannelparameters**	All parameters of the 6th AUX channel are stored in this structure.

Parameters	Data type	Description
Parameters_AUX_Channel_7	**typeSM1281AUXChannelparameters**	All parameters of the 7th AUX channel are stored in this structure.
Parameters_AUX_Channel_8	**typeSM1281AUXChannelparameters**	All parameters of the 8th AUX channel are stored in this structure.

[1] When an invalid value is preselected, an error message is output on the "SM1281_Module" block with the `StateOpModeChange` output parameter.

[2] With channel parameter "EnableRawDataRecording" on the FC Channel, it is specified whether or not the raw data signal of the vibration channel is written to the raw data recording (yes=1, no=0). The raw data recording is started with command parameter "RawDataRecording" on the FB Module.

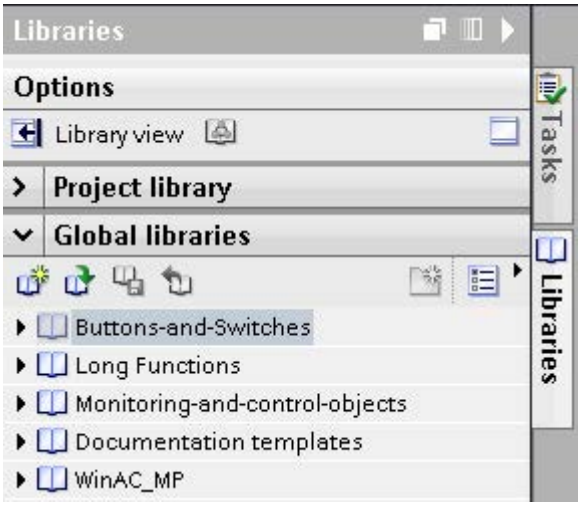
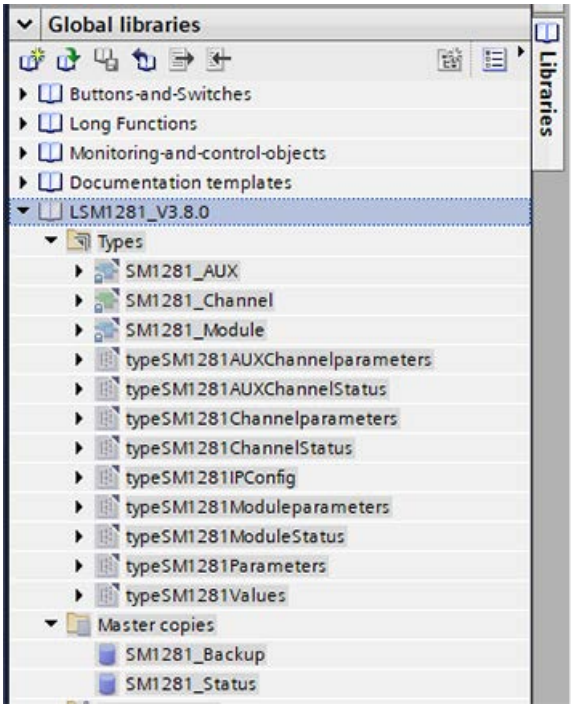
10.4 Working with the library

10.4.1 Integrating the library in STEP 7

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:

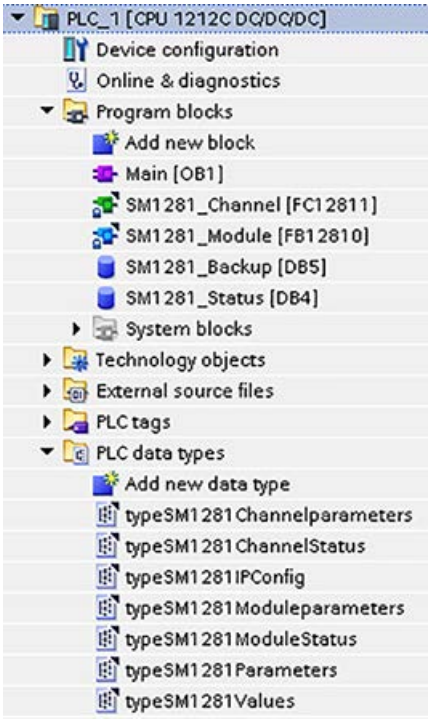
No.	Step	View in the TIA Portal
1	The library is available as ZIP archive. Unzip the ZIP archive into a folder on your PC, from which you would like to open the global library. Choose "Options > Global libraries > Retrieve library" from the menu to do so.	-
2	Open the library. To do this, open the display of the global libraries on the right in the TIA Portal. In the display, you can open the library "SM1281_Library". 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. • Types The needed PLC data types, the "SM1281_Channel" function, and the "SM1281_Module" function block are saved here. • Copy templates The two global data blocks are saved here.	

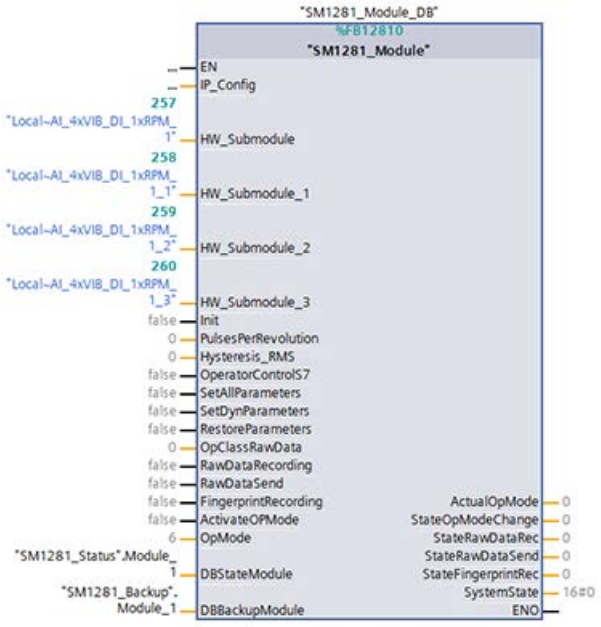
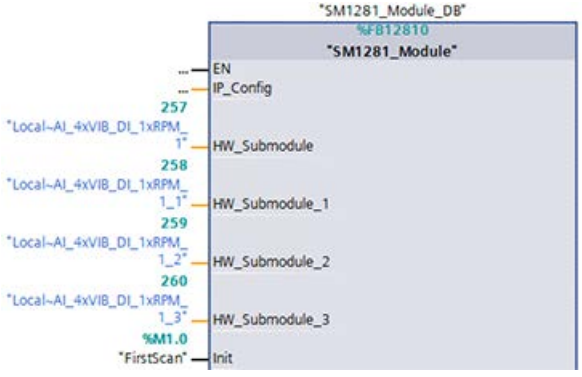
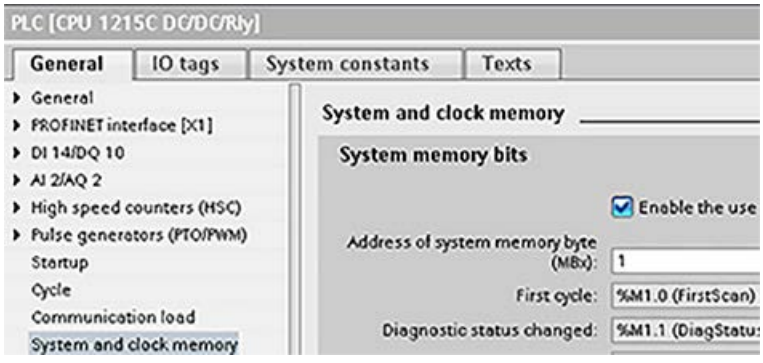
Result

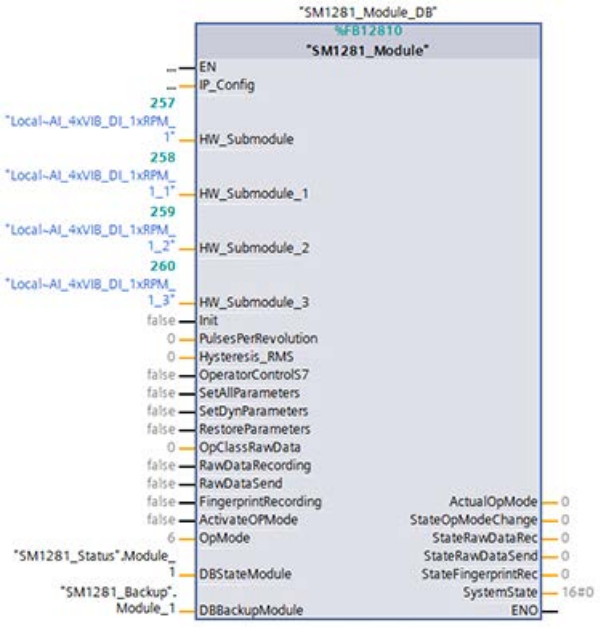
The library is integrated in STEP 7 and you can use the blocks of the library.

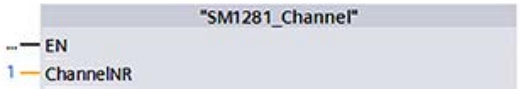
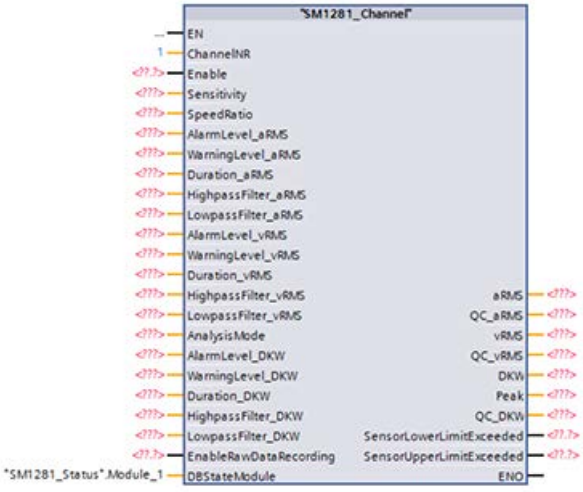
10.4.2 Integrating blocks in STEP 7

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. The PLC data types that are referenced in the blocks are automatically copied as well. 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. **Result**: 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: 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. This is done via the four input parameters: • `HW_Submodule` • `HW_Submodule_1` • `HW_Submodule_2` • `HW_Submodule_3` 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. 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 (FirstScan) of your S7-1200 CPU to the input parameter `Init`.	
	If necessary, you must activate the system flag under the properties of the S7-1200 CPU in the device configuration beforehand.	
		

No.	Step	View in the TIA Portal
5	Assign the corresponding element from the data blocks "SM1281_Status" and "SM1281_Backup" to the input/output parameters `DBStateModule` and `DBBackupModule`. To do this, connect the input/output parameter `DBStateModule` to the variable "Module1" of the data type "Struct" from the "SM1281_Status" data block. You interconnect the input / output parameter `DBBackupModule` to the variable "Module1" of the data type "Struct" from the "SM1281_Backup" data block. **Result**: After you have performed all of the steps, the block is connected (see figure). 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.	
6	Next, call the function "SM1281_Channel" in a cyclic organization block in the user program. 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".	-

No.	Step	View in the TIA Portal
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 you assign the corresponding element from "SM1281_Status" data blocks to the input / output parameters `DBStateModule` . You also interconnect the input / output parameter `DBStateModule` to the variable "Module1" of the "Struct" data type from the "SM1281_Status" data block as in step 5. **Result**: After you have performed all of the steps, the block is connected (see figure). The remaining input and output parameters must still be connected to the user program. Repeat steps 6 to 8 for each additional channel and adapt the parameters to the channel accordingly.	

10.4.3 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.

10.4.3.1 Select operating mode/CPU restart

The SM 1281 has the following selectable operating modes:

- (6) STOP: System ready
- (7) RUN: System diagnostics
- (8) RUN: Measuring

- (9) RUN: Monitoring inhibited
- (10) RUN: Monitoring
- (12) RUN: X-Tools
- (253) RESET: Restart
- (254) RESET: Factory Settings
- (255) RESET: Password

The three RESET operating modes restart the SM 1281. "RESET: Factory Settings" also resets the module to the factory state, "RESET: Password" resets the password back to the default value ("0000").

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. (e.g. after selection of a RESET mode)
- 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. 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 110).

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 only the SM 1281 fails, e.g. due to an interruption of the power supply, the operating mode selected at the input parameter `OpMode` is automatically set when the module restarts.

10.4.3.2 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.

10.4.3.3 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.

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, unlike `SetAllParameters`.

The dynamic parameters at the input parameters of the block "SM1281_Channel" are transferred using a rising edge at the input parameter `SetDynParameters`. This is only possible in the mode "RUN: Monitoring" or "RUN: Monitoring deactivated".

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 10 dynamic parameters serve as limit values of the vRMS and aRMS, DKW and AUX monitoring:

Parameters	Data type	Description
AlarmLevel_aRMS	Real	Limit value alarm aRMS in m/s²
WarningLevel_aRMS	Real	Limit value warning aRMS in m/s²
AlarmLevel_vRMS	Real	Limit value alarm vRMS in mm/s
WarningLevel_vRMS	Real	Limit value warning vRMS in mm/s
AlarmLevel_DKW	Real	Limit value alarm diagnostic characteristic value
WarningLevel_DKW	Real	Limit value warning diagnostic characteristic value
LowerAlarm	Real	Lower limit alarm AUX value
LowerWarning	Real	Lower limit warning AUX value
UpperAlarm	Real	Upper limit alarm AUX value
UpperWarning	Real	Upper limit warning AUX value

Note

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

10.4.3.4 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` (status and error displays table (Page 113)).

Note

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

Only when the current recording has been completed successfully or the recording could not be executed due to an error, a new recording can be requested.

See also

FB SM1281_Module - Parameters (Page 108)

10.4.3.5 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.

"The edge-controlled input `RawDataRecording` can be disabled (Inhibit) with the input parameter `EnableDataRecording`."

The status of the recording is displayed on the output parameter `StateRawDataRec` (see status and error displays table (Page 108)).

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

FC SM1281_Channel - Parameters (Page 119)

10.4.3.6 Request raw data transmission

Previously recorded raw data can be transmitted to a server with a rising edge at the input parameter `RawDataSend` of the block "SM1281_Module". The module establishes an unencrypted FTP connection to an FTP server set via the web server, authenticates itself there and transfers all raw data files from the operating-class-specific subdirectories. Successfully transferred files are deleted from the module.

If the connection to the FTP server or the authentication on the FTP server fails, an error is signaled at the output parameter `StateRawDataSend` (error during last transmission).

Note

No new transmission can be requested as long as a raw data transmission is running. A new transmission can only be requested after the active transmission has been successfully completed or if the transmission could not be executed because of an error.

See also

FB SM1281_Module - Parameters (Page 108)

10.4.3.7 Backing up and restoring parameters

At each successful transition into the operating states

- "RUN: Monitoring"
- "RUN:Measuring"
- "RUN: System diagnostics"
- "RUN:X-Tools"

the parameters last 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`.

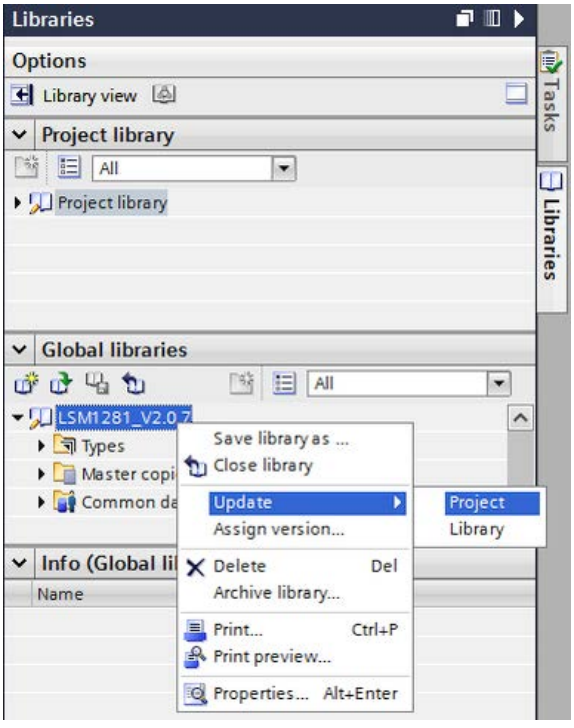
Note

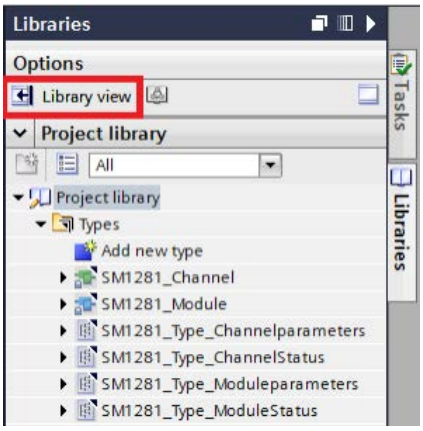
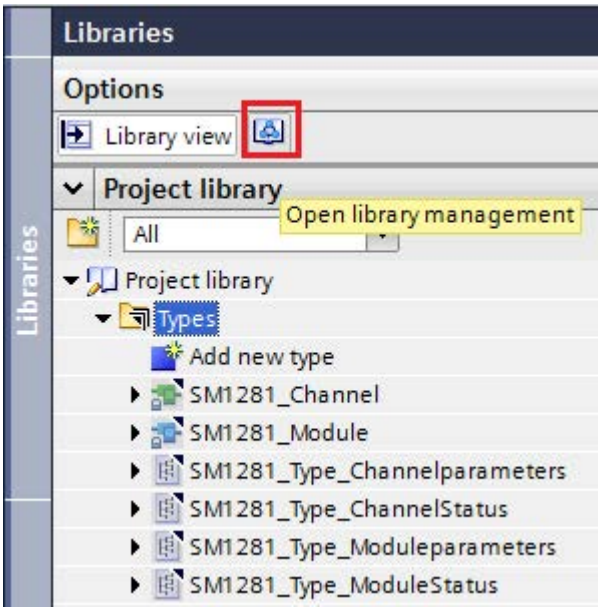
While the parameters are being restored, no commands can be set via the blocks.

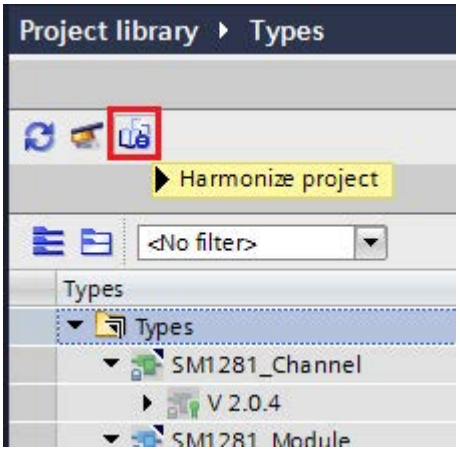
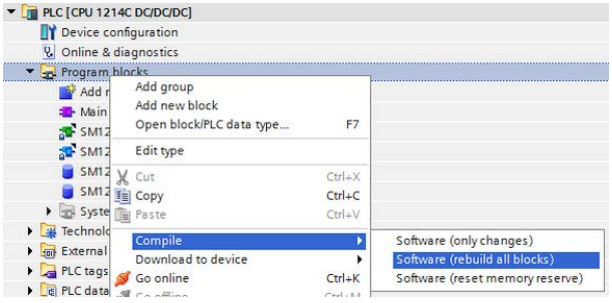
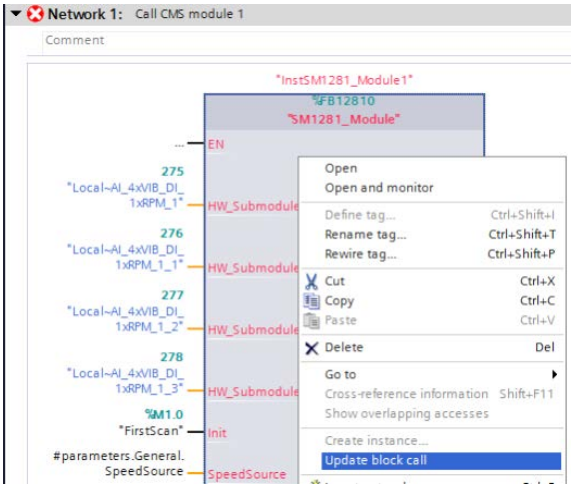
10.5 Update library

Update library

For operation of the SM 1281, 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, the blocks from the V2.x library for modules with firmware version V2.x, and the blocks from the library V3.x for modules with firmware version V3.x.

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 130).	
2	Right-click on the global library and select the "Update > Project" command from the shortcut menu. 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. The following changes were made to the project: 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 can change, it may be necessary to manually update the interface of the blocks in the call environment (OB, FC, FB). To do this, open the OB, FC or FB in which the SM 1281 blocks are called. Update the interface by right-clicking on the block -> Refresh. Once you have updated all SM 1281 blocks in the project, it may still be necessary to interconnect the new or modified parameters.	

See also

S7 Professional V18.0 (https://support.industry.siemens.com/cs/de/en/view/109815056)

Parameter assignment/configuring 11

11.1 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, e.g.:

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

Advanced settings via the SM 1281 Web server, for example:

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

11.2 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.

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

Note

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

- Module parameters (Page 108)
- Channel parameters (Page 119)

11.3 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 199).

11.3.1 Software and hardware requirements

Supported browsers

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

- Mozilla Firefox
- Microsoft IE
- Google Chrome

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.

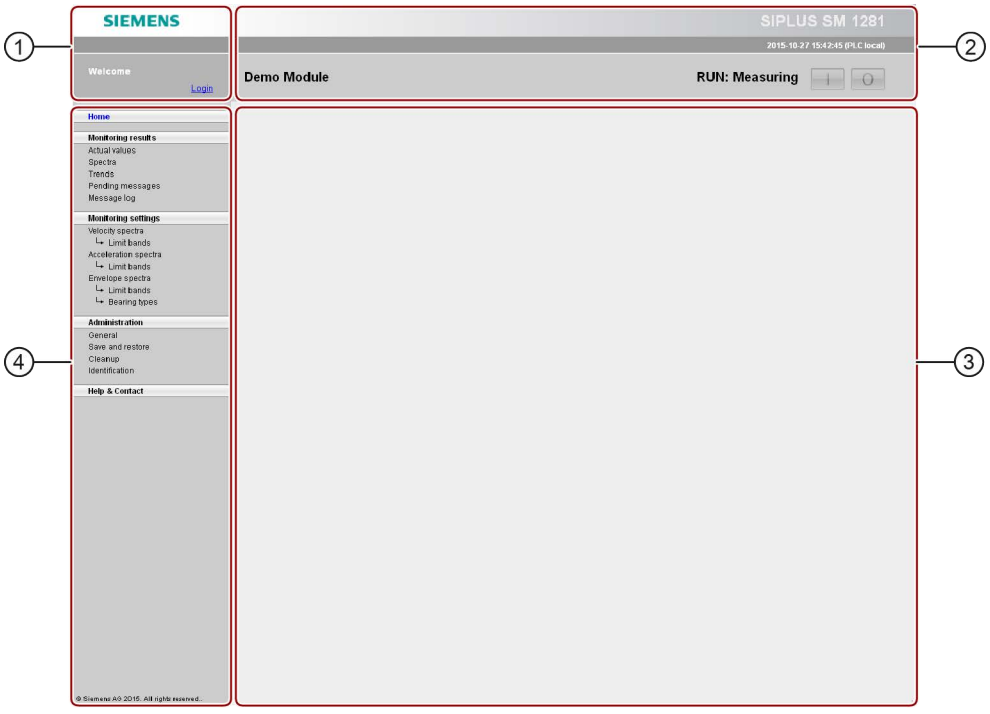
Screen resolution

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

11.3.2 General operation

11.3.2.1 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 57)
- Button for switching to STOP if the device is in RUN
- Capability of switching to the device mode "RUN: Monitoring", "RUN: Measuring" and "RUN: X-Tools" when the device is in STOP mode

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

11.3.2.2 Logging in / logging out

Requirement

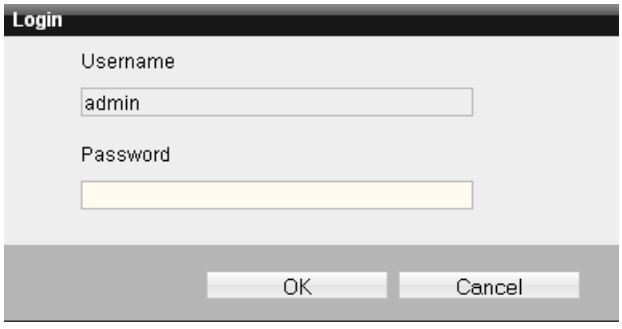
You have the operator authorization for the websites via the S7 user program.

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 187).

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.

11.3.2.3 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 187) 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.

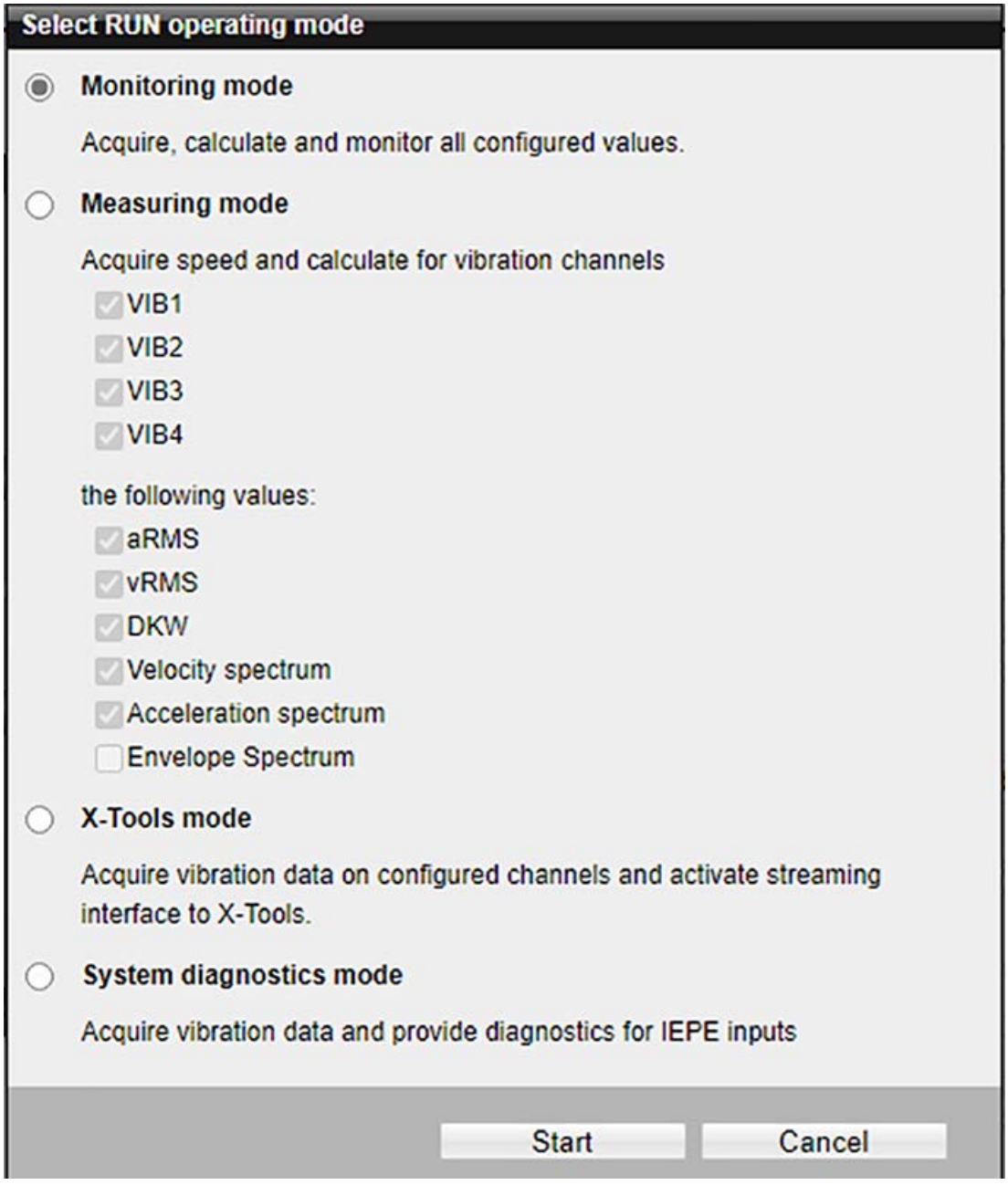
11.3.2.4 Changing operating mode

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. No monitoring tasks are implemented in measurement mode.

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

X-Tools mode

In X-Tools mode the vibration data for all configured channels is recorded and the streaming interface for X-Tools is activated. If SM 1281 is in this operating mode, X-Tools can establish a streaming connection.

Note

If SM 1281 is in the operating mode "RUN: X-Tools", no monitoring functions are executed.

System diagnostics mode

In diagnostics mode (RUN: System diagnostics), all parameterized channels are measured. The collected data is not further processed or monitored.

11.3.2.5 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.
- There is no plausibility check of parameters against each other until the system switches to RUN.

Saving data

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

11.3.2.6 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.

11.3.2.7 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:

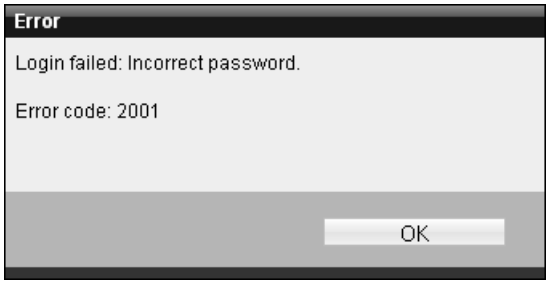


Figure 11-1 Example of an error message

11.3.3 Home page

11.3.3.1 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 CMS 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: X-Tools	Vibration data is recorded, and characteristic values calculated / spectra are not calculated / streaming interface for X-Tools is active.
RUN: System diagnostics	All of the parameterized vibration channels are measured. No further processing of the vibration data takes place. The sensor operating point is established and transferred to FB_Channel.

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 165).

11.3.4 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 154)
- Spectra (Page 158)
- Trends (Page 161)
- Pending messages (Page 165)
- Message log (Page 165)

11.3.4.1 Actual values

Read all current measured values of the system on the "Actual values" page. To open the web page, click "Monitoring results > Actual values" in the navigation area.

Vibration

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

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

Speed

Up to 4 speed values are valid for the corresponding channel in the line.

Auxiliary

The last AUX values provided by the S7-1200 with their monitoring states. The monitoring states of the activated AUX channels are indicated by stylized LEDs whose colors indicate the status (see table).


Actual values
Vibration
aRMS (m/s²)
vRMS (mm/s)
DKW
aPeak (m/s²)
v
a
e
Rotational speed (rpm)
VIB1: My_VIB_Channel_1
2.89
2.05
31.24
10.81
123.0
VIB2: My_VIB_Channel_2
2.93
4.37
34.63
11.81
600.0
VIB3: My_VIB_Channel_3
2.93
1.83
32.14
10.98
1782.0
VIB4: My_VIB_Channel_4
2.89
2.11
32.91
11.39
800.0
Auxiliary
AUX1:My channel 1
10.10
Unit 1
AUX2:Speed Drive B
20.00
rpm
AUX3:Oil temp. T1
-15.00
°C
AUX4:Temp.Bearing B3
3.00
°C
AUX5:Oil pressure P1
0.00
bar
AUX6:My channel 6
0.00
Unit 6
AUX7:Speed Drive A
0.50
rpm
AUX8:My channel 8
2.50
Unit 8
Record raw data
Start recording
Start

Display of values

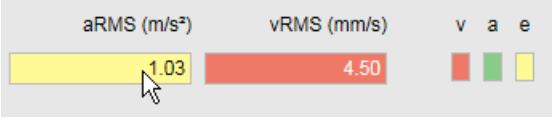
Display of value	Meaning
???	The value is configured but not yet known, or the calculation has not yet finished. The sensor or connecting cable may be defective.
<Value>?	The value has been calculated, but the result is uncertain. An uncertain result can arise, for example, if the value is located in 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

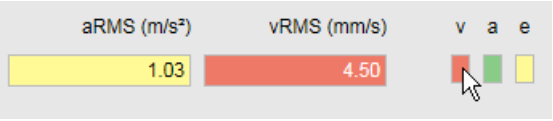
Correctly calculated values are highlighted using different background colors to indicate any limit transgressions.

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. You can use the mouse to jump to a trend for: • Speeds • vRMS, aRMS, DKW, peak value, AUX channel	

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. v = velocity spectrum v(f) a = acceleration spectrum a(f) e = envelope spectrum env(f)	

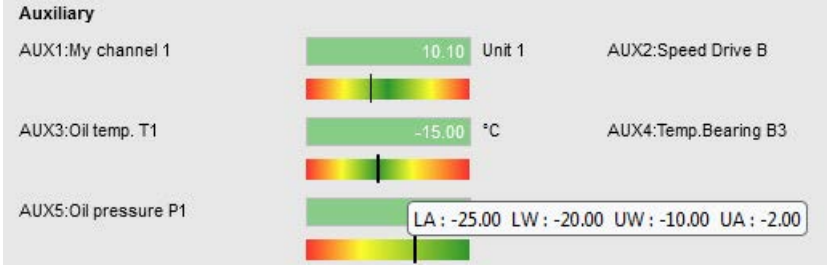
Recording raw data

Save the current measured values as raw data in a file via the "Start" button.

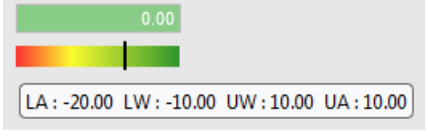
Tooltip

When the mouse pointer is moved on the measured value display, activated alarm and warning values are displayed as tooltip information.

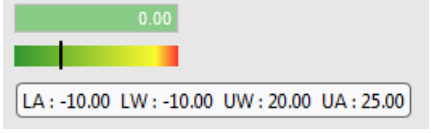
For the AUX channels, it is possible to set up to 4 levels of limit values, e.g. to monitor the permissible temperature range of the machine.



If only lower limit values are required, the upper limit values (UW and UA) must have the same value.



If only upper limits are required, the same applies. If they have the same value, the lower limits (LA and LW) are disabled.

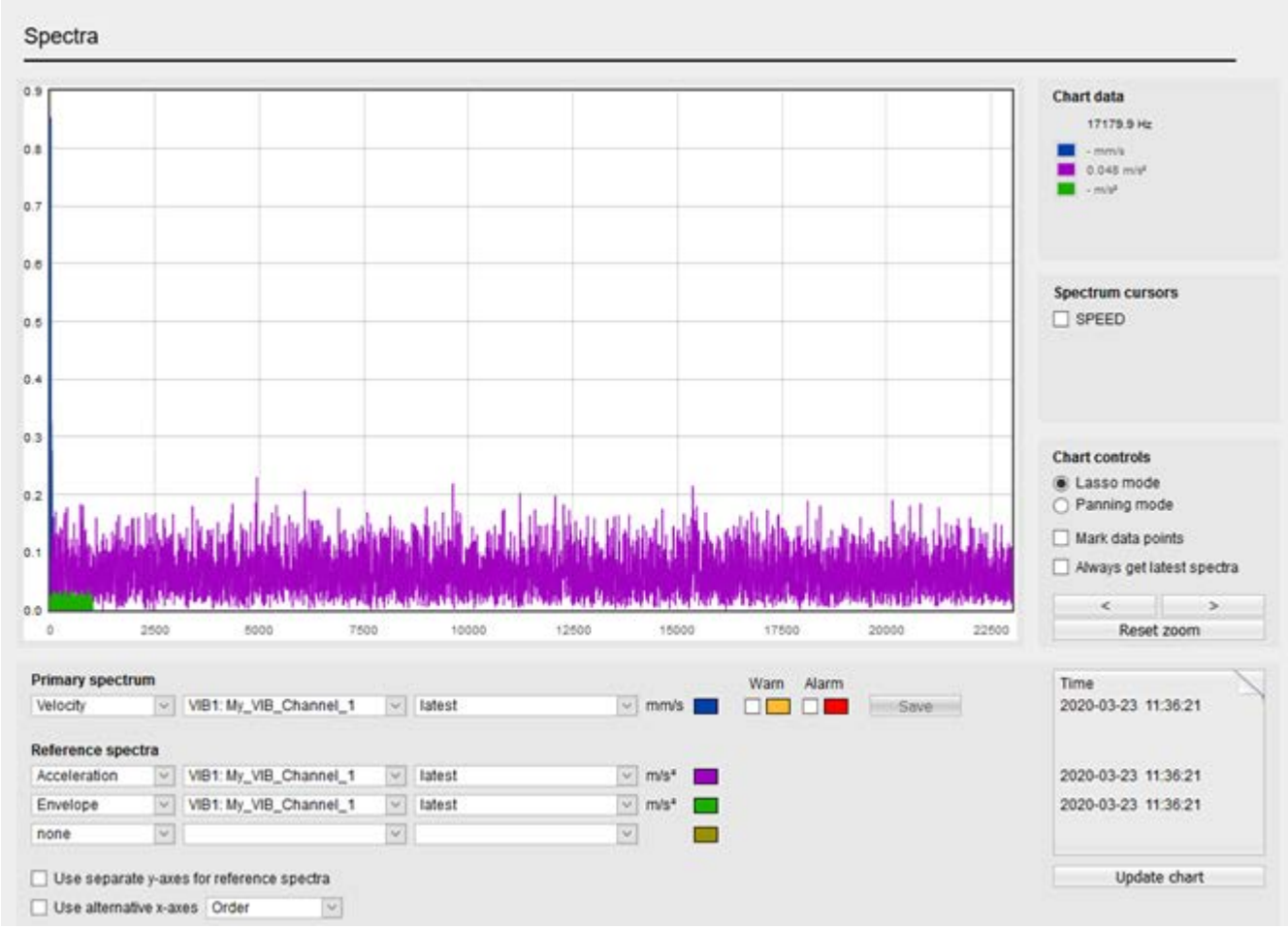


11.3.4.2 Spectra

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. If the background color is orange, the calculation was performed with values outside of the measuring range.

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.

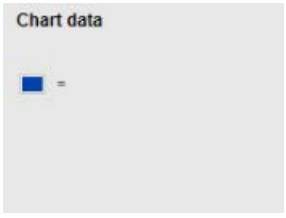
Saving a fingerprint

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. Click the button to page through the following displays: Time stamp, aRMS, vRMS, speed.

Chart data

	The frequency 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 values will be displayed.

Cursor

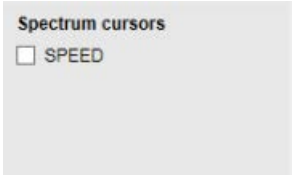
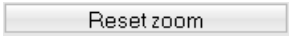
	For the selected primary spectrum, you can display markings in the charts based on the associated speed and the currently stored bearing type: • For all spectra: Speed cursor (with multiples) • For envelope spectrum: Bearing fault frequencies (with multiples) Meaning of the abbreviations: BPFO: **B**all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

Chart controls

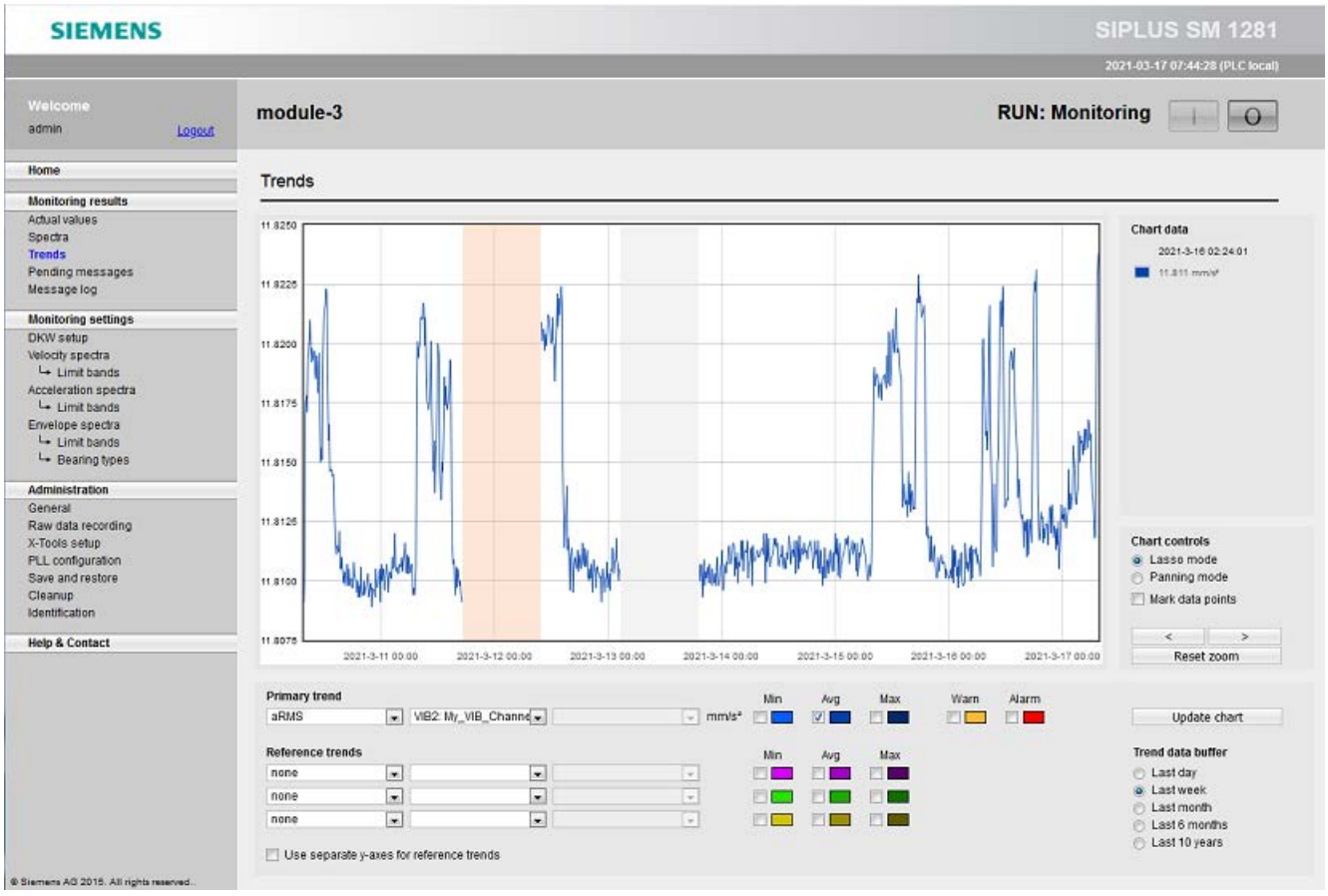
	**Lasso mode:** You show a magnified view of a specific section using the mouse wheel or lasso (drag the rectangle over the required area using the left mouse button).
	Panning mode: In this mode, you can pan the area of the screen being displayed holding the left mouse button down.
	Mark data points: Highlight / hide curve interpolation points.
	Always get latest spectra: Active (checkbox selected): Cyclic updating of the displayed spectra 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. **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 range.
	Apply settings and update chart display

11.3.4.3 Trends

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

Optionally, vRMS, aRMS, DKW or associated peak value, AUX value, speed and recorded spectrum 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

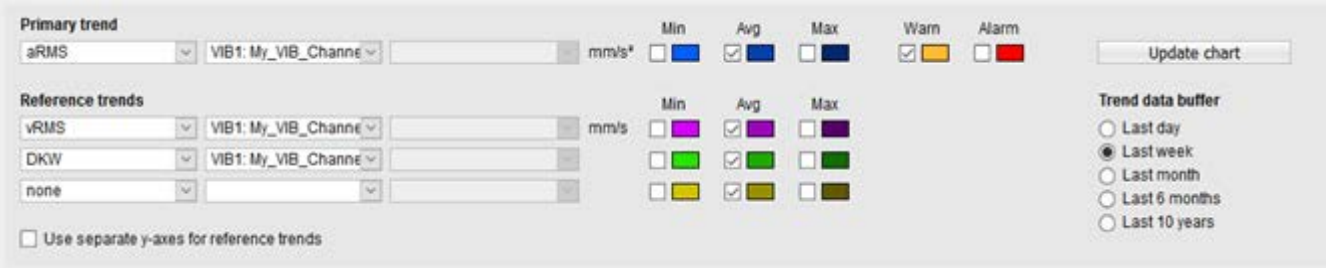
Trend values are displayed in the trend chart when the SM 1281 is in RUN mode and the measured values are in the valid measuring range. If there are gaps in the display (figure), it is due to the following states and properties. If the background color of the gap is white, the module was in STOP mode. In case of an orange background, the module was in RUN mode, but the measured values were in the invalid measuring range. In case of a gray background, the module was in RUN monitoring disabled mode.

Primary trend, reference trends

For the display of trend curves select:

- Any channel-related measured value as a primary value, e.g. aRMS on VIB1,
- Up to 3 further channel-related values as reference values, e.g. vRMS on VIB2.

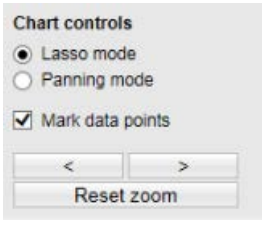
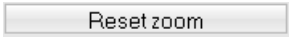
Recorded spectra trends are selected by choosing the spectrum (envelope, acceleration, velocity), the channel (VIB1 - VIB4) and the trend name (assigned by the user to the corresponding limit bands). If you select RMS or speed instead of a spectrum in the line concerned, the fields for trend names remain grayed out and disabled.



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:** To zoom in on a specific section, use the mouse wheel or lasso to drag a rectangle with the left mouse button over the desired area. This zoom setting is retained if the chart is updated. 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. Select a smaller time range for this.
	Panning mode: In this mode, you can pan the area of the screen being displayed holding the left mouse button down. "Panning mode" can only be active if "Lasso mode" is inactive.
	Mark data points: Highlight / hide curve interpolation points. 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.

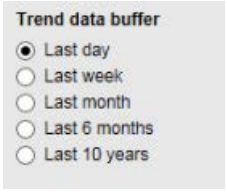
	Define here the time range from the trend data memory to be displayed. The smaller the time range chosen, the finer the time resolution of the data and therefore the greater the precision. • Last day: 1 minute (lowest resolution - high accuracy) • Last week: 10 minutes • Last month: 30 minutes • Last 6 months: 3 hours • Last 10 years: 24 hours (highest resolution - low accuracy)

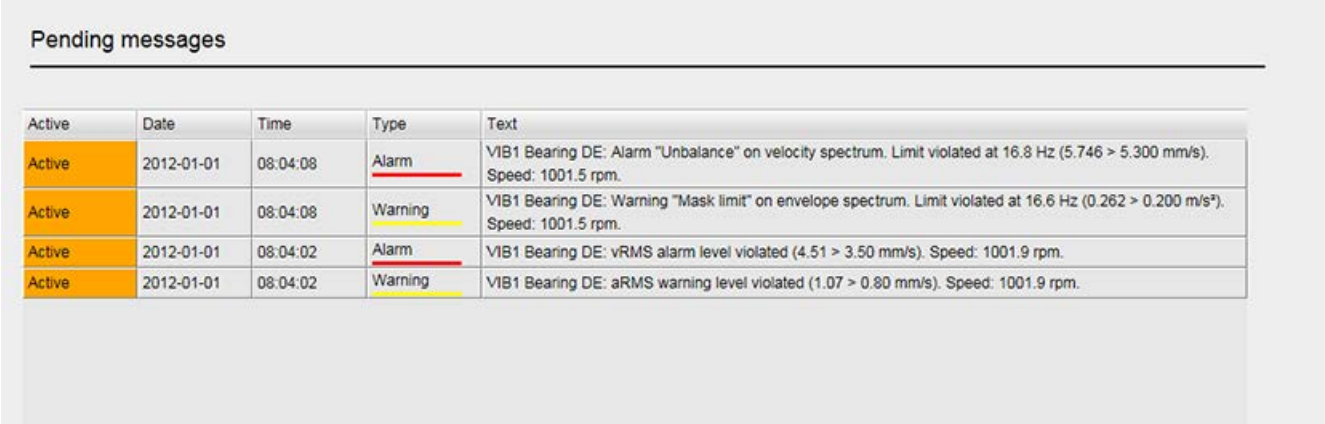
Chart data

	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.

11.3.4.4 Pending messages

All currently active messages are displayed on this website.

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



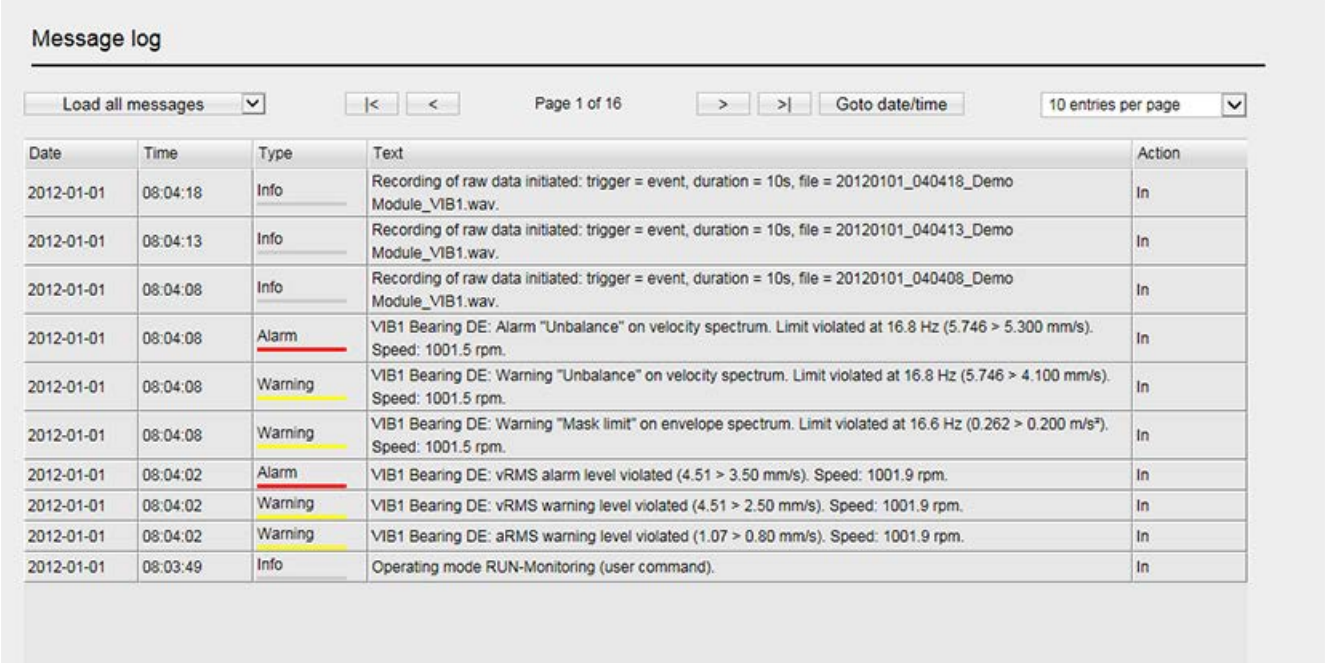
The list of messages is sorted by the time of creation of the message, most recent first.

11.3.4.5 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).

11.3.5 Monitoring configuration

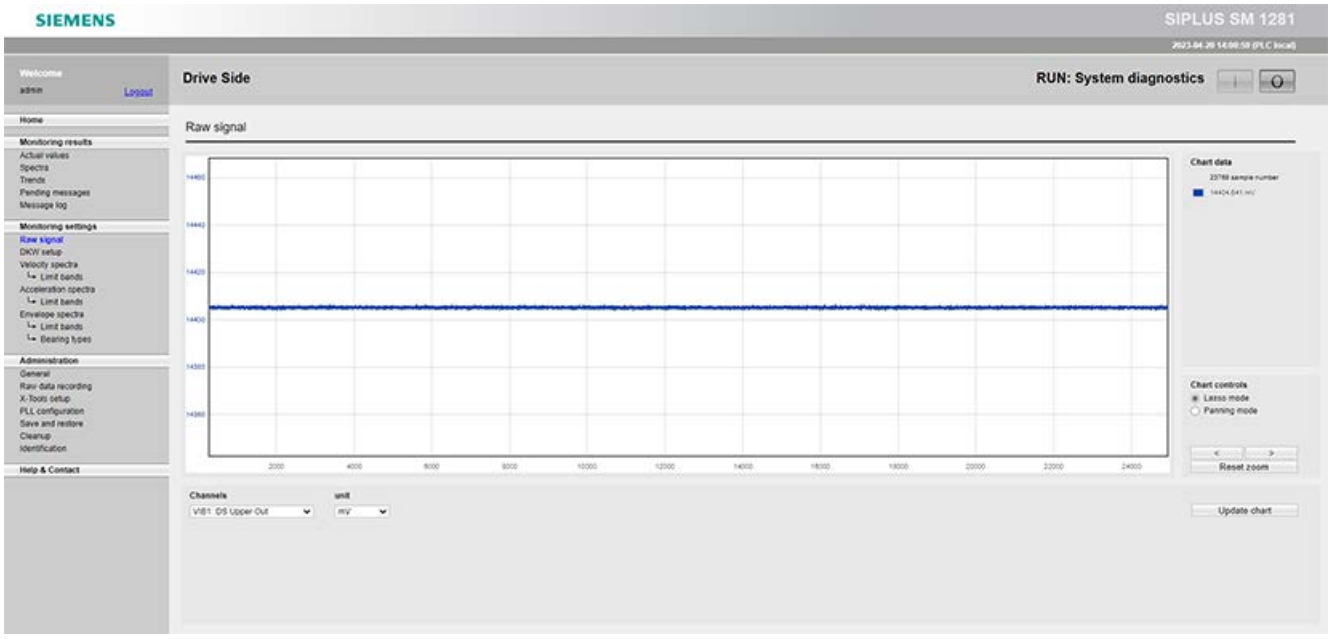
The **monitoring settings** encompass the websites which you need for setting the parameters for the monitoring algorithms and for defining the monitoring responses.

Three spectra are available for monitoring:

- Velocity spectrum (Page 170)
  - Velocity spectrum > Limit bands (Page 171)
- Acceleration spectrum (Page 175)
  - Acceleration spectrum > Limit bands (Page 177)
- Envelope spectrum (Page 180)
  - Envelope spectrum > Limit bands (Page 181)
  - Envelope spectrum > Bearing types (Page 184)

11.3.5.1 Raw signal

On the "Raw signal" page, you can check the quality of the signal at the connected sensor by viewing it directly. By selecting a channel and then refreshing, a 10 second snapshot of the signal is graphically displayed. This function can only be used in RUN: System diagnostics.



11.3.5.2 DKW

On the page "DKW settings" you can define DKW reference values and view teaching results.

To open the page, click "Monitoring settings > DKW" in the navigation area.

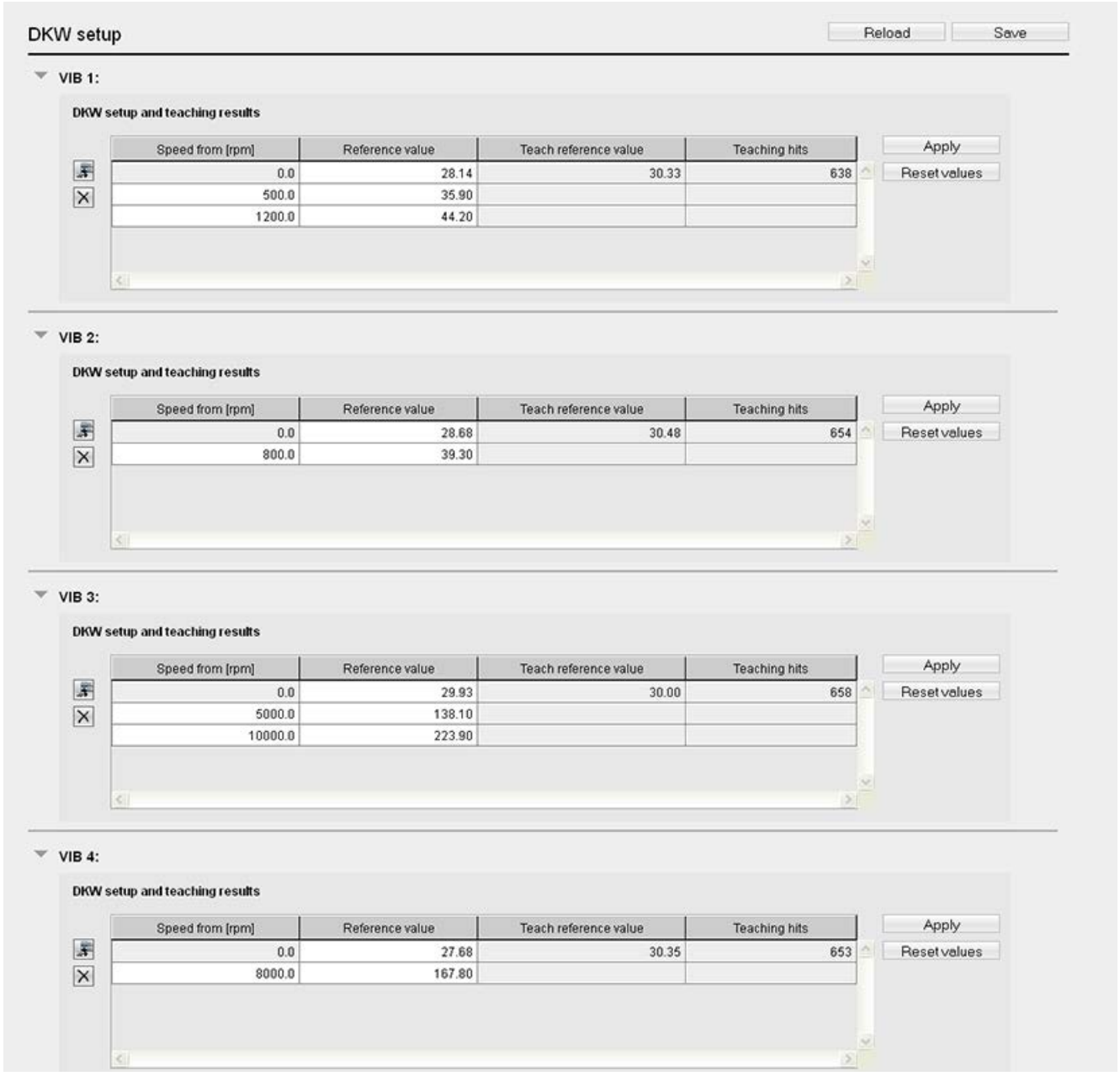


Figure 11-2 DKW setup

DKW setup and teaching results

To specify the speed-dependent reference values, the corresponding rows must be added to the table. The acquired speed of the monitored plant is assigned to the row with the next lowest speed value in each case. The reference value saved in this row is then used for calculation of the DKW. The row for speed "0" is entered by the system. If a measured speed cannot be assigned to one of the entered speeds, it will be entered in row "0". This row cannot be deleted and the value 0 for the speed cannot be changed.

The reference values determined from teaching can be used for DKW calculation.

Even without using "Measuring mode (RUN: Measuring)", reference values can be manually entered and saved in the table.

Note

The teaching reference values are automatically determined and continuously saved in measuring mode (RUN Measuring). Only by actuating the Apply button are the teaching reference values applied as the reference value for the DKW calculation.

The values calculated during the teaching process are updated cyclically. The "Teaching hits" column contains the number of calculated reference values that were determined at this speed, for each speed range. You can apply the reference values obtained by teaching with the "Apply" button.

With "Reset values," you can delete the teach values obtained. For each vibration channel, up to 1000 teaching results per speed range are saved in the device. Following "Reset", 1000 measurements are again available per speed range.

Note

Applying a changed speed distribution

Please note that when the speed distribution is changed, settings must be saved by clicking the "Save" button. Otherwise the last settings saved will be used for teaching.

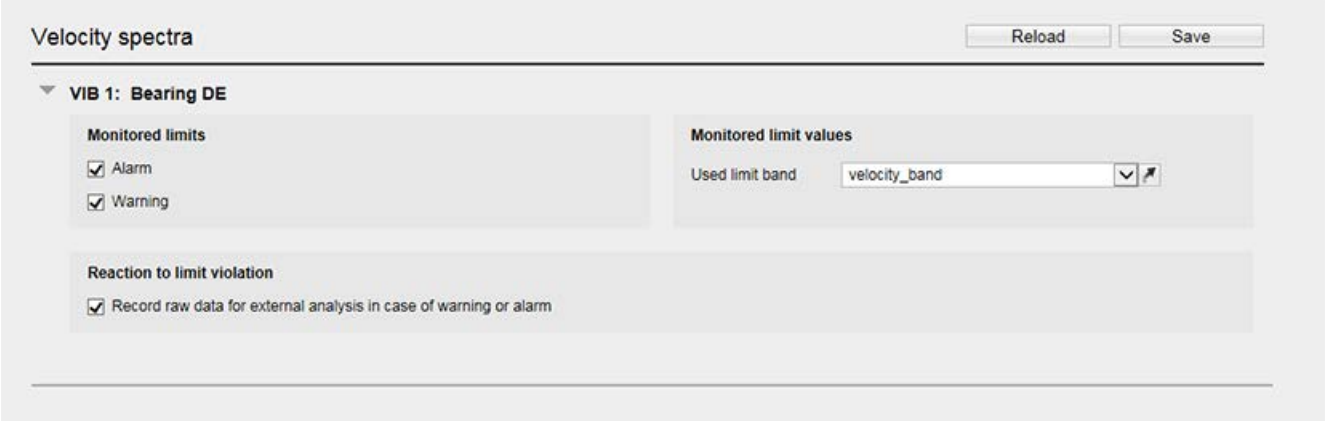
NOTICE
Teaching The teach values reflect the current state. Bearing damage existing at the time of the teach is measured as reference value. It is therefore necessary to monitor the trend curve of the DKW. If the teaching process is performed with a new, intact bearing, the teach value can be designated as good state.

11.3.5.3 Velocity spectra

On the "Velocity spectra" page, you can activate the limits and define the associated limit bands.

Note

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

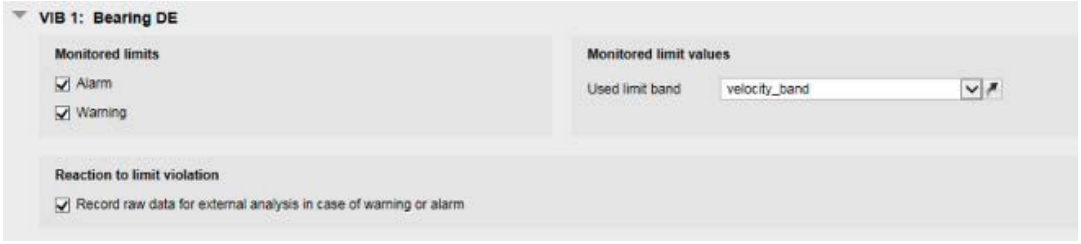


Monitored limits

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 171). 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

11.3.5.4 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

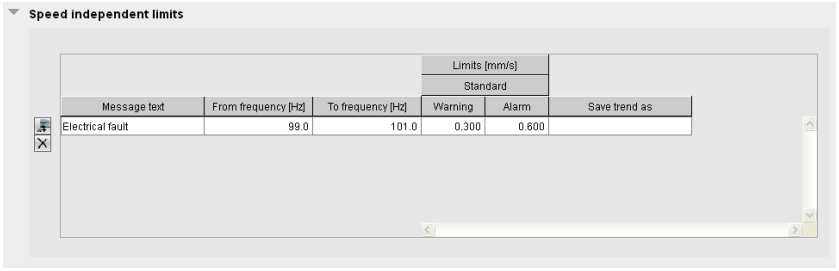
Here you define the hysteresis (Page 64) for the limit bands. This value applies to the entire limit band defined here.

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.

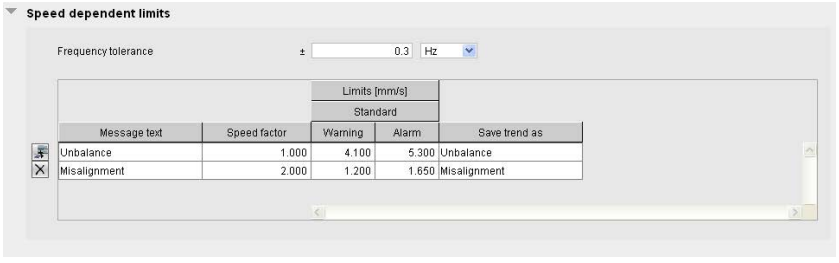
Speed-dependent limits

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 A new row is always added at the end of the table.
	Deleting a row 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

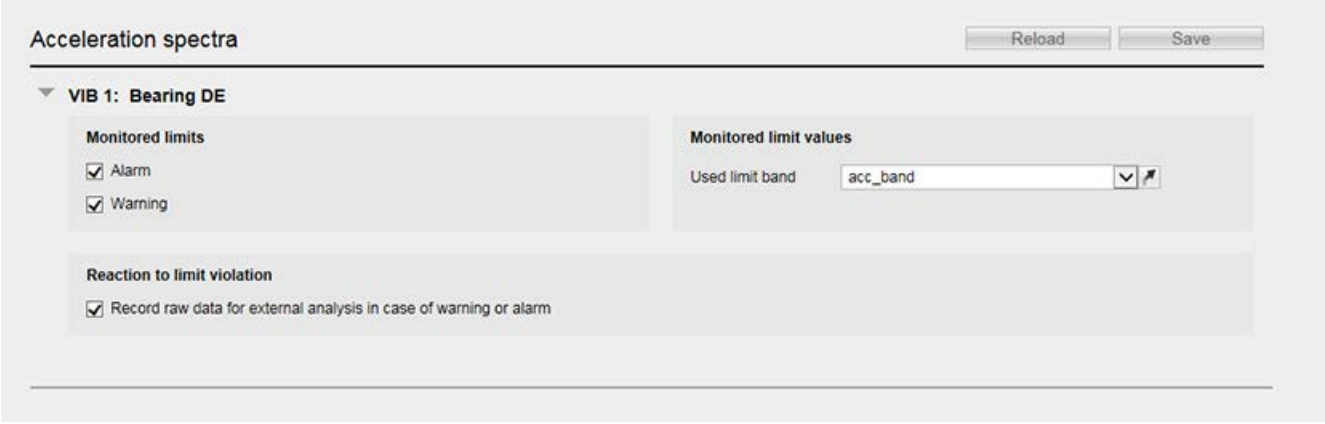
Save the trends under the names that you have not used yet. If you save a trend under a name that has already been used, it may be possible that outdated values are still saved under this name.

11.3.5.5 Acceleration spectra

On the "Acceleration spectra" page, you can activate the limits and define the associated limit bands.

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 177). 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

11.3.5.6 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 64) for the limit bands. The value applies to all the limit bands defined here.

You can specify the value in m/s^2 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.

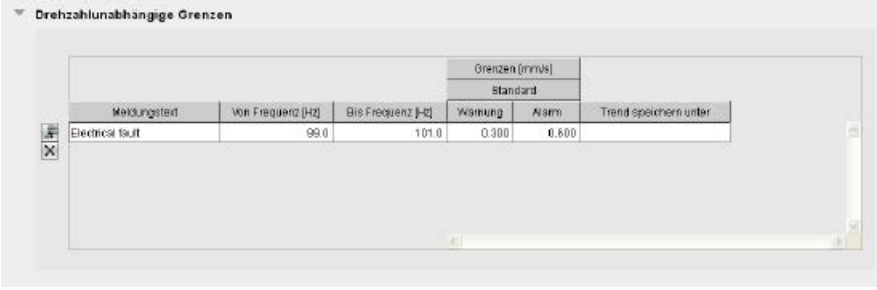


Figure 11-3 Speed-independent limits

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.

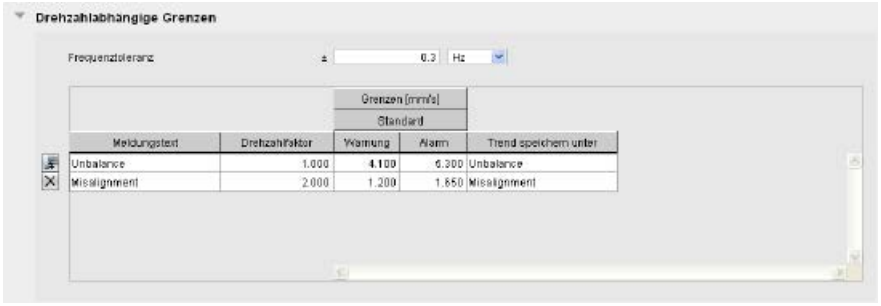


Figure 11-4 Speed-dependent limits

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 A new row is always added at the end of the table.
	Deleting a row 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.

Button	Meaning
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.

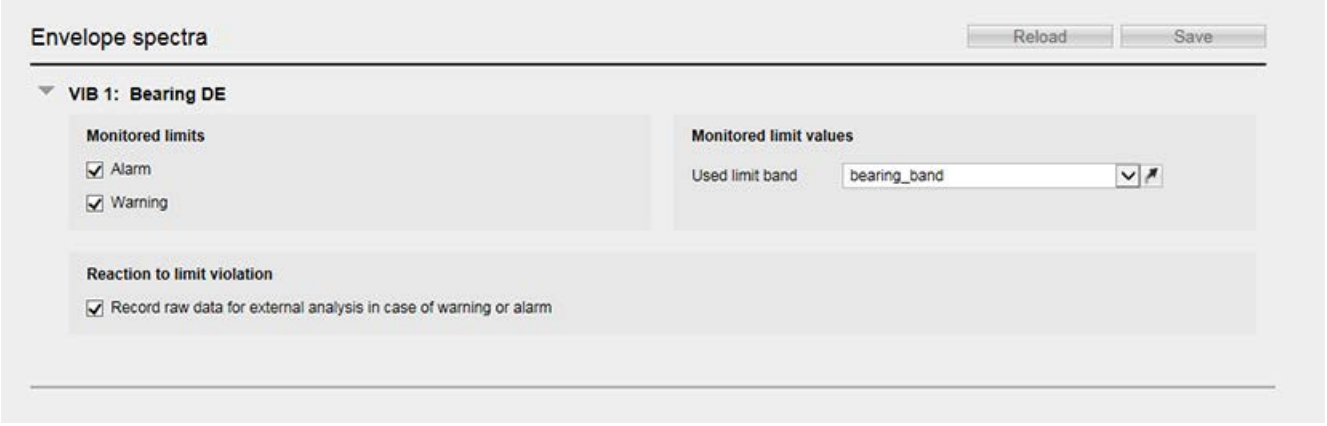
Trend name assignment

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.

11.3.5.7 Envelope spectra

On the "Envelope spectra" page, you can activate the limits and define the associated limit bands.



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 181). 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

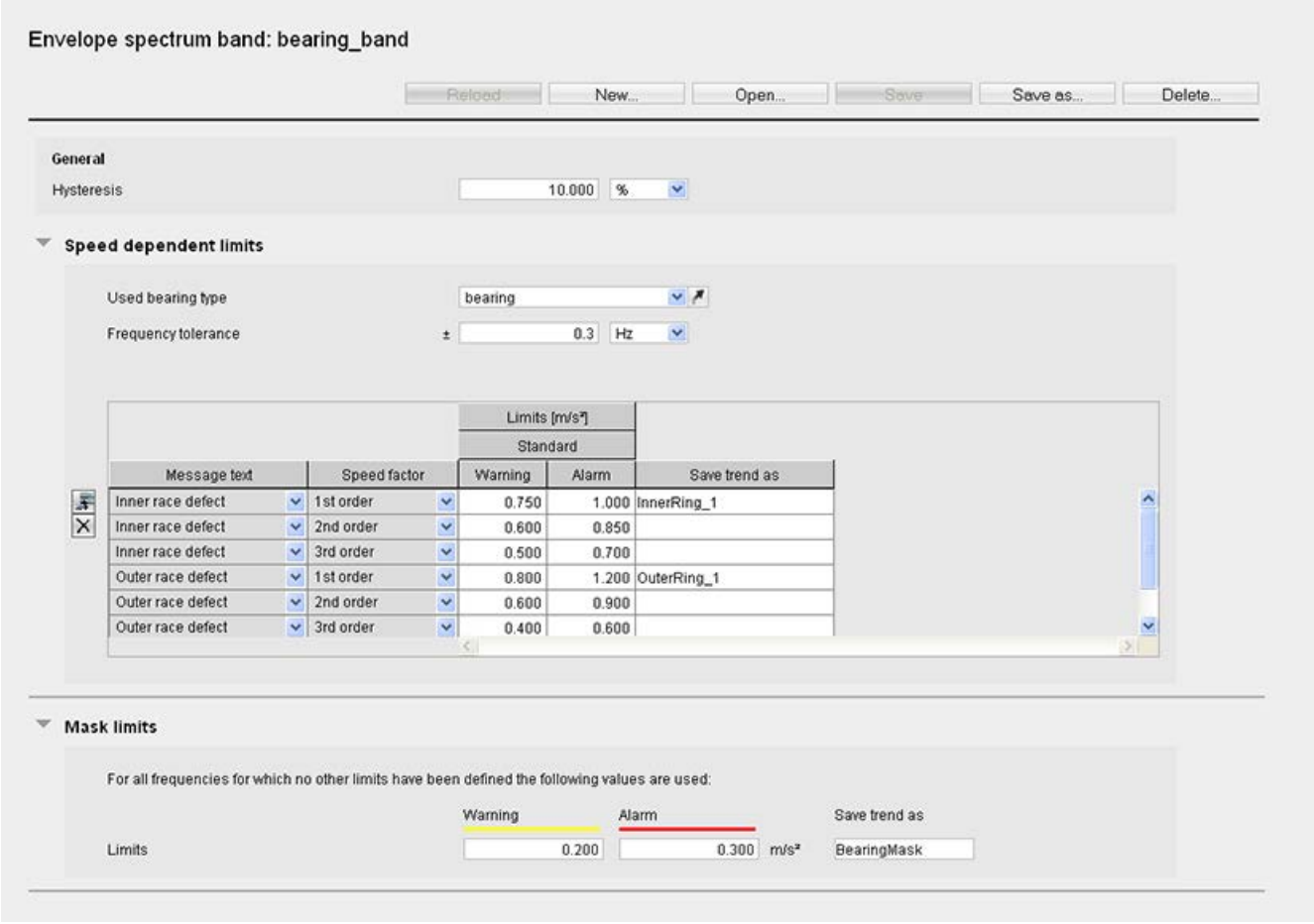
Here you activate the response to a limit violation.

- Start raw data recording

11.3.5.8 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 64) 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 184).

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

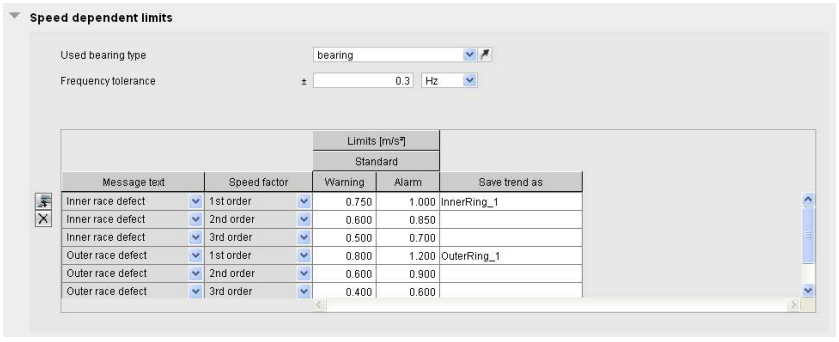
The frequency tolerance can be specified absolutely in hertz or relatively as a percentage. It states the band around a certain frequency in the spectrum that will be monitored for limits. The default value for the frequency tolerance is ±0.3 Hz.

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 A new row is always added at the end of the table.
	Deleting a row 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

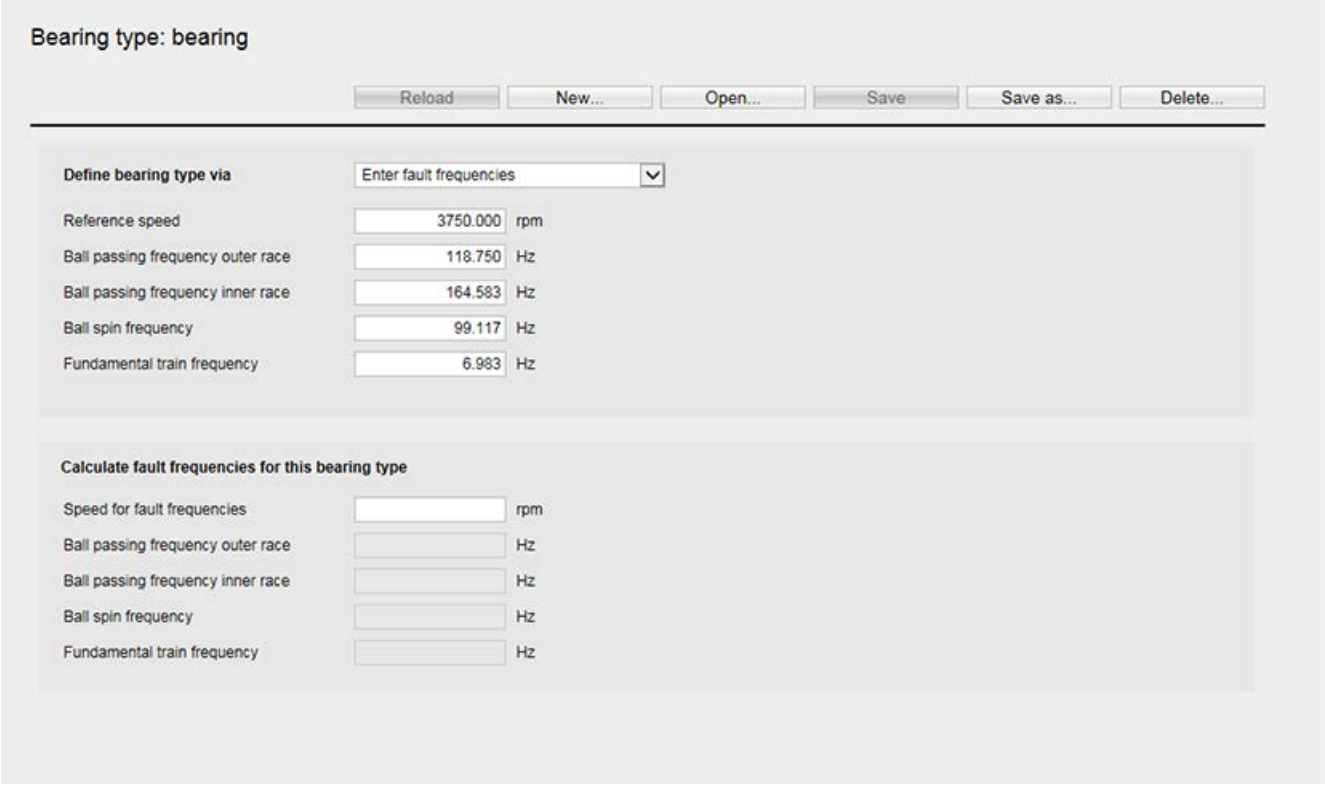
Save the trends under the names that you have not used yet. If you save a trend under a name that has already been used, it may be possible that outdated values are still saved under this name.

11.3.5.9 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 monitoring defined in the limit bands (for example 1st-order frequency outer race defect) is based on the assigned fault frequencies for the bearing type

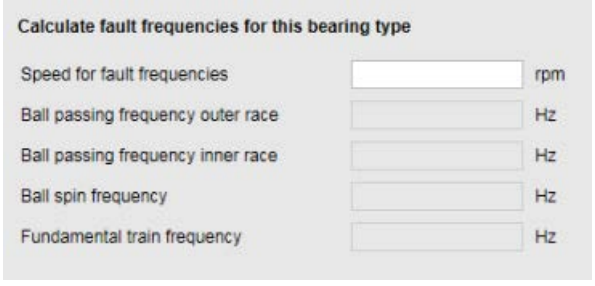
To open the page, click "Monitoring settings > Envelope spectra > Bearing types" in the navigation area.



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

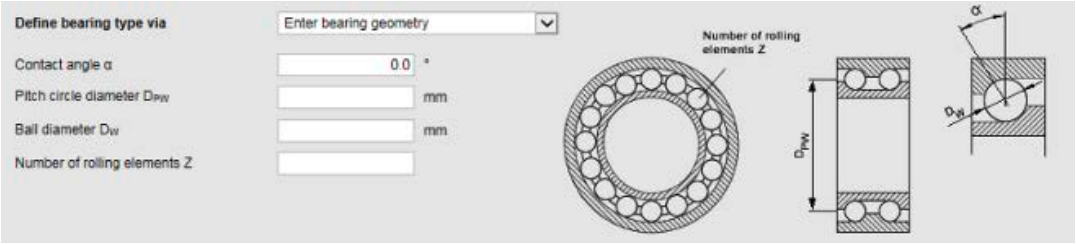
Direct entry of the fault frequencies



For direct entry of frequencies, you enter a speed as the reference value and the corresponding 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_{pW}
- Ball diameter D_W
- Number of balls Z

Fault frequency calculator

The "Bearing types" menu contains a fault frequency calculator. After a speed ("Speed of shaft/axis") has been entered, the fault frequencies for outer race, inner race, 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.

11.3.6 Administration

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

- General (Page 187)
- Save and restore (Page 191)
- Cleanup (Page 195)
- Identification (Page 197)

Note

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

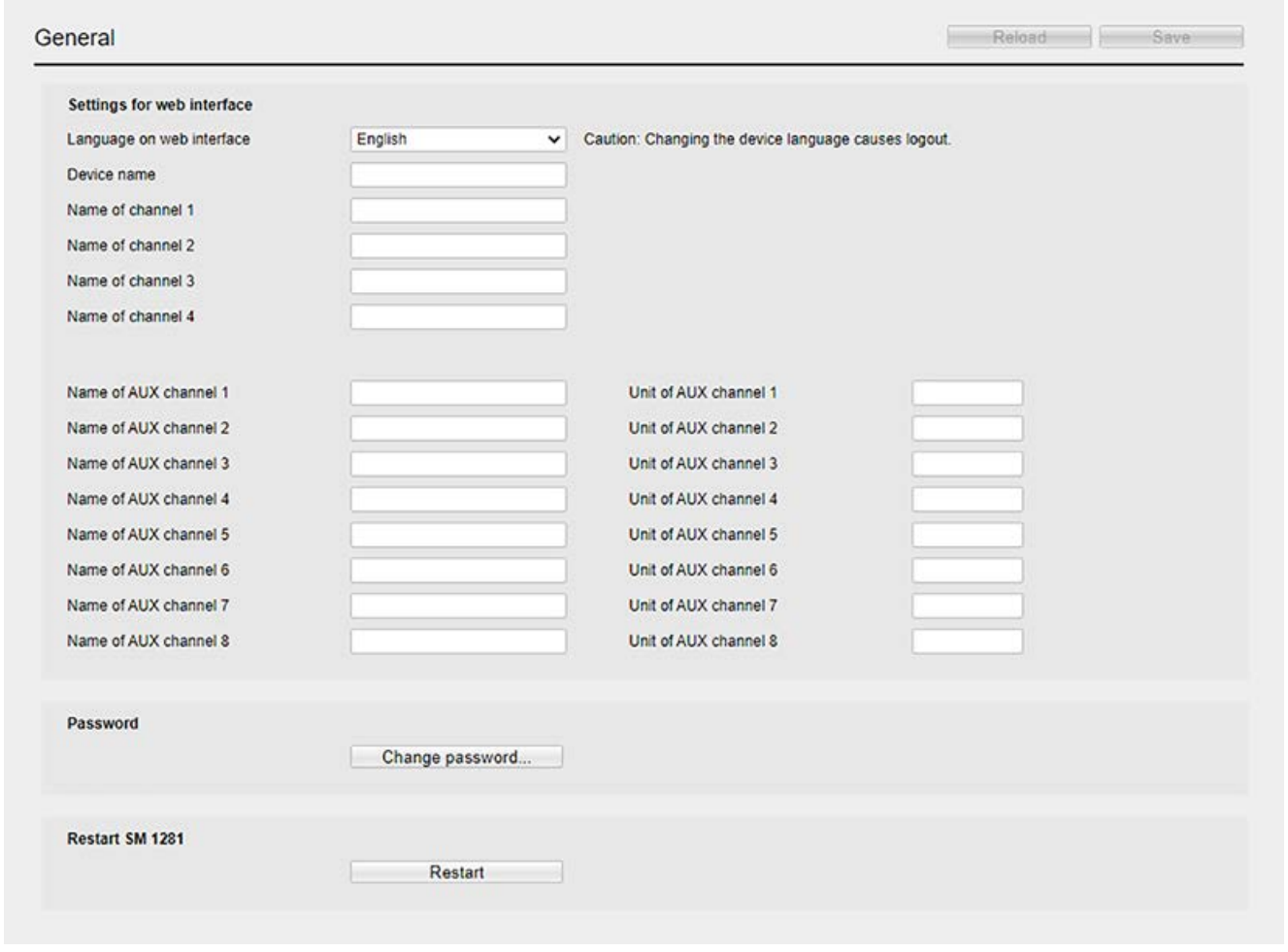
See also

Factory settings and default settings (Page 197)

11.3.6.1 General

Make general administrative settings on the "General" page. Click "Save" to save inputs.

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



Web interface settings

- Device name: Enter the name of the device. This will appear in the title area and on the page Identification (Page 197).
- Device language: Switch the language of the web interface between English and German. A change of languages logs off the user.
- Name of the channel: Enter the name of the vibration or AUX channel.
- Unit of the AUX channel: Enter the unit of the corresponding AUX channel.

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 the new password. Additionally, 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

The configuration/parameterization cannot be changed on the web interface without entering the password. If the password has been lost, the S7 program can be used to reset the password to the default value "0000".

Therefore, keep your password safe!

Restarting SM 1281

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

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.

11.3.6.2 Raw data recording

You can define the settings for "Raw data recordings" and automatic FTP transfer on the "Raw data recordings" page.

To open the page, click "Administration > Raw data recordings" in the navigation area.

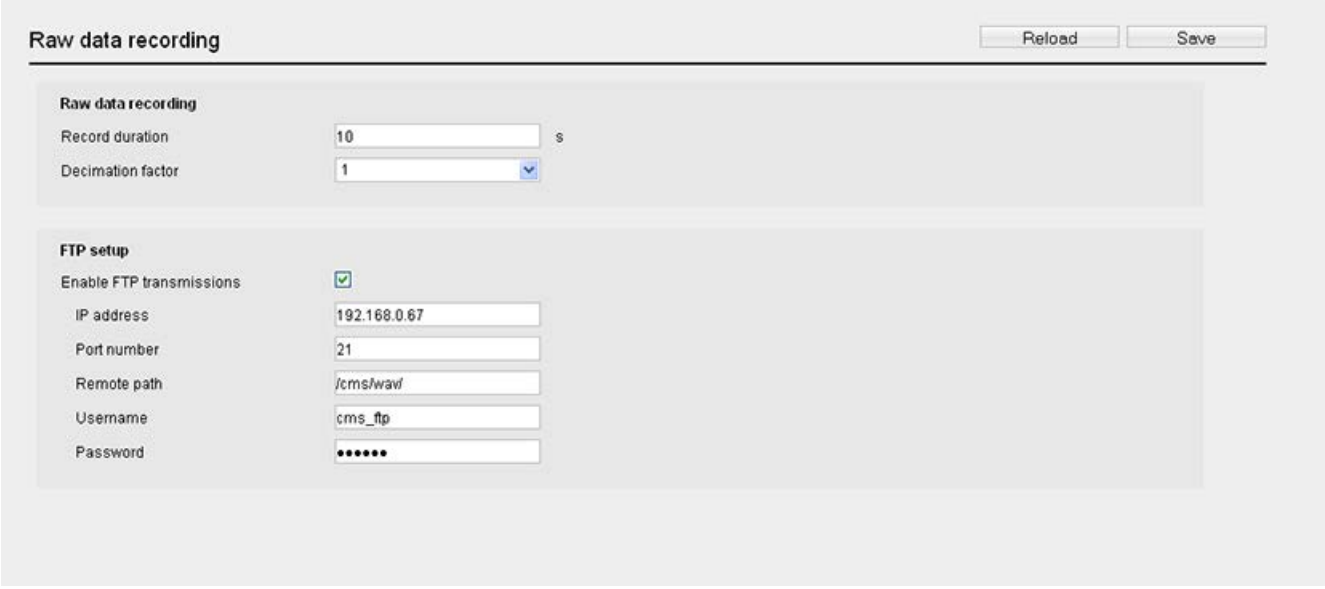


Figure 11-5 Raw data recording

Raw data

- Recording duration: You can enter 1 to 90 seconds.
- Decimation factor: The decimation reduces the sampling rate and therefore the size of the raw data file. This means that more raw data recordings are possible. The maximum recording duration is independent of the decimation factor.

FTP settings

Here, you can make the settings for an automated FTP transfer of the raw data. All existing raw data files, which are operating class specific, are transferred to the set FTP server during this transmission and then deleted from the memory of SM 1281. The FTP transmission is triggered using the S7 interface.

- Activate FTP transmission: This option is used to activate the automatic transmission of raw data via FTP.
- IP address: The IP address of the target FTP server.
- Port: The port of the target FTP server.
- Target path: Here you set the storage patch on the target FTP server.
- User name: The user name on the target FTP server for authentication.
- Password: The password for authentication on the target FTP server.

Note

The FTP file transfer protocol works unencrypted with data transmission and authentication (user name and password) taking place unencrypted over the network.

Please note that the FTP file transfer protocol allows only one connection at a time.

11.3.6.3 X-Tools settings

On the "X-Tools" page, you set the parameters for the online data interface to X-Tools.

To open the page, click "Administration > X-Tools" in the navigation area.

Figure 11-6 X-Tools settings

The port addresses for the command and data connection to X-Tools can be freely assigned. The following port addresses are set as defaults:

Command port	51010
Data port	51011

Save: The SM 1281 must be in STOP for this purpose.

In operating mode "RUN: X-Tools", X-Tools can establish a connection to SM 1281.

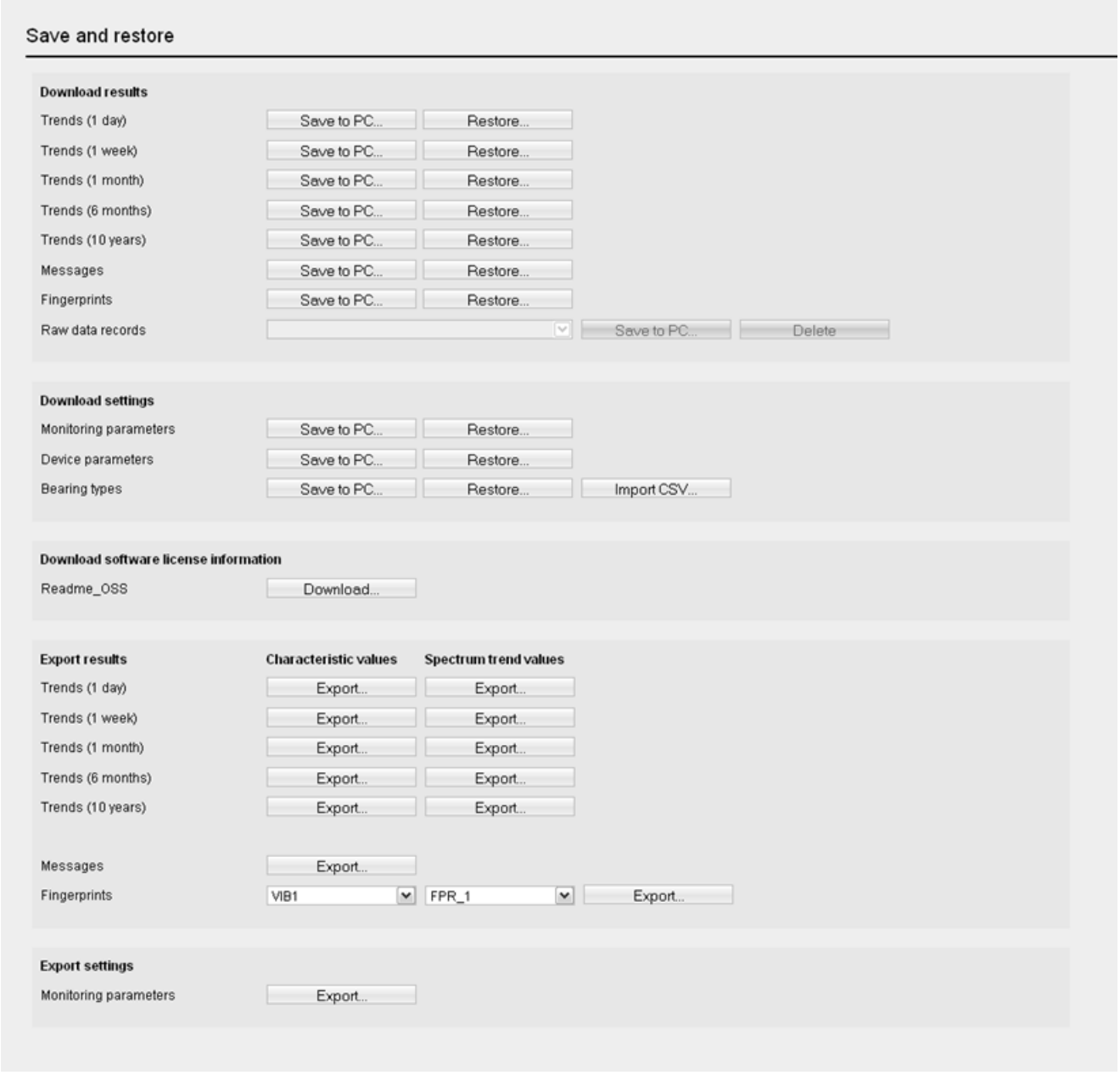
An active connection with X-Tools is indicated under "Pending messages" as a status display.

11.3.6.4 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 analytical 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. • Downloading raw data: Select a file from the list of existing files and click the "Save to PC..." button next to it. • Deleting raw data: 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. In addition to uploading and downloading the database of bearing types, you can click the "Import CSV ..." button to include a CSV file with additional bearing types to the existing database.

Importing a file with bearing types as a CSV file

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

A UTF 8 coded data record must be created for each bearing 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 bearing 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 r/min)

The name of the bearing 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 bearing types.

SM 1281 reports the successful import of the data in the alarm log of the web server. For additional information, see Message log (Page 165).

Exporting results

The measuring results of the system can be exported for further processing using these functions. For this purpose, the buttons can be used to download the corresponding data as CSV files.

Trends	This CSV file contains the trend values of the respective time period. The trends are subdivided once again into characteristic values (aRMS, vRMS, DKW, aPeak, speed) and spectrum trend values.
Messages	Messages created based on events, e.g. limit value violations.
Fingerprints	The selected fingerprint is saved in this CSV file.

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.

11.3.6.5 PLL configuration

On the "PLL configuration" page, you can set the parameters for the speed acquisition via PLL. To open the page, click "Administration > PLL Configuration" in the navigation area.

The center frequency is the start value of the speed calculation and should be close to the expected speed.

The loop gain is the internal gain factor. A higher factor leads to faster adaptation to the actual speed. If the value is too high, the PLL result can fluctuate. If it is too low, the actual speed may not be able to be reached.

The D-frequency is the limit frequency of an internal low-pass filter of the PLL.

Save: The SM 1281 must be in STOP for this purpose.

Recommendation: Use only one PLL speed source per module.

11.3.6.6 Cleanup

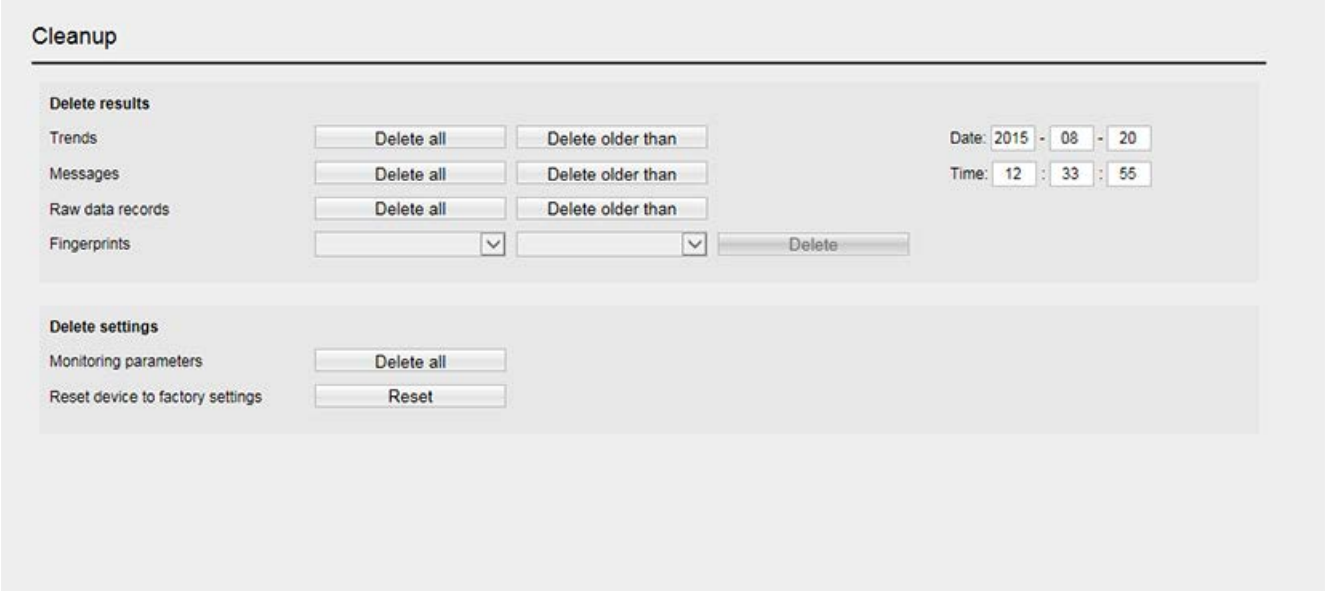
On the "Cleanup" page, you can delete unneeded data from the device or reset the device to the factory settings.
The following data can be deleted:

- 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 11- 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.
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")

11.3.6.7 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.

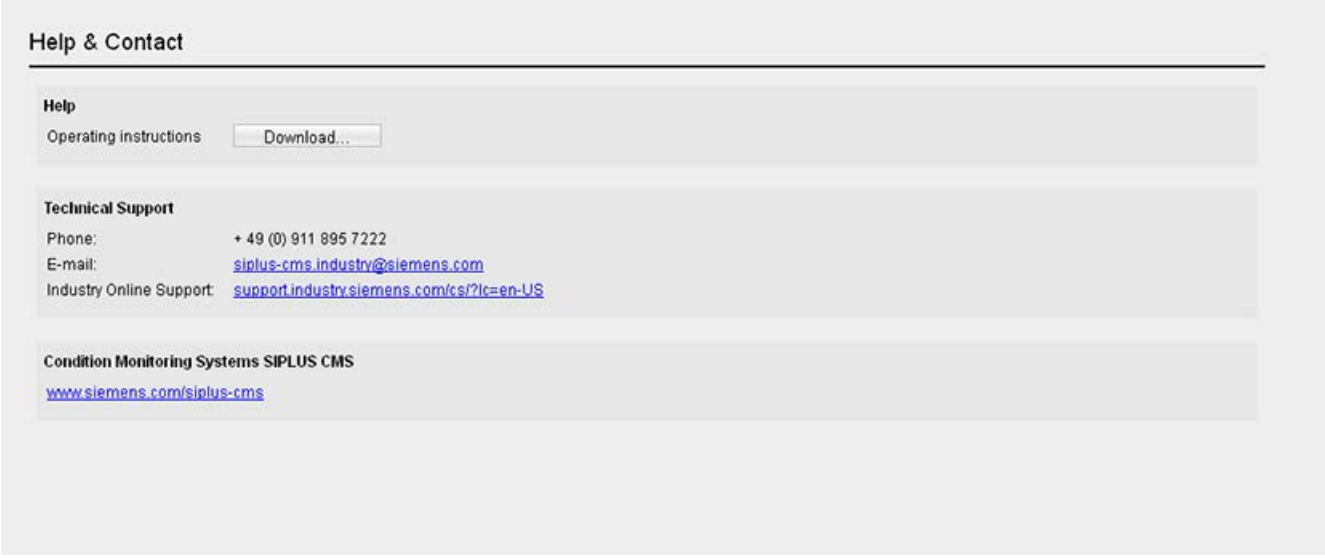
Display parameters

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. This name can be changed on the General (Page 187) 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. The identification depends on the compatibility settings of the browser

11.3.7 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.



11.3.8 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

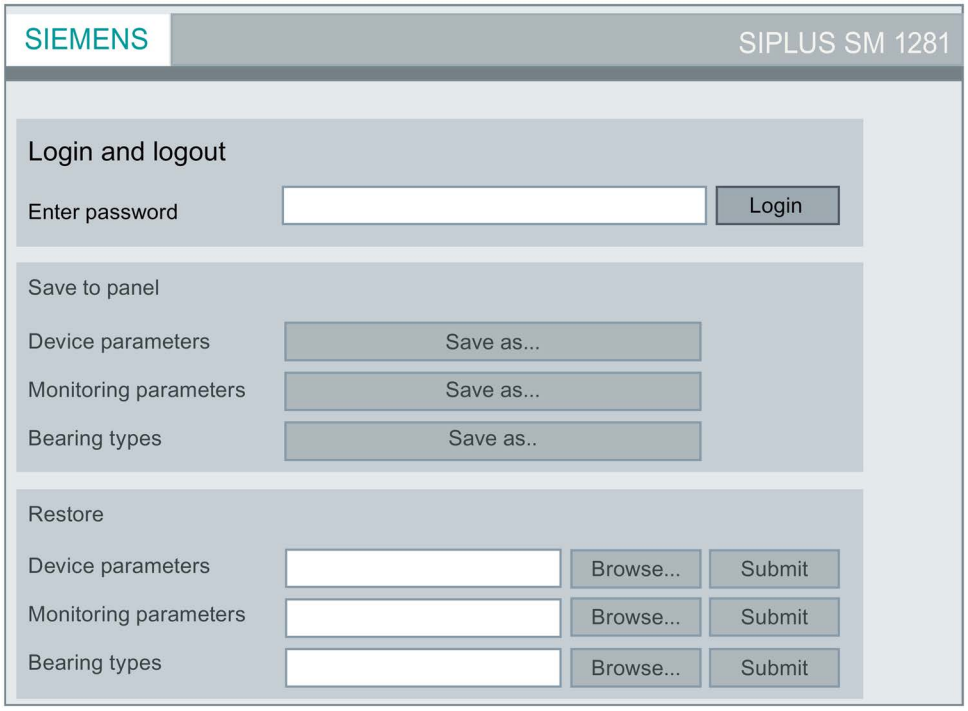


Figure 11-7 Mobile website SM 1281

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 using 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 12

12.1 Firmware installation

12.1.1 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/ww/en/view/36932465).

12.1.2 CM firmware update

The firmware for the device is supplied as the file "sm1281.cab" on request. Use the communciation channels specified under AUTOHOTSPOT 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 section Save and restore (Page 191). 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 sections Data transfer over WebDAV (Page 74) or Data exchange via FTP (Page 76).
   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 that the supply voltage is not interrupted during firmware updates.

NOTICE
If a CM-FW update is performed, it must be ensured that the compatible S7 firmware for this CM-FW is also installed, and the compatible S7 library blocks must be integrated in the S7 user program.

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 214)".

In this case, perform the update procedure again.

You will in this case file the file "Update.log" in the update directory of the SM 1281. This file contains information about the update process and is for Siemens Support should the problem persist.

12.1.3 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).

12.2 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 191).

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/ww/en/view/36932465)).
3. Disassembling the device from the DIN rail. Proceed in the reverse order to that described in section Assembly (Page 91).
4. Installing and connecting the new device.
5. Restore (Page 191) the CMS databases on the device.

Replacement of modules with different firmware versions

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

You can find additional information in the overview (Page 53).

Additional information

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

12.3 Transferring configuration data backup to the SM 1281

Requirement

- The SM 1281 is connected to a PC via Ethernet.
- The backup of the SM 1281 configuration data is available.

Transferring configuration 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
The transfer of impermissible files can lead to a malfunction of the device.
Only transfer databases to the SM 1281 that have also been exported from an SM 1281 device with the same firmware version.

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

   To do this, use WebDAV (Page 74) or FTP (Page 76) or the Save and restore (Page 191) 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 187) website.

12.4 Recycling and disposal

For environmentally friendly recycling and disposal of your old equipment, contact a certified electronic waste disposal company or dispose of the equipment according to the applicable regulations in your country.

SM 1281 is recyclable due to its low-pollutant components.

NOTICE
• Dispose of products described in this manual in compliance with the valid national regulations. • 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 (https://www.automation.siemens.com/partner):

Process and system messages, error handling 13

13.1 Status LEDs

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)	Off	■	• Correct operation • Channel deactivated
		Illuminated red	■	• Vibration sensor of the respective channel faulted • Short-circuit or interruption of the sensor line • Channel activated, no sensor connected

13.2 S7 diagnostics alarms

Diagnostics alarms

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

Table 13- 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 Cause: Sensor overload Measure: Check the sensor operating point	Wire break in a sensor cable	Check the wiring of the connected sensor.

Diagnostic interrupt	Cause	Measure
Lower limit violated Cause: Sensor underload Measure: Check the sensor operating point	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". • The update of the "CMFirmware" was not successful. • 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. • Repeat the CM firmware update. • 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.

13.3 SM 1281 Web server messages

Error messages

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

Table 13- 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.

Message text	Cause	Measure
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. Reinstall the current firmware if required.
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. You will find details in the "update.log" file in the update directory of the SM 1281.	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 13- 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	-

Message text	Description	Remarks
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 section Operating mode: "ERROR: System not ready" (Page 214)
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.	-
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.
<AUX channel>: AUX warning lower limit violated (<actual value> > <threshold>).	The lower AUX warning level was violated on the specified AUX channel.	The current AUX value, the exceeded threshold.
<AUX channel>: AUX alarm lower limit violated (<actual value> > <threshold>).	The lower AUX alarm level was violated on the specified AUX channel.	The current AUX value, the exceeded threshold.
<AUX channel>: AUX warning upper limit violated (<actual value> > <threshold>).	The upper AUX warning level was violated on the specified AUX channel.	The current AUX value, the exceeded threshold.
<AUX channel>: AUX alarm upper limit violated (<actual value> > <threshold>).	The upper AUX alarm level was violated on the specified AUX channel.	The current AUX value, the exceeded threshold.

Message text	Description	Remarks
<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: - Speed not acquired - Speed unstable - Speed less than 120 r/min - Vibration acquisition disturbed
<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: - Speed not acquired - Speed unstable - Speed less than 120 r/min - Vibration acquisition disturbed
<VIB channel>: DKW monitoring failed.	DKW monitoring could not be successfully run on the specified vibration channel; monitoring is no longer running.	Possible causes: - Speed not acquired - Speed unstable - Speed less than 120 r/min - 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: - Speed not acquired - Speed unstable - Speed less than 120 r/min - 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: - Speed not acquired - Speed unstable - Speed less than 120 r/min - 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: - Speed not acquired - Speed unstable - Speed less than 120 r/min - Vibration acquisition disturbed
Recording of raw data <Operation> <Further information>	Raw data recording was started, has failed, etc.	-

Message text	Description	Remarks
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.	-
User is logged in (admin).	A user has logged in successfully as "admin".	-
User is logged out (admin).	The user "admin" was logged out.	-
Login attempt failed.	A login attempt has failed.	-
Password was changed (admin).	The password of the user "admin" was changed successfully.	-

13.4 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 165). The current error situation is explained in more detail here.
- A firmware update may be possible; see CM firmware update (Page 203) (in some cases re-installation of the firmware currently running).
- 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

14

14.1 Technical specifications SM 1281

Technical specifications SM 1281

Article number	6AT8007-1AA10-0AA0
General information	
Product type designation	SM1281
Product description	S7-1200 module for the monitoring of vibrations on mechanical components based on parameters and frequency-selective analysis functions
Installation type/mounting	
Mounting type	Rail or wall mounting
Mounting position	Horizontal, vertical
Recommended mounting position	Horizontal
Supply voltage	
Rated value (DC)	24 V
permissible range, lower limit (DC)	20.4 V
permissible range, upper limit (DC)	28.8 V
Input current	
Current consumption, typ.	200 mA
Current consumption, max.	250 mA
from backplane bus 5 V DC, typ.	80 mA
from backplane bus 5 V DC, max.	85 mA
Power loss	
Power loss, typ.	4.8 W
Memory	
Total memory capacity	1 Gbyte
Hardware configuration	
Design of hardware configuration	Modular, up to 7 modules per CPU
Digital inputs	
Number of speed inputs	1
Input voltage	
• Rated value (DC)	24 V
Sensor input	
Number of IEPE sensor inputs	4
Sampling frequency, max.	46 875 Hz
Interfaces	
Type of data transmission	Export of raw data as WAV file for further analysis (e.g. using CMS X-Tools) can be downloaded via browser/FTP, online data transfer to CMS X-Tools
Ethernet interface	Yes
Protocols	

Article number	**6AT8007-1AA10-0AA0**
Bus communication	Yes
Web server	
• HTTP	Yes
Interrupts/diagnostics/status information	
Alarms	
• Diagnostic alarm	Yes
Diagnostics indication LED	
• for status of the inputs	Yes
• for maintenance	Yes
• Status indicator digital input (green)	No
Integrated Functions	
Monitoring functions	
• Monitoring of the sensor inputs	Yes; Cable break and short-circuit
• Vibration characteristic monitoring via RMS value of the vibration speed	Yes
• Vibration characteristic monitoring via RMS value of the vibration acceleration	Yes
• Vibration characteristic monitoring via diagnostic characteristic value	Yes
• Frequency-selective monitoring via vibration speed spectrum	Yes
• Frequency-selective monitoring via vibration acceleration spectrum	Yes
• Frequency-selective monitoring via envelope curve analysis	Yes
Measuring functions	
• Physical measuring principle	Vibration acceleration
Measuring range	
– Measurement range vibration frequency, min.	0.1 Hz
– Measurement range vibration frequency, max.	23 000 Hz
Standards, approvals, certificates	
Certificate of suitability	CE
CE mark	Yes
China RoHS compliance	Yes
Ambient conditions	
Free fall	
• Fall height, max.	0.3 m; five times, in product package
Ambient temperature during operation	
• horizontal installation, min.	-20 °C

Article number	**6AT8007-1AA10-0AA0**
• horizontal installation, max.	60 °C
• vertical installation, min.	-20 °C
• vertical installation, max.	45 °C
Ambient temperature during storage/transportation	
• Storage, min.	-40 °C
• Storage, max.	70 °C
• Transportation, min.	-40 °C
• Transportation, max.	70 °C
Air pressure acc. to IEC 60068-2-13	
• Operation, min.	795 hPa
• Operation, max.	1 080 hPa
• Storage/transport, min.	660 hPa
• Storage/transport, max.	1 080 hPa
Relative humidity	
• Operation, min.	5 %
• Operation, max.	95 %
• Condensation permissible	No
Software	
Browser software required	Web browser Mozilla Firefox (ESR31) or Microsoft Internet Explorer (10/11)
Connection method	
required front connector	Yes
Design of electrical connection	Screw connection
Mechanics/material	
Material of housing	Plastic: polycarbonate, abbreviation: PC- GF 10 FR
Dimensions	
Width	70 mm
Height	112 mm
Depth	75 mm
Weights	
Weight, approx.	260 g

14.2 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) • Nominal range	 -3.0 V ... +3.0 V
Operating point voltage (DC) of the sensors • Raw data • aRMS calculation	 +9.0 V ... 12.0 V +9.5 V ... 11.5 V
Constant current supply (DC) • Nominal range • Typical	 +4.1 mA ... 4.55 mA +4.35 mA
Input resistance	> 10 MΩ
Input frequency range • Raw data	 0.5 Hz to 23 kHz
Resolution	0.1526 mV (= 5V / 2^{15})
coupling	DC
Crosstalk attenuation (CTA) • Channel to channel with f = 1 khz	 -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 • 0.5 Hz to 2 kHz • 1 kHz to 23 kHz	 ±2 % (typ. ±1 %) ±3 % (typ. ±2 %)
AC accuracy acceleration RMS value • 5 Hz to 1 kHz	 ±2 % (typ. ±1 %)
Temperature-based DC and AC measurement	±50 ppm/K
Linearity errors • DC measurement • AC measurement	 ±0.1 % ±1 % (typ. ±0.5 %)
Galvanic isolation	No; specified by individual sensors at the process end
Cable break detection:	Yes
Cable short-circuit detection	Yes

Measuring inputs	Value
Common-mode rejection (working voltage) • Raw data • Acceleration RMS value:	 > 68 dB > 56 dB
Maximum speed with DI as speed source	16000 r/min

Filter characteristic curve analog inputs

The following diagram shows the amplitude-frequency response (with antialiasing) for the analog inputs of the SM 1281.

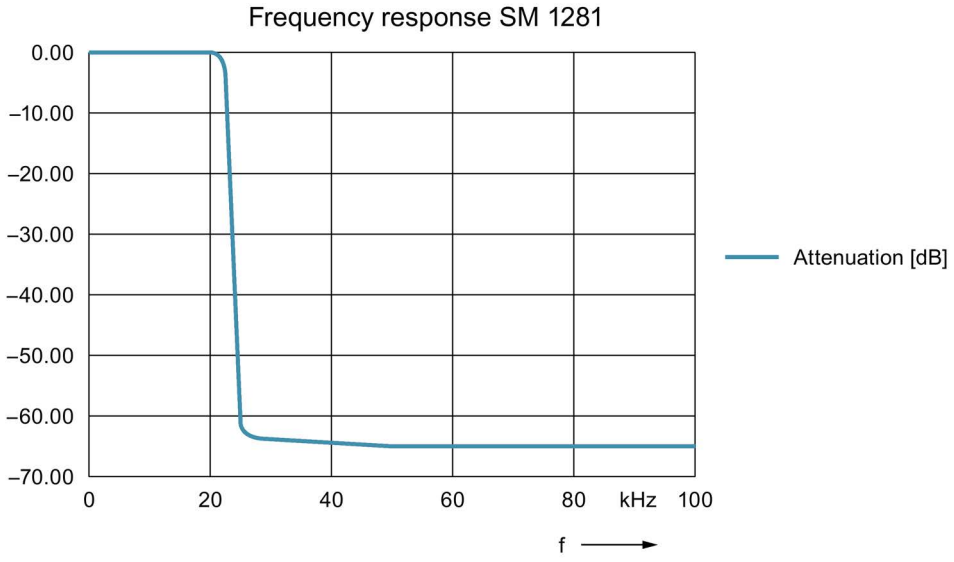


Figure 14-1 Filter characteristic curve for analog inputs of SM 1281

14.3 Dimensional drawing

Dimensional drawings of the SM 1281 Condition Monitoring

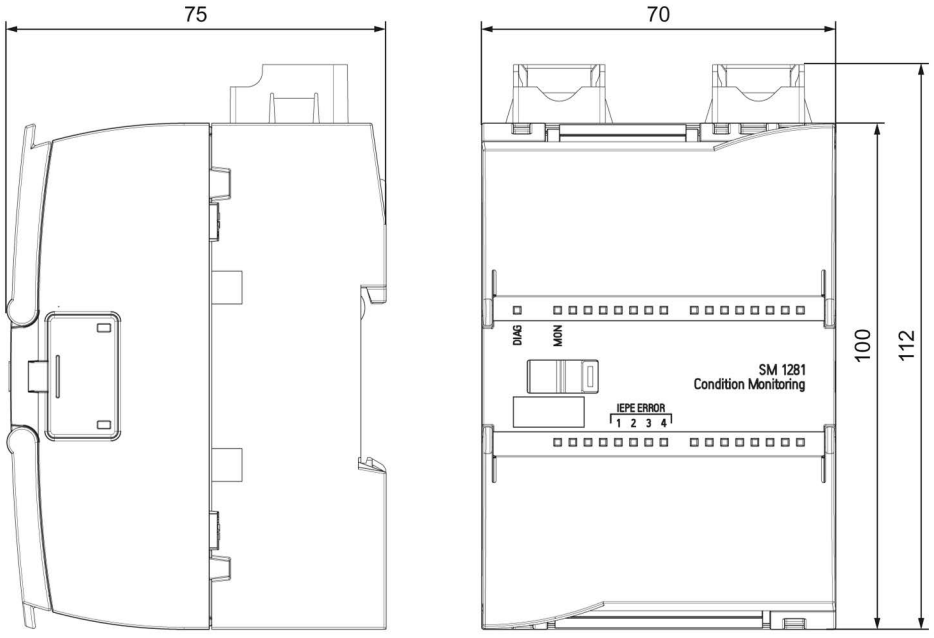


Figure 14-2 Dimensional drawings SM 1281

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 (https://support.industry.siemens.com/cs/ww/en/view/36932465).

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
MC HQ
Frauenauracher Str. 80
DE-91056 Erlangen
GERMANY

Approvals

- CE
- UL 508

- CSA C22.2 No. 14
- KC
- RCM

Marine approval

- DNV GL
- Lloyds Register (LRS)
- Polish Register (PRS)
- ClassNK
- American Bureau of shipping (ABS)
- Korean Register (KR)

Further applied standards

- IEC 61131-2 / 2007
- IEC 61010-1 / 2010 + C1 (2011) + C2 (2013)

A.2 Contact address

Contact address

Siemens AG
MC HQ
Frauenauracher Str. 80
DE-91056 Erlangen
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 191).

Sources under the GNU General Public License are provided to you free of charge on request. Use the communication channels specified under AUTOHOTSPOT to do this.

More information

Siemens:
www.siemens.com/simatic

Industry Online Support (Service and Support):
www.siemens.com/online-support

IndustryMall:
www.siemens.com/industrymall

Siemens AG
Digital Industries
Motion Control
Postfach 31 80
91050 ERLANGEN
Germany

A5E36912747