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SAFETY MANUAL

vibro-meter®

SpeedSys300 ODS301 overspeed detection system (ODS)

SIL Safety

This document contains important information about products that are intended for use in safety-related applications.

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For more information about the SpeedSys300 ODS301 overspeed detection system (ODS), and other Meggitt vibro-meter® products, visit the Meggitt vibro-meter® Energy website at www.meggittsensing.com/energy.
For more information about the SpeedSys300, SpeedSys 200 and other ISTEC products, visit the ISTEC website at www.istec.com.

IMPORTANT NOTICE

This product has been tested according to the listed standards. If the product is used in a manner not specified by manufacturer the degree of protection may be impaired. Therefore, this user manual must be read completely, carefully and all safety instructions must be followed.

Meggitt / ISTEC has made every effort to include all specific safety-related instructions and warnings in this manual, but the completeness and accuracy of this data cannot be guaranteed. Not all possibilities or situations are described in this manual. Before using this product, the user must evaluate it and determine its suitability to the intended application.

This manual is written for operators and integrators of the SpeedSys product. All operating personnel is expected to follow the specific safety related procedures and all applicable other (general) safety procedures. Operating personnel is assumed to have the necessary technical training and proven competence to enable them to install the product correctly and safely.

In case of unsafe, inexpert or irregular use, Meggitt / ISTEC will decline any liability or warranty claims.

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Table of contents

1. Safety instructions

In addition to the present safety manual, the documentation also consists of the operating (user) manual. This safety manual does not replace the operating manual!

- *SpeedSys300 ODS301 overspeed detection system (ODS) user manual* (Meggitt vibro-meter® document reference MAODS301/E).

MODELS

This functional safety manual applies to the SpeedSys300 ODS301 overspeed detection system (ODS), from Meggitt's vibro-meter® product line. Where this manual refers to *SpeedSys*, it refers specifically to the SpeedSys300 ODS301.

DISCLAIMER

The device is only approved for the intended use as defined in this safety manual. In case of violation, all manufacturer's responsibility and warranty will expire.

The user is responsible for planning, installation, commissioning, operation and maintenance.

Only qualified personnel may carry out installation, commissioning, operation and maintenance. The personnel must be familiar with the operating manual and safety manual.

QUALIFIED PERSONNEL

are persons who are familiar with the documentation of the device, as well as with the installation, commissioning, operation and maintenance of the device and have the appropriate qualifications for their work. For example:

- Training, instruction or authorization to operate and maintain devices/systems in accordance with the standard of safety technology for electrical circuits, high pressures and aggressive and hazardous media.
- For devices with explosion protection: training, instruction or authorization to carry out work on electrical circuits for potentially explosive systems.
- Training or instruction in accordance with the standard of safety engineering in the maintenance and use of appropriate safety equipment.

2. Specification of functionality and failure types

Introduction

SpeedSys is an industrial and professional overspeed protection system intended for heavy and/or (semi-)critical machinery in the oil, gas and process industries, but can also be used on wind or hydro turbines or any similar application. It forms an independent layer and is meant to be placed inside a field cabinet.

SpeedSys is a one channel transmitter and is designed to be compatible with the three most commonly used rotational speed probes; eddy current (proximity), Hall-effect and electromagnetic (VR/MPU). Only one of these three types can be connected per transmitter. For generating trip signals every transmitter has two fast-signalling energized-closed safety relays (SIL 2). Additionally, for warning or status signals every transmitter has two status/alarm relays (non-safety) and one digital output (non-safety, SpeedSys300 ODS301 only). These outputs can all be individually configured. Moreover, SpeedSys allows for additional monitoring and tailing equipment to use a SIL 2 rated 4-20 mA analog output, a frequency output and/or a Modbus RTU RS-485 connection (SpeedSys300 ODS301 only).

Analog output (current loop signal, 4-20 mA)

The analog output represents the measuring signal in the form of a 4 to 20 mA current loop signal. The maximum load of 600 Ω allows a current of 22 mA at an output voltage of 13.2 V.

In the **safe state** the current of the analog output is limited to < 3.6 mA.

Relay output (alarm output)

The relay output represents the result of a limit check of the measuring signal as a switching output. The maximum ratings are given in the operating manual.

In **safe state** the relay contact opens (NO contact, in safe state de-energized).

2.1 Interfaces

The device is equipped with the following **safety relevant interfaces**:

- Measuring input, internally redundant:
  - 2-wire voltage input, connectors B01, B02 (B03, B04 bridge)
  - 3-wire voltage input, connectors B05, B06, B07
  - 2-wire current input, connectors B09, B10.
- Analog output (current loop), connectors A13, A14.
- Relay output 1/2, connectors B17, B18 / B19, B20 and B21, B22 / B23, B24.

The device is equipped with the following **non-safety relevant interfaces**:

- Supply input, connectors A17, A18 and A21, A22.
- Relay output 3/4, connectors B13, B14 and B15, B16.
- Digital frequency output, connectors A15, A16.
- Digital input, connectors C13, C14 (SpeedSys300 ODS301 only).
- Digital output, connectors C15, C16 (SpeedSys300 ODS301 only).
- RS485 interface, connectors C17, C18, C19 (SpeedSys300 ODS301 only).
- USB configuration Interface (USB-B mini).

2.2 Assumptions and limitations

The FMEA was based on the following **assumptions**:

- The failure rates of the considered components are based on the Siemens standard SN 29500.
- The analysis was based on average industrial environmental conditions:
  - Average environmental temperature 40 °C
  - The device is mounted stationary.
  - The failure rates are constant, attrition is not taken into account.
- The failure rates of the other components (other than the SpeedSys) in the safety loop are not included.

The following **restrictions** apply to the application:

- The single device may only be used in an application that requires a safety integrity level of 2 (SIL 2) or less.
- The single device may only be used in an application where the demand rate of the safety function is less than once a year (low demand).
- The device may only be used in an application that allows a hardware fault tolerance of 0 (HFT 0).
- The device may only be used in an application where the allowable mean probability of failure on demand (PFDG) for the device is up to 17e−3 (device claims 18 % of the total failure rate of SIL 2).

3. Safety characteristics and device configuration

Safety parameters	
SIL level	2
Systematic capability (SC)	3
Mode	Low demand / Demand mode
Device type	B
Hardware fault tolerance	0
Safety function reaction time	Tm + 8 ms (measuring time + HW response time)
Safety function response time including system diagnostics	5 h (duration of RAM check)
Error rate (safe)	479 FIT
Error rate (dangerous, detected)	608 FIT
Error rate (dangerous, undetected)	28 FIT
SFF value (safe failure fraction)	97 %
Proof test interval	10 years
PFDG (10 y, 40 °C, MTTR 72 h)	1.7e−3

Device configuration	
Board designation	SpeedSys 200: (A), (B) SpeedSys300 : (A), (B), (C)
Board revision	2020-10
Schematic revision	0.14.0
Firmware designation	SSY master, SSY slave
Firmware revision	1.20 (master), 1.0 (slave)

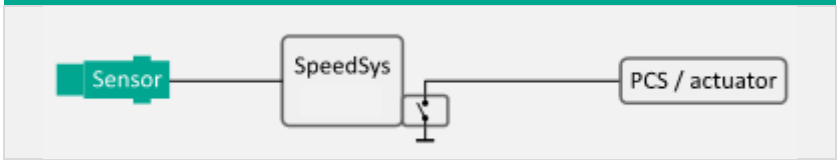
4. Overall safety loop

SpeedSys is to be used in a safety loop, sketched in the following figures, in which the safety function is to react to a limit-violation of the measured rotation frequency. In this context, the SpeedSys evaluates the measured frequency-value, as well as its derivation (acceleration) against configurable minimum and maximum limits. The outcome of the evaluation is signaled using two safe (SIL 2 in standalone configuration, up to SIL 3 (SpeedSys300 ODS301 only) in redundant configuration) relay outputs (relay1, relay2). Furthermore, the SpeedSys retransmits the measured value in the form of a calibratable, safe (SIL 2) current-loop signal (mA out) to a process control system (PCS). Errors, detected by self-diagnosis, leads to a switching to the safe state of the outputs.

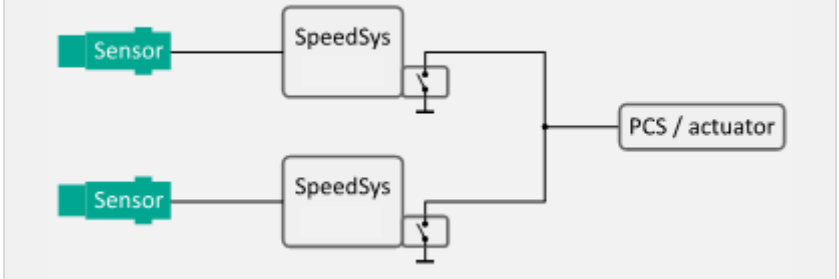
Depending on the setup, different SILs and different "availability HFTs" can be achieved. The different setups are exemplarily and show only one safety-relevant relay.

4.1 SIL 2 relay signalling

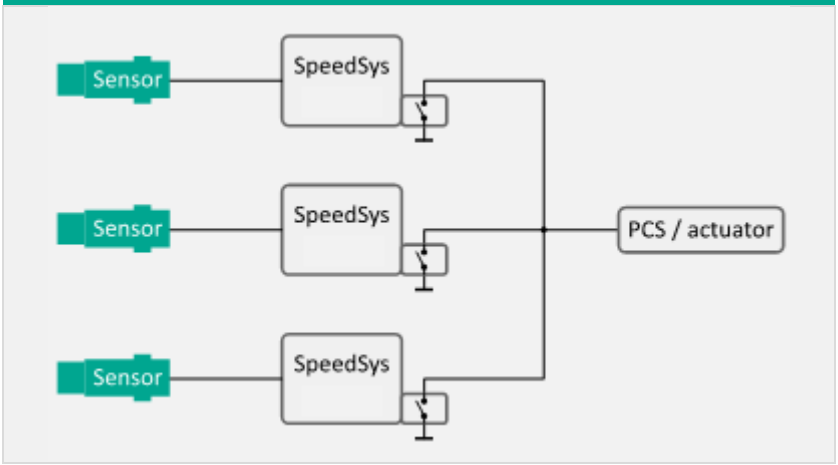
SIL 2 relay signalling, using 1 × SpeedSys device
HFT = 0, "1oo1"



SIL 2 relay signalling, using 2 × SpeedSys devices
HFT = 0, "2oo2"

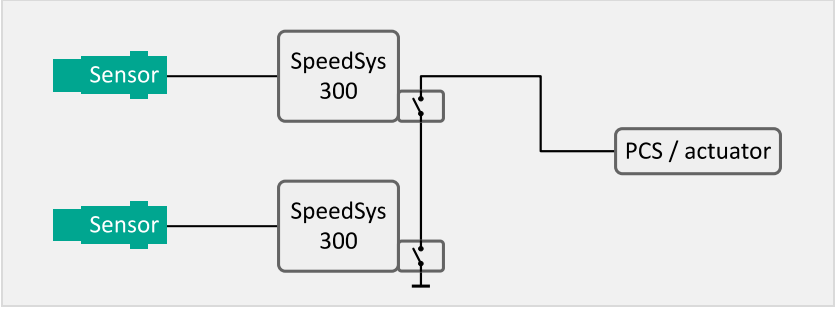


SIL 2 relay signalling, using 3 × SpeedSys devices
HFT = 0, “3oo3”

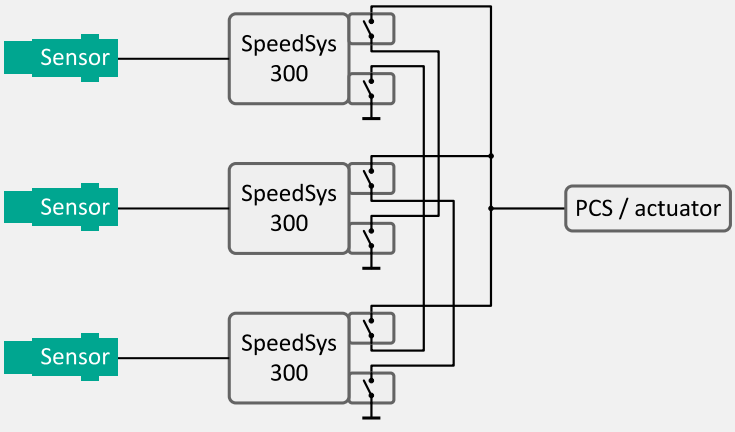


4.2 SIL 3 relay signalling (SpeedSys300 ODS301 only)

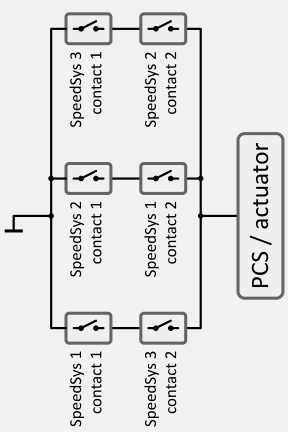
SIL 3 relay signalling, using 2 × SpeedSys300 ODS301 devices
HFT = 1, “1oo2”



SIL 3 relay signalling, using 3 × SpeedSys300 ODS301 devices
HFT = 1, “2oo3”

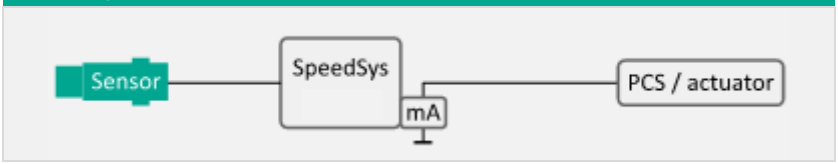


Relay configuration



4.3 SIL 2 analog signalling

SIL 2 analog signalling, using 1 × SpeedSys device
HFT = 0, “1oo1”



5. Installation and commissioning

The installation must be in accordance with the **operating manual** and this **safety manual**. This device may only be connected to devices that are suitable for safety applications.

To ensure the maximum current rating of the relay contacts, appropriate current limiting measures must be taken in the safety-relay loops.

The following steps must strictly be followed during the commissioning to ensure the expected behaviour of the safety function:

- Programming of the device parameters (values customized to the targeted safety purpose – See operating manual for description and procedure).
- Verification, of the programmed parameters (have the parameters been programmed correctly – This is carried out by the parametrization software).
- Validation of the intended safety function (does the setup fulfil the requirements to the safety loop).

6. Operation

Operation must be in accordance with the **operating manual** and this **safety manual**.

If the safety circuit is compromised, the safety function is no longer guaranteed!

- Do not manipulate the device!
- Do not repair the device!

6.1 Useful life time

The estimation of the useful life time is based on the assumption of constant failure rates of the components involved in the device. This assumption is based on the bathtub curve, which is typical for electronic components: the higher probability of early failures (for which it is assumed that they are already detected during manufacture and installation) is followed by the constant failure rate during the useful life time. Once the useful life time has been reached, the probability of failures typically increases significantly. Although the actual life time of the device may be higher than the operation life, the calculation of the safety characteristics is based on the assumption of constant failure probabilities and is therefore limited to the useful life time.

The useful life time of the individual components depends on the component itself, but also on its ambient conditions (especially the ambient temperature).

However, according to IEC 61508-2, a useful life time, based on experience, should be assumed. Experience has shown that the useful life time often lies within a range period of about 8 to 12 years.

The useful life time of the device may be longer under favourable ambient conditions, for example, if the ambient temperature is significantly below 60 °C.

7. Proof test

The purpose of the proof test is to detect potentially dangerous failures that were not detected by the internal diagnosis. The proof test must be performed according to the **proof test interval** given in the safety parameters and the **PFDG** value. The plant operator is responsible for planning and carrying out the proof tests.

The proof test procedure is focusing on the safety relay function. All other functions do not require testing during the life time of the SpeedSys.

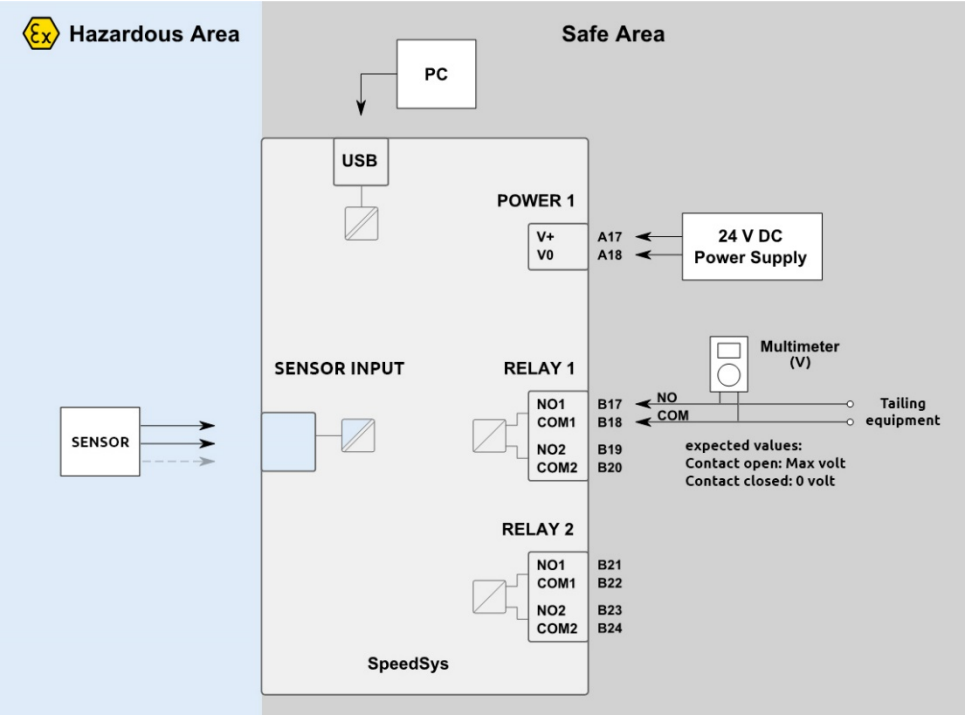
7.1 Required equipment

- PC, USB cable and SpeedSys300 configuration software (*SpeedSys300.exe*)
- Digital voltmeter.

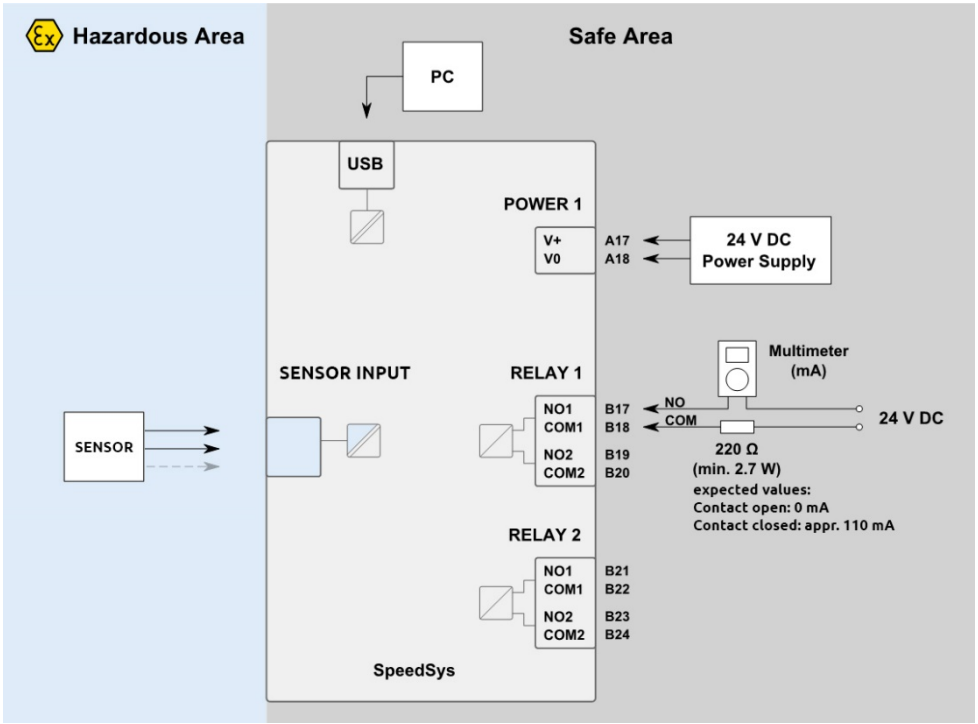
If the test is not performed in situ, additional equipment is required:

- Power supply with a nominal voltage of 24 V_{DC}, SELV
- Resistor of 220 Ω (2.7 W minimum)
- Speed sensor as used in the application.

Prepare the test setup according to one of the figures below. Note that the test requires a sensor to be connected, in order to avoid sensor diagnostic errors. Please refer to the operation manual for sensor connections.



Test setup if performed in situ



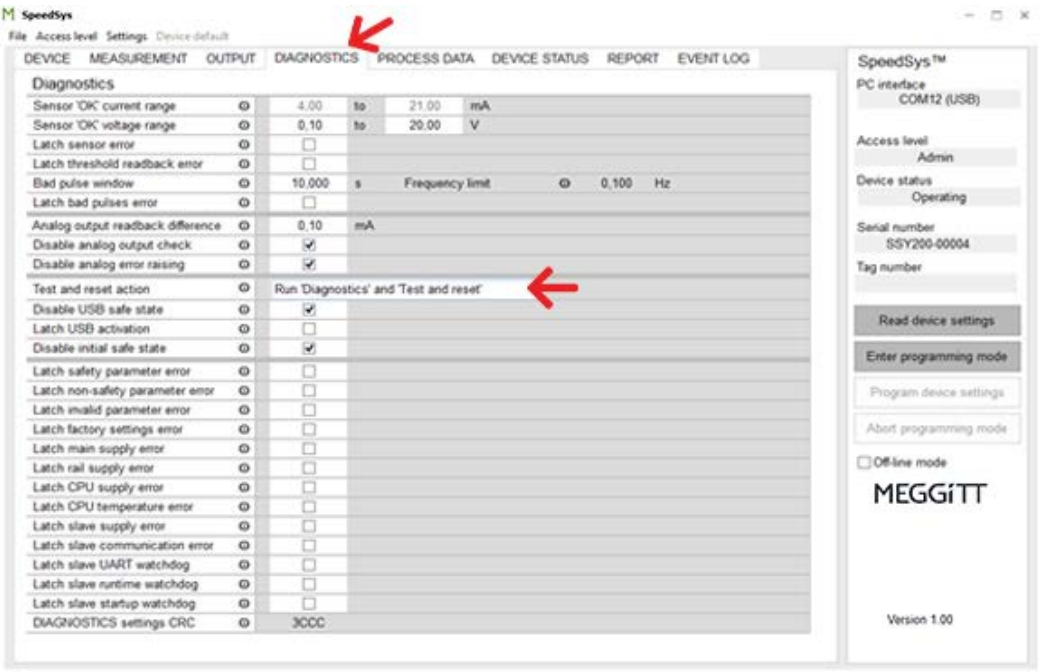
Test setup if not performed in situ

7.2 Proof test procedure

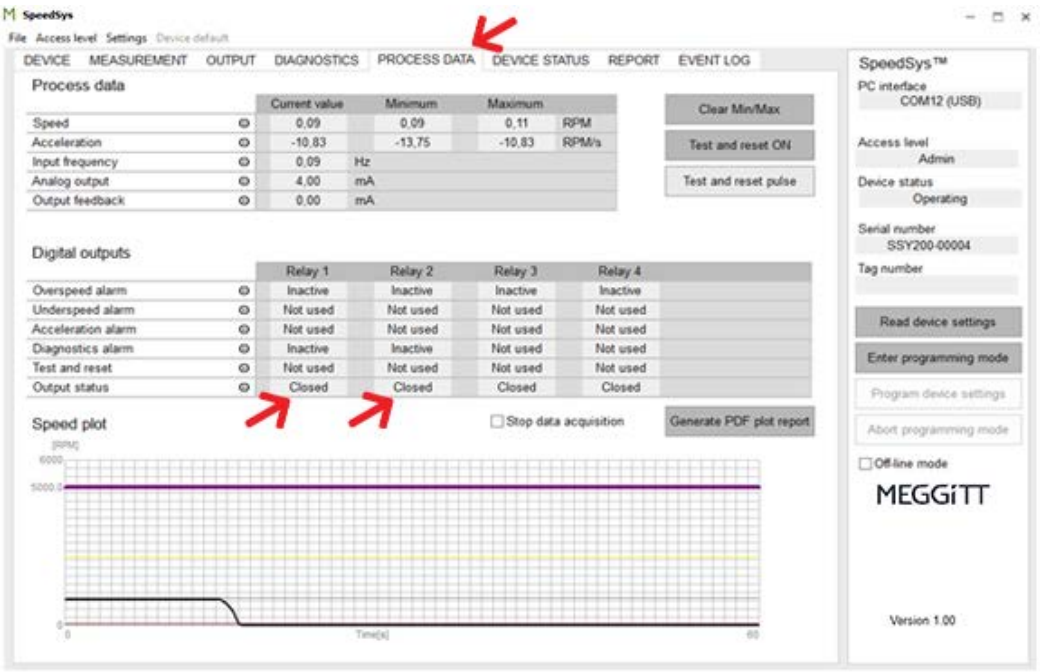
1. If tested in situ: Ensure that the unit under test is not affecting the safe operation.
    a. It is preferred to perform the proof test during scheduled outage.
    b. If applicable, a specific HAZOP has to be performed before executing the proof test.
    c. If applicable, protect the application by means of other measures.

2. Connect a PC with the USB cable to the device and open the SpeedSys300 configuration software (*SpeedSys300.exe*) as described in the operation manual.

3. Select the *DIAGNOSTICS* menu and verify if the option *Test and measurement* is set to *Run Diagnostics and Test and reset*. If yes, continue to the next step. If no, refer to the operation manual to set this parameter.

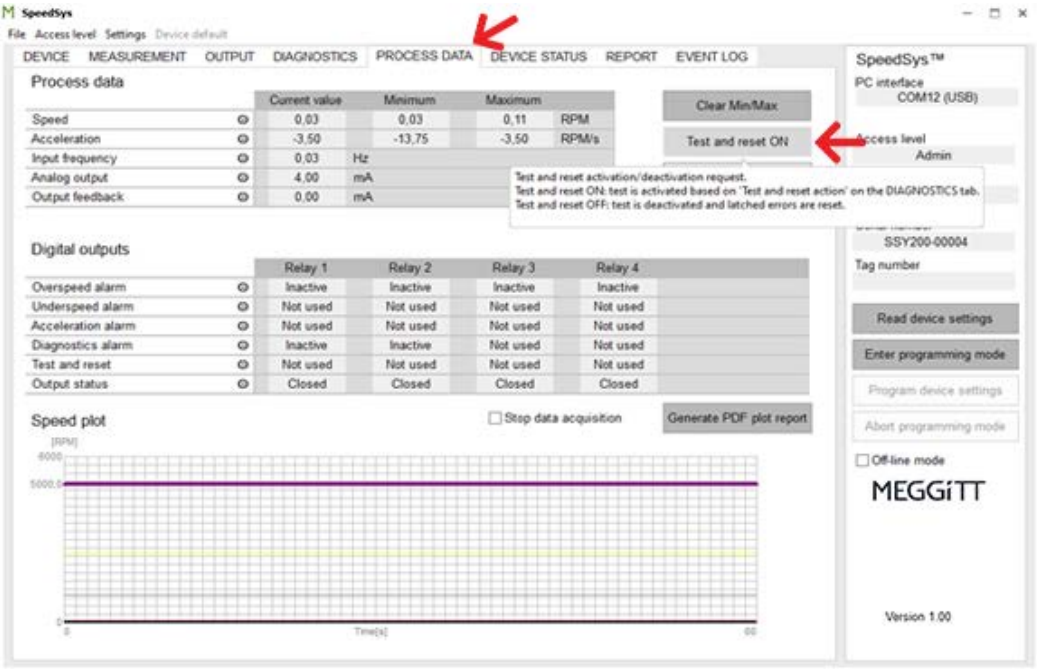


4. Select the *PROCESS DATA* menu and verify if the table *Process data* and the table *Digital outputs* are according to expectation.

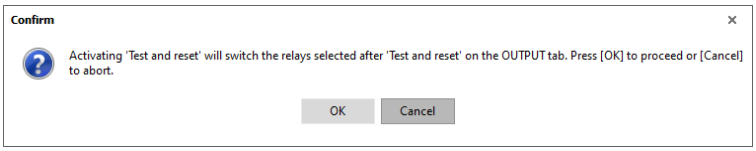


5. Use the multimeter to verify all relay outputs of the safety relays 1 and 2. Check that the relay contacts are closed. The yellow relay LEDs are ON.

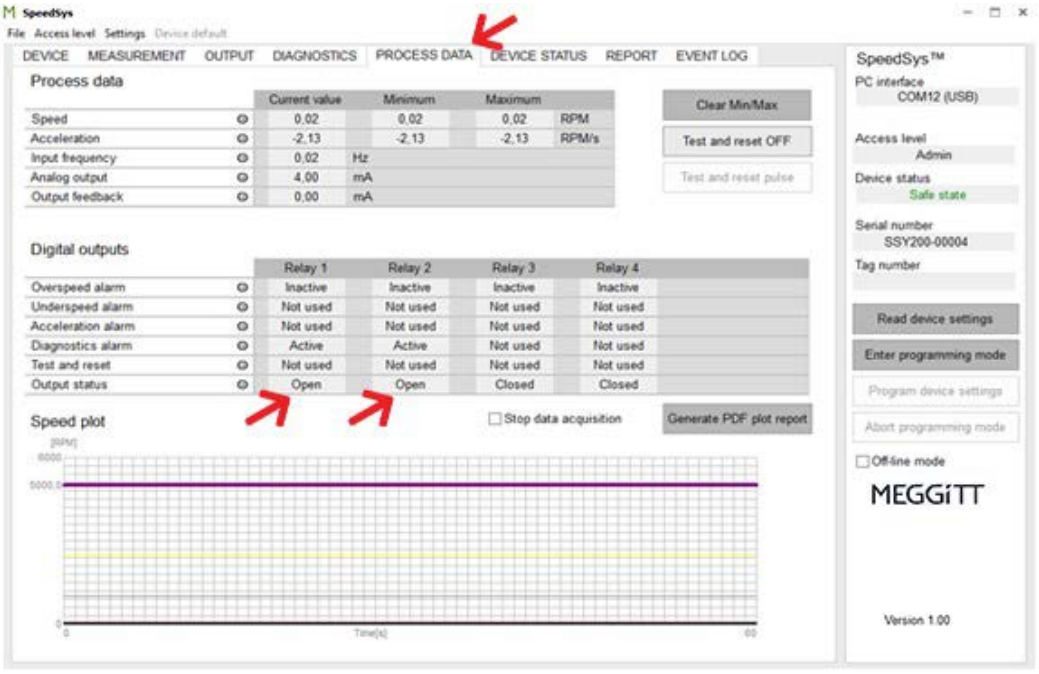
6. Press *Test and reset ON* button to activate the test signalling.



7. Press *OK* to confirm.



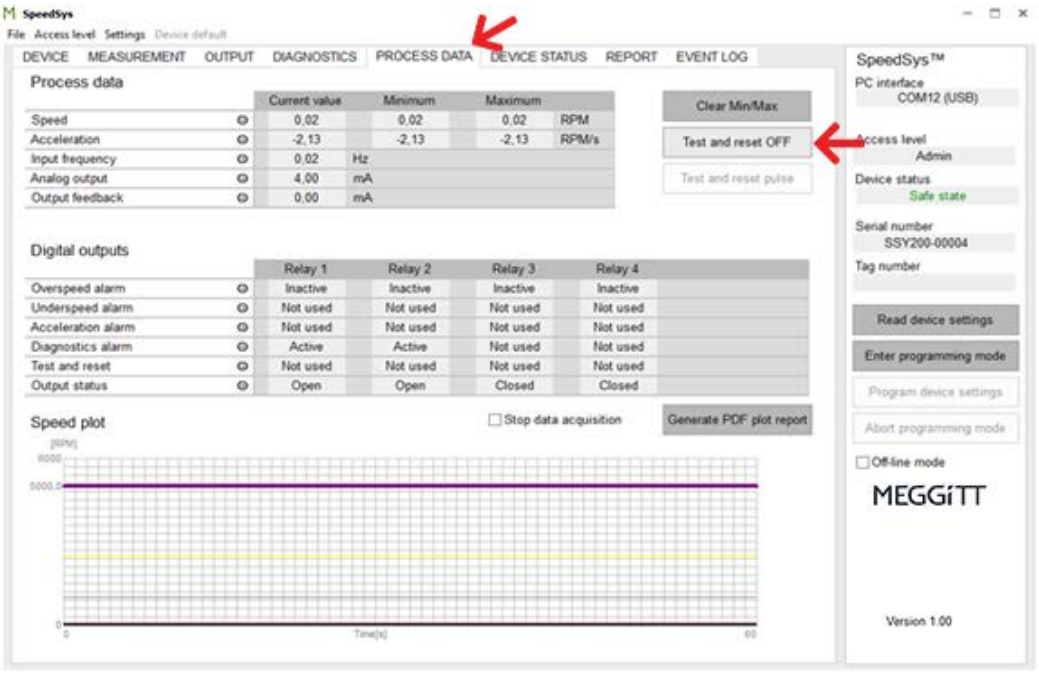
8. Verify if the table *Output status* shows the required status of the safety relays.

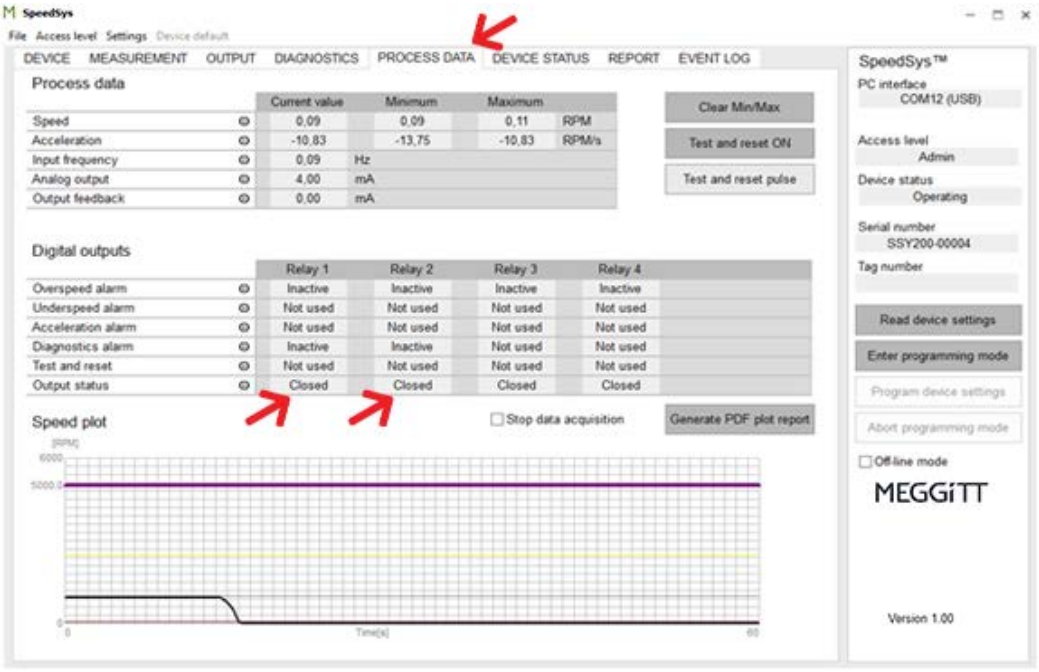


9. Use the multimeter to verify all relay outputs of the safety relays 1 and 2. Check that the relay contacts are open. The yellow relay LEDs are OFF.

10. Optional tailing equipment verification (in situ test only): Verify the registration and feedback of tailing equipment (connected to safety relay 1 and 2).

11. After verification, press *Test and reset OFF* button to return to normal operating state.





12. Use the multimeter to verify all relay outputs of the safety relays 1 and 2. Check that the relay contacts are closed. The yellow relay LEDs are ON.

13. After successful performing the tests and documenting the results the unit under test can be restored to its original configuration. If it is not clear how to restore the original configuration, refer to the manual. **Before bringing the unit under test back to operation, verify if the unit operation is according to its intended safety function!**

8. Maintenance

With the exception of the proof test, the device is maintenance free. Repairs to the device may only be carried out by the manufacturer.