

DATA SHEET

vibro-meter®

SpeedSys300 ODS301 overspeed detection system



KEY FEATURES AND BENEFITS

- From the vibro-meter® product line
- Overspeed detection and protection system with overspeed, underspeed and acceleration detection
- Alarm limit checking with safety relays for critical protection
- Alarm limit checking with non-safety relays for non-critical alarms or status monitoring
- One speed (tachometer) channel configurable for all common speed sensors
- Frequency range: 0.025 Hz to 35 kHz
- Fast response time: 10 ms
- Safety outputs: two safety relays (DPST) and one analog output (4 to 20 mA)
- Non-safety outputs: two relays (SPST) and one frequency (speed) output
- Galvanically separated speed (tachometer) inputs to support sensors/measurement chains installed in hazardous areas
- Advanced self-monitoring and diagnostics to detect sensor / measurement chain and SpeedSys300 ODS301 module problems

KEY FEATURES AND BENEFITS *(continued)*

- SIL 2 and SIL 3 capable: certified by design
- Proof-test interval: 10 years
- Fully software configurable using SpeedSys300 software
- Front-panel status indicators (LEDs)
- Modbus RTU serial interface for data sharing with external systems
- Redundant power supply inputs for improved availability
- Removable screw-terminal connectors
- DIN-rail mounting

APPLICATIONS

- Overspeed, underspeed and acceleration protection for critical rotating machinery, such as gas, steam and hydro turbines
- Suitable for use in functional safety contexts in accordance with IEC 61508: for example, SIL 3 solutions use 3 × SpeedSys300 ODS301 modules with 2oo3 voting logic
- API 670 and API 612 applications



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DESCRIPTION

Introduction

The SpeedSys300 ODS301 overspeed detection system is an overspeed detection and protection system with additional monitoring from Meggitt's vibro-meter® product line. It is a dedicated safety system for critical rotating machinery, designed using the latest technology and standards for one main purpose – to accurately detect overspeed, underspeed and/or acceleration in order to shutdown a machine and protect plant and personnel.

SpeedSys300 ODS301 overspeed detection system

The SpeedSys300 ODS301 overspeed detection system is a fundamentally simple and highly robust system, designed for ease of use and reliable operation, with an exceptionally long proof-test interval of typically 10 years.

In operation, a shaft with a multi-toothed speed sensing surface, known as a speed wheel, is monitored by an industry-standard proximity, electronic or magnetic speed sensor. The sensor / measurement chain pulses (frequency) are counted by the SpeedSys300 ODS301 module and converted to a rotational speed measurement and an acceleration measurement.

The SpeedSys300 ODS301 module then compares the speed and acceleration measurements against the configured alarm limits, and will activate the safety relays and additional (non-safety) relays should a measurement exceed a limit. In general, the safety relays are used for critical alarms and the additional relays are used for non-critical alarms or other alarm/status information for the module.

The SpeedSys300 ODS301 module also uses the measured shaft rotational speed to drive the analog 4 to 20 mA current loop output and update the frequency (speed) output, so that the information can be shared with external third-party systems such as a DCS or PLC, or even a simple display.

Note: The safety relays and the analog output (4 to 20 mA) are safety outputs. More specifically, they are SIL certified and can be used for critical functions in machinery protection applications, such as initiating the shutdown (trip) of a machine.

SIL safety

The SpeedSys300 ODS301 overspeed detection system is certified as SIL 2 and SIL 3 capable "by design". Accordingly, the SpeedSys300 ODS301 module includes advanced self-monitoring and diagnostics (also known as built-in self-test (BIST)) to detect problems with the complete system. More specifically, the module's diagnostics can detect problems with the sensor / measurement chain, the cabling and the module itself. If the SpeedSys300 ODS301 module detects any problems that could prevent it from implementing the configured safety function, the module will drive the safety relays and the analog output to their safe states (de-energised and "zero" respectively) in order to ensure that the machine being monitored is always safe.

The SIL 2 design of the SpeedSys300 ODS301 module is SIL 3 capable when used in a redundant 2oo3 architecture. To implement the 2oo3 voting logic required by SIL 3 safety applications, the safety relay outputs from three SpeedSys300 ODS301 modules can either be wired directly together or they can be connected to an external system such as a safety PLC so that the required logic is evaluated before initiating a shutdown.

Safety related and non-safety related functionality

While the two safety relays and analog output provide the safety related outputs, other SpeedSys300 ODS301 module functionality and outputs provide additional monitoring capability.

Two additional (non-safety) relays are available for alarm/status use depending on the requirements of the application. For example, the additional relays can be used to indicate when a measurement exceeds a non-critical limit or to communicate module status information, as configured using the SpeedSys300 software.

A digital frequency (speed) output is available providing a digital output equivalent to the measured speed processed by the SpeedSys300 ODS301 module. This is typically used with a simple panel-mounted display in order to have a local digital readout of the speed for the machine being monitored.

A serial communications interface supporting Modbus RTU is available to share SpeedSys300 ODS301 module information with

DESCRIPTION *(continued)*

external third-party systems such as a DCS or PLC. The Modbus RTU interface is read only and cannot be used to change the configuration or operation of the module.

While the proof-test interval of the SpeedSys300 ODS301 module itself is typically 10 years (depending on the application), a digital proof-test control input is available to effectively bypass the module's safety relays for test purposes. This supports the proof test of a complete system containing a SpeedSys300 ODS301 module, for example, external systems such as a safety PLC.

Note: During a proof test, the SpeedSys300 ODS301 module cannot provide its normal machinery monitoring and protection functions. Accordingly, it is highly recommended that proof tests are only performed in accordance with the operating procedures for the machinery being monitored and that appropriate precautions are taken at the control system level (such as DCS or PLC).

Finally, a binary (status) output is used to indicate the status of the complete system (sensor / measurement chain, the cabling and the module itself), that is, the result of the advanced self-monitoring and diagnostics (BIST).

Software

The SpeedSys300 ODS301 overspeed detection system is configured using the SpeedSys300 software, proprietary Windows® application software that is supplied with the SpeedSys300 ODS301 module. The computer running the SpeedSys300 software connects to the SpeedSys300 ODS301 module via a USB connector on the front panel of the module.

Like the SpeedSys300 ODS301 module, the SpeedSys300 software is easy to use and engineered for safety and security. For example, in order to ensure that a configuration is correct, there is auto configuration checking. In order to ensure that the configuration is downloaded to the SpeedSys300 ODS301 module correctly, there is auto read-back checking. And in order to ensure that the configuration cannot be inadvertently changed or interfered with, there is password authentication.

SpeedSys300 ODS301 module configurations can be saved to a configuration file for development and documentation purposes. This allows a configuration to be downloaded in order to

support the hot-swap of a module. It also allows configurations to be shared between similar systems.

In typical overspeed monitoring and protection applications, the SpeedSys300 software is connected to a SpeedSys300 ODS301 module for configuration and commissioning only, after which the system operates standalone.

Hardware

The SpeedSys300 ODS301 overspeed detection system hardware and firmware (embedded software) are designed and certified for SIL 2 and SIL3 capability, and include advanced self-monitoring and diagnostics (BIST) with redundant processing and data comparison. The SpeedSys300 ODS301 module also has redundant power supply inputs for improved availability.

The SpeedSys300 ODS301 module's housing features removable screw-terminal connectors that can unplugged from the main body of the housing to simplify installation and mounting.

It also features a DIN-rail mounting adaptor that allows it to be mounted directly on a DIN rail.

Application information

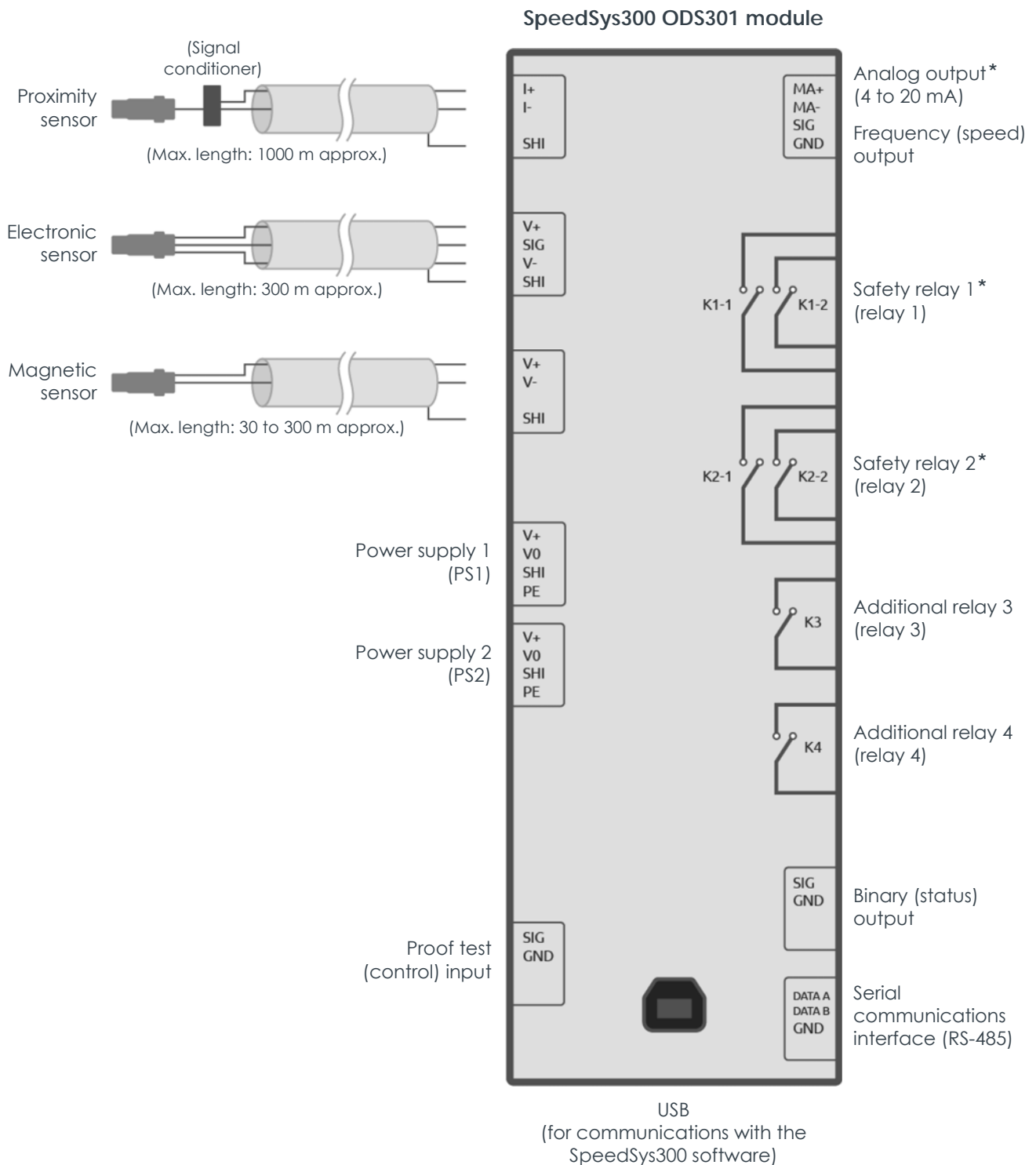
The SpeedSys300 ODS301 overspeed detection system solves overspeed safety requirements in a simple, reliable and cost-effective way. It is simple to install, configure and integrate into existing monitoring and protection applications.

For critical rotating machinery that requires monitoring and protection of both overspeed and vibration, the SpeedSys300 ODS301 module complements the VM600 and VibroSmart® machinery monitoring systems. As the safety critical speed system (SpeedSys300 ODS301) and any other systems (vibration and/or combustion) are completely separate ("segregated"), the SpeedSys300 ODS301 can always be relied upon to shut down a machine, even in the event of a problem with other systems.

Because the SpeedSys300 ODS301 overspeed detection system is SIL certified "by design", it is not limited to specific applications and there are fewer restrictions compared to equivalent "proven in use" systems. And being a new design, it uses the latest technology so there are no component supply or obsolescence issues.

For specific applications, contact your local Meggitt representative.

INTERFACE DIAGRAM



Notes

The SpeedSys300 ODS301 module is a single channel device. It has three separate input interfaces for connection to different types of speed sensor / measurement chain but only one measurement channel can be configured and used by the module at any one time.

* **Only Safety relay 1, Safety relay 2 and the Analog output are safety outputs.** No other outputs should be used to implement a safety function.

SPECIFICATIONS

Supported sensors

Compatible with a wide range of industry-standard speed measurement chains (sensors/signal conditioners):

Proximity sensors

- Description : Proximity (eddy current) sensors use a coil of wire to generate an electromagnetic field which induces eddy currents in a metal target. As the distance to the target changes, the electrical characteristics of the magnetic circuit (sensing element) change, which the signal conditioner converts into a proportional analogue signal. Accordingly, these sensors provide an accurate measurement of the distance to the speed wheel.
Note: Meggitt vibro-meter® TQxxx proximity measurement sensors/systems with a current output are supported by the SpeedSys300 ODS301 module and are suitable for signal transmission up to 1000 m – further than any other solution.
- Interface type : 2-wire current signal (analogue)
- Sensor power supply (output) : -20 to $-32 V_{DC}$ / 25 mA max.
- Input current range : -15.5 mA (min. gap) to -20.5 mA (max. gap)

Electronic sensors

- Description : Electronic (Hall-effect) sensors contain a magnet and a semiconductor material. The semiconductor detects changes in the magnetic field strength, proportional to the distance to the target, and uses signal conditioning to generate a fixed amplitude output voltage. As the sensing element (semiconductor) measures the strength of the magnetic field (that is, they depend on magnetic flux density and do not require a changing signal), they can be used for low-speed applications and zero-speed detection. However, the built-in electronics does limit operating temperatures. Note: Electronic sensors are typically suitable for signal transmission up to 300 m.
- Interface type : 3-wire voltage signal (digital)
- Sensor power supply (output) : 10 to 30 V_{DC} / 14 mA max.
- Input voltage range : $<1.5 V_{DC}$ (low) to $>(\text{supply} - 2.5) V_{DC}$ (high)

Magnetic sensors

- Description : Magnetic (variable reluctance) sensors contain a magnet and a coil. The coil detects changes in the magnetic field, proportional to the distance to the target, and generates a varying amplitude output voltage. As the sensing element (coil) detects changes in the magnetic field (that is, they depend on the rotational speed of the target), they are not suitable for low-speed applications or zero-speed detection. However, due to their simplicity (passive design), they are inherently reliable and suitable for high-temperature applications.
Note: Magnetic sensors are typically suitable for signal transmission from 30 to 300 m.
- Interface type : 2-wire voltage signal (analogue)
- Sensor power supply (output) : None
- Input voltage range : Bipolar voltages up to 80 V_{DC}

Note: The advanced self-monitoring and diagnostics (BIST) of the SpeedSys300 ODS301 module incorporates line-fault (open-circuit or short-circuit) and incorrect power consumption checks for proximity sensors and electronic sensors, and line-fault (open-circuit or short-circuit) checks for magnetic sensors.

SPECIFICATIONS *(continued)*

Input channel(s)

Number of independent speed (tachometer) channels	: 3 separate interfaces for different types of sensor / measurement chain. Note: Only one sensor / measurement chain at any one time.
Frequency/speed measurement range	: 0.025 Hz to 35 kHz
Maximum measurable frequency	: 35 kHz
Measurement accuracy (frequency)	: 0.05%
Input range	
• Voltage	: 20 mV _{RMS} to 80 V _{RMS} / 100 kΩ
• Current	: 200 mA max.
Trigger level	: 0 to 5 V (configurable using the SpeedSys300 software)

Note: The input channel interfaces for all sensor types (proximity, electronic and magnetic) are galvanically separated in order to allow a direct connection to a sensor/measurement chain installed in a hazardous area (potentially explosive atmosphere), eliminating the need for additional external safety barriers such as Zeners. See **Potentially explosive atmospheres on page 9**.


Response times

Measurement time	: Depends on input frequency and SpeedSys300 ODS301 module configuration (averaging, etc). Contact Meggitt SA for further information.
Hardware reaction time	: ≤8 ms
Total response time	: 10 ms (typical)

Relays

Safety relays

Number	: 2 (safety relay 1 and safety relay 2)
Type and contact arrangement	: Double-pole single-throw (DPST) safety relays – certified for SIL safety loops. 2 × COM and 2 × NO contacts available per relay (see Connectors on page 10).
Switching voltage	: 30 V _{DC}
Switching current	: 2 A max. (resistive load) / 100 mA max. (inductive load)
Response time	: See Response times on page 6
Operation	: The SpeedSys300 ODS301 module's safety relays are user-configurable except for the safe state, which is always normally de-energised (NDE). In general, the SpeedSys300 ODS301 module compares the measured speed against the configured limits and will put the safety relays into the safe state should the measured value exceed a critical alarm limit related to overspeed, underspeed and/or acceleration.
Safe state	: In the safe state, the safety relays are activated (de-energised) so that there is an open-circuit between the COM and NO contacts. Note: The SpeedSys300 ODS301 module's safety relays follow the "de-energise to trip principle", that is, they are normally energised (NE) during normal operation and are normally de-energised (NDE) to indicate a problem.

 **The SpeedSys300 ODS301 module's safety relays are SIL certified and can be used for critical functions in machinery protection applications, such as initiating the shutdown (trip) of a machine.**

SPECIFICATIONS *(continued)*


Additional (non-safety) relays

Number	: 2 (additional relay 3 and additional relay 4)
Type and contact arrangement	: Single-pole single-throw (SPST) relays. 1 × COM and 1 × NO contact available per relay (see Connectors on page 10).
Switching voltage	: 30 V _{DC}
Switching current	: 2 A max. (resistive load) / 100 mA max. (inductive load)
Operation	: The SpeedSys300 ODS301 module's additional (non-safety) relays are user-configurable including for the default state, which can be either normally energised (NE) or normally de-energised (NDE). In general, the SpeedSys300 ODS301 module can use the additional relays to indicate overspeed, underspeed and/or acceleration conditions or other alarm/status information for the module. For example, a relay can be used to indicate when a measurement exceeds a non-critical alarm limit or to communicate module status information.

 **The SpeedSys300 ODS301 module's additional (non-safety) relays are not SIL certified and must not be used for critical functions in machinery protection applications.**

Analog output

Number	: 1 (analogue output) – certified for SIL safety loops
Type	: 4 to 20 mA current loop
Measurement accuracy (frequency)	: 0.1%
Resolution	: 16 bit
Operation	: The SpeedSys300 ODS301 module updates the analog output to transmit a current value in the configured range, equivalent to the measured speed. Note: The analog output can be disabled using the SpeedSys300 software, if not required.
Safe state	: In the safe state, the analog output is de-activated, that is, driven to a configurable "zero" value. For example, 3.6 mA.

 **The SpeedSys300 ODS301 module's analog output is SIL certified and can be used for critical functions in machinery protection applications.**

Frequency (speed) output

Number	: 1 (frequency (speed) output)
Type	: Digital
Levels	: Open-collector output signal up to 24 V _{DC} / 100 mA.
Operation	: Digital output equivalent to the measured speed processed by the SpeedSys300 ODS301 module

 **The SpeedSys300 ODS301 module's frequency (speed) output is not SIL certified and must not be used for critical functions in machinery protection applications.**

SPECIFICATIONS *(continued)*

Control input/output

Proof test input

: Signal to support the proof test of a complete system containing an SpeedSys300 ODS301 module, for example, external systems such as a safety PLC

- Levels
- Operation

: <5 V_{DC} ("low") or >15 V_{DC} ("high")

: • Low enables the proof test, that is, the SpeedSys300 ODS301 module's safety relays are put into the safe state.
• High disables the proof test, that is, the SpeedSys300 ODS301 module resumes normal operation.

Binary (status) output

- Levels
- Operation

: Signal to indicate the status of the SpeedSys300 ODS301 module

: Open-collector output signal up to 24 V_{DC} / 90 mA

: • Low indicates a problem with the SpeedSys300 ODS301 module.
• High indicates normal operation of the SpeedSys300 ODS301 module.

The SpeedSys300 ODS301 module's advanced self-monitoring and diagnostics (BIST) continuously checks and monitors the status of the sensor / measurement chain, the cabling and the module itself, and uses the binary output to indicate the status of the module. Note: If a safe state is the result of a system problem, the binary (status) output indicates this.

Status (LED) indicators

Relay 1 / Relay 2

: Indicates the status of safety relay 1 and safety relay 2

Power / Error

: Indicates the status of the power supply to the SpeedSys300 ODS301 module and the operational status of the complete system (sensor / measurement chain, the cabling and the module itself)

Communications

Configuration

Operation

: The SpeedSys300 ODS301 module connects to a computer running the SpeedSys300 software, which is used to configure and manage modules

Type

: USB

Connector

: USB Mini-B connector (female)

Note: Each SpeedSys300 ODS301 module is supplied with a USB cable (USB Type-A to USB Mini-B) that is suitable for connecting the module to a computer. It is also supplied with access (via FTP) to a copy of the SpeedSys300 software, proprietary Windows[®] software.

External communications

Operation

: Modbus RTU serial interface to share SpeedSys300 ODS301 module information with external systems such as a DCS or PLC.

Note: The Modbus RTU interface is read only and the information to be shared is defined by the SpeedSys300 ODS301 module's configuration.

Type

: RS-485 (half-duplex)

Connector

: See **Connectors on page 10**

SPECIFICATIONS *(continued)*

Environmental

Temperature

- Operating : -20 to 60°C (-4 to 140°F)
- Storage : -40 to 85°C (-40 to 185°F)

Humidity

- Operating : 90% max. non-condensing
- Storage : 95% max. non-condensing

Protection rating
(according to IEC 60529)



: IP20.


Note: The SpeedSys300 ODS301 is suitable for indoor use only unless it is installed in an industrial housing or enclosure that ensures a higher level of environmental protection.

Potentially explosive atmospheres

Ex certified input channel interfaces for use with sensors/measurement chains in hazardous areas

Inputs

Type of protection Ex ia: intrinsic safety		
Europe	EU type examination certificate	IBExU 20 ATEX 1157  II (1) G [Ex ia Ga] IIC (outside of Ex Zone)  II (1) D [Ex ia Da] III
International	IECEx certificate of conformity	IECEx IBE 20.0045 [Ex ia Ga] IIC (outside of Ex Zone) [Ex ia Da] IIIC

 For specific parameters of the mode of protection concerned and special conditions for safe use, refer to the Ex certificates that are available from Meggitt SA.

Approvals

- Conformity : CE marking, European Union (EU) declaration of conformity
- Electromagnetic compatibility (EMC) : EN 61000-4-2:2009, EN 61000-4-3:2006/A1:2008/A2:2010, EN 61000-4-4:2012, EN 61000-4-5:2014/A1:2017, EN 61000-4-6:2009, EN 61000-4-16:2011, EN 61000-4-29:2000, EN 61326-1:2013, EN 61326-3-1:2017 (SIL), EN 55011:2016/A1:2017.
- Electrical safety : IEC 61010-1:2010, IEC 61010-1:2010/AMD1:2016
- Environmental management : RoHS compliant (EN IEC 63000:2018)
- Hazardous areas : Ex approved (see **Potentially explosive atmospheres on page 9**). EN IEC 60079-0:2018, EN 60079-11:2012.
- Functional safety : SIL 2 and SIL 3 capable in accordance with IEC 61508:2010
- American petroleum institute : Compliant with API 670 (machinery protection systems) and API 612 ("steam turbines")

SPECIFICATIONS *(continued)*

Power supply (input)

Input voltage range	: 24 V _{DC} nom. (18 to 36 V _{DC})
Redundancy	: Two separate inputs to support external power supply redundancy
Current consumption (with nominal 24 V _{DC} supply)	: 220 mA nom. <315 mA max.
Power consumption	: 5.3 W max. (at 24 V _{DC})
Reverse-voltage protection	: Yes

Power supplies to measurement chains (output)

Number of independent sensor power supplies	: 1
Sensor power supply output	: Current, voltage or none – depending on the sensor type (input channel configuration). See Supported sensors on page 5 .
Short-circuit protection	: Yes

Connectors

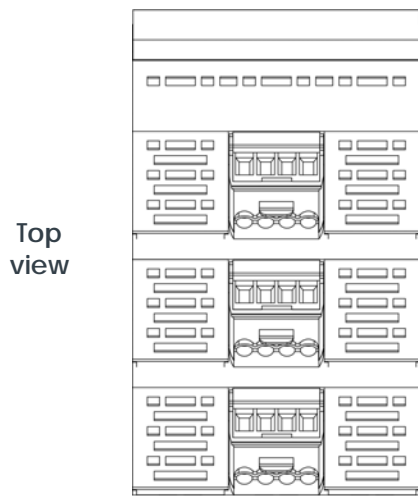
Screw-terminal connectors (inputs)	: 4 contacts per connector for sensor-side signals
Screw-terminal connectors (outputs)	: 4 contacts per connector for monitor-side signals
Electrical connections	
• IEC	: 320 V / 10 A
• CSA/UL	: 300 V / 10 A / 26 to 12 AWG
Clamping range	: 0.13 to 3.31 mm ² / 26 to 14 AWG
Connectors	
• 2-WIRE VOLTAGE	: Magnetic (variable reluctance) sensor interface
• 3-WIRE VOLTAGE	: Electronic (Hall-effect) sensor interface
• 2-WIRE CURRENT	: Proximity (eddy current) sensor interface
• SAFETY ANALOG / FREQ OUT	: Analog output (4 to 20 mA) and frequency (speed) output
• POWER PSU 1	: Power supply 1 (PS1) input
• POWER PSU 2	: Power supply 2 (PS2) input
• RELAY 3 / RELAY 4	: Additional (non-safety) relays 3 and 4
• SAFETY RELAY 1	: Safety relay 1
• SAFETY RELAY 2	: Safety relay 2
• PROOF TEST IN / BINARY OUT	: Proof test (control) input and binary (status) output
• MODBUS RS485	: Serial communications interface (RS-485, half-duplex)

Note: All inputs and outputs use removable screw-terminal connectors that can be unplugged from the main body of the housing to simplify installation/replacement of the module. The input connections (sensor interfaces) are located on top of the module and all other connections are located on the bottom of the module.

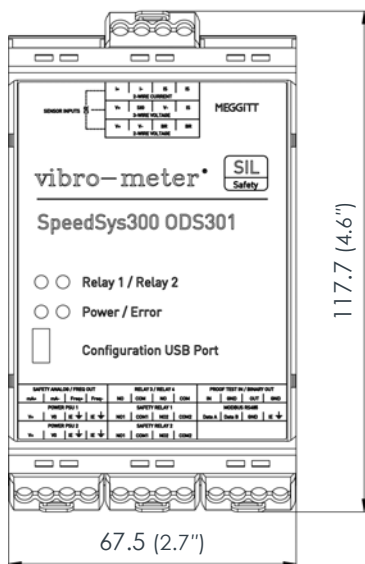
Physical

Electrical connections	: Removable screw-terminal connectors. See Connectors on page 10 .
Housing	: Polyamide (PA 66 GF 30)
Dimensions (height × width × depth)	: See Mechanical drawings on page 11
Weight	: 350 g (0.77 lb) approx.
Mounting	: Mounts on a TH 35 DIN rail (according to EN 50022 / IEC 60715). For example, TH 35-7.5 or TH 35-15.

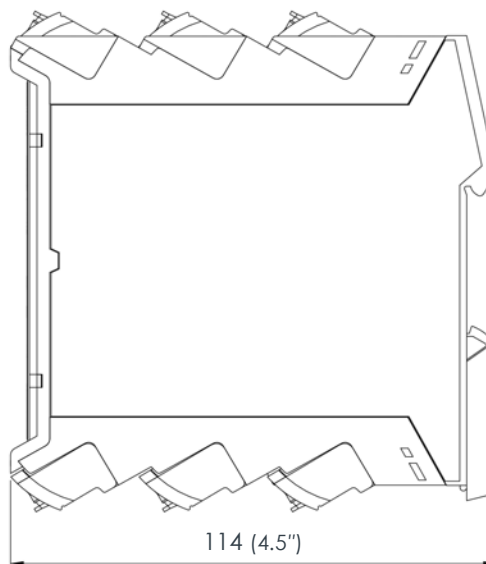
MECHANICAL DRAWINGS



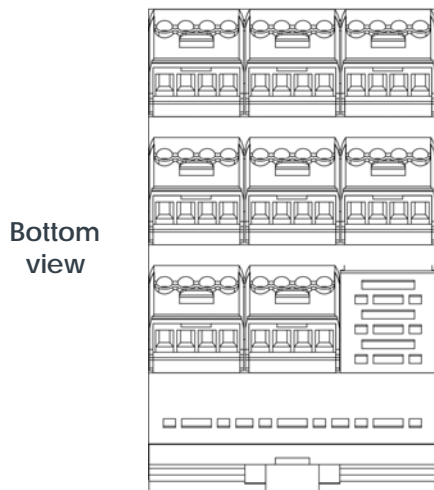
Top view



Front view



Side view



Bottom view

Note: All dimensions in mm (in) unless otherwise stated.

ORDERING INFORMATION

To order please specify

Type	Designation	Ordering number (PNR)
SpeedSys300 ODS301	Overspeed detection system (module)	600-046-000-001

Notes

Each SpeedSys300 ODS301 overspeed detection system (module) is supplied with a USB cable (USB Type-A to USB Mini-B) that is suitable for connecting the module to a computer. It is also supplied with access (via FTP) to a copy of the SpeedSys300 software, proprietary Windows® software for the configuration and operation of SpeedSys300 ODS301 modules.

RELATED PRODUCTS

TQ4xx, EA40x and IQS450	Proximity measurement systems	: Refer to corresponding data sheets
TQ9xx, EA90x and IQS900	Proximity measurement chains	: Refer to corresponding data sheets

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