

FAG



FAG SmartCheck

Machinery monitoring for every machine

SCHAEFFLER



Foreword

Increasing competition leads to increased cost pressures and drives companies to reduce their maintenance costs.

It is therefore vital to avoid unplanned downtime and maximise machine lifetime.

In expensive plant in the steel and paper industries, for example, rolls and the associated bearing arrangements have therefore been fitted for many years with complex and costly continuous online monitoring systems.

In the case of standard machines such as pumps, fans and gearboxes, continuous monitoring is often not applied since an affordable online solution has not been available so far.

FAG SmartCheck is a cost-effective, innovative online measuring system for the continuous monitoring of machine and process parameters on a decentralised basis. It offers the performance features of expensive systems but is compact in design, easy to fit and simple to use.

The system can be expanded on a modular basis and can thus be adapted at any time to meet changing requirements.

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FAG SmartCheck

- Features** FAG SmartCheck is an innovative online system that can be used on numerous machines.
- FAG SmartCheck has numerous advantageous features including:
- small and robust
 - cost-effective
 - intuitive operation
 - expandable
 - comprehensive information on machine condition taking account of process parameters such as:
 - load
 - pressure
 - flow rate
 - information available on the long term development of machine condition by means of the integrated data memory
 - connection to control room or controller by means of interfaces
 - reliable alarm system by means of an alarm threshold adjustment system applied for as a patent
 - direct system access via Ethernet and Web interface
 - protected data by means of a multistage access concept
 - free of charge app for smartphones
 - complete service for rolling bearings and for machinery diagnostics.

Operation and communication

FAG SmartCheck can be used easily and on an intuitive basis by means of two capacitive keys.

Due to the software FAG SmartWeb integrated in the device, it can be accessed via a Web interface using any standard browser.

The device can be connected via interfaces to, for example, a controller, control room or PC, *Figure 1*.

- ① Status LED, red, yellow, green
- ② Membrane key, alarm reset
- ③ Membrane key, activate teach mode
- ④ Interface: Ethernet, power supply, PoE
- ⑤ Interface: RS485, power supply
- ⑥ Interface: inputs and outputs, analogue and digital

Figure 1
LEDs, keys and interfaces



Function

FAG SmartCheck is ready for immediate use as soon as it is delivered. The integrated characteristic value set allows general, reliable monitoring.

For more precise monitoring, a component template stored in the device can be selected for applications such as fans or pumps. The component template is filled with the component data. The device has an integrated rolling bearing database containing data for FAG and INA standard bearings. The user can add further rolling bearings to the database at any time.

Depending on the component template selected, certain parameters can be adjusted, such as:

- bearing type
- number of fan blades
- gear teeth
- belt lengths.

The characteristic value set thus generated allows highly precise monitoring of the machine.

FAG SmartCheck

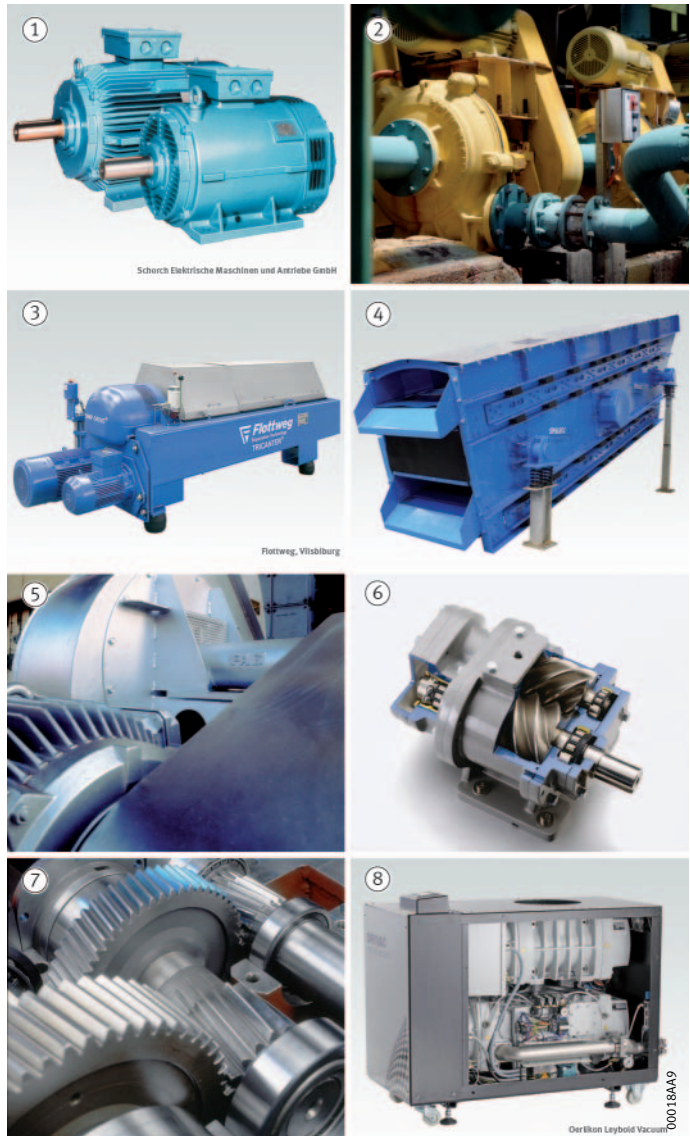
- Configuration** With one FAG SmartCheck, it is possible to monitor several components of a machine at the same time. A separate configuration can be generated using wizards by means of a Web browser. Several component templates are combined in an overall configuration for the machine to be monitored. This configuration can be copied to any number of devices required.
- Monitoring** Vibrations and process parameters such as pressure and flow rate are determined and correlated.
- Alarm system** The automatic alarm threshold adjustment, for which a patent has been applied, allows a reliable alarm system. An alarm is indicated immediately by an LED on the device. The alarm can be transmitted to the control room by means of interfaces. A free of charge app can convert any smartphone into an alarm receiver on a WLAN network, *Figure 2.*



Figure 2
Smartphone as alarm receiver

Application

The device detects damage to a wide variety of machines at an early stage. A selection is shown in *Figure 3*.



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Standard templates The standard templates in FAG SmartCheck detect the following damage:

- rolling bearing damage
- imbalance
- misalignment
- impacts.

Expanded monitoring The user can apply the standard templates for monitoring. He also has the option of using templates for specific machines. Specific damage patterns are detected precisely and can be allocated to a component. Examples are shown in the table.

Templates for specific machines

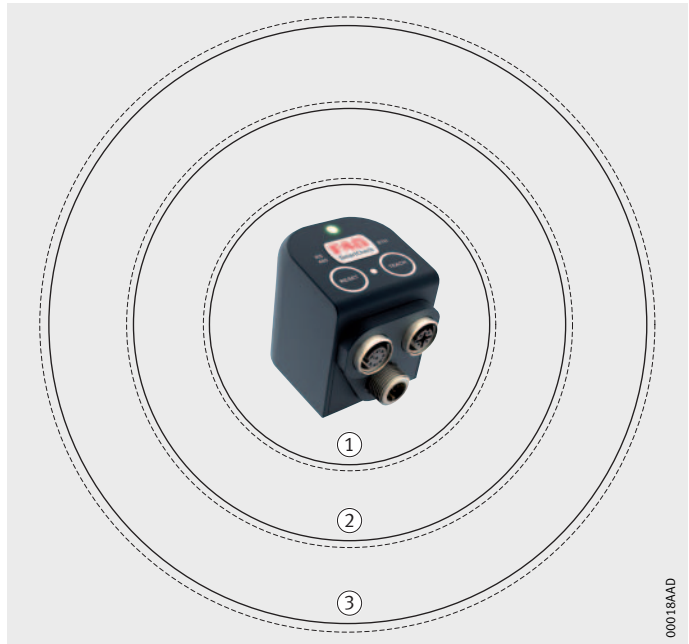
| Machine | Characteristics identified using template for specific machines |
|----------------------------|---|
| Electric and geared motors | Winding damage and loose rotor bars |
| Vacuum and fluid pumps | Wear and cavitation |
| Ventilators and fans | Blade and vane rotational frequencies |
| Compressors | Changes to the typical vibration pattern |
| Gearboxes | Tooth set damage |
| Separators and decanters | Cavitation, floating imbalance between screw and drum |
| Vibrating screens | Settling of screen mats, loose springs, spring breakage |

Concept

Monitoring using FAG SmartCheck can be carried out in three stages. In the first stage, individual machines are monitored on a decentralised basis. If the user selects the second stage, the device is intelligently integrated in the machine controller. In the third stage, the service is provided from a single source by an external service provider. This can include remote access via an Internet connection as well as advice and other services, *Figure 4*.

- ① Decentralised machinery and process monitoring
- ② Intelligent process integration
- ③ Service from one source

Figure 4
Multistage concept



Decentralised machinery and process monitoring

Installation and cabling of FAG SmartCheck is a simple process. The device is ready for immediate use. Data can be accessed directly from the device.

Intelligent process integration

Intelligent process integration is the option of communication via interfaces. During communication, data are exchanged with, for example, a PLC or control station. User-specific integration in bus systems can be achieved, for example, by means of an RS485.

Service from one source

The Web interface for FAG SmartCheck allows remote access to measurement data via an Internet connection. Monitoring can thus be outsourced to an external service provider.

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Software

Each FAG SmartCheck includes the integrated software FAG SmartWeb. The device can be accessed by means of FAG SmartWeb using any Web browser.

The software FAG SmartUtility light is a free of charge PC software. The software can be used to configure the Web address, save data and update firmware.

The paid-for PC software FAG SmartUtility allows unrestricted access to all the functions in FAG SmartCheck, see table.

Functional scope

| Function | SmartWeb | SmartUtility light | SmartUtility |
|--|----------|--------------------|--------------|
| Display characteristic value status | ● | – | ○ |
| Display system information | ● | – | ○ |
| Display measurement data | ● | – | ○ |
| Display trend | ● | – | ○ |
| Select component templates | ● | – | ○ |
| Configure inputs and outputs | ● | – | ○ |
| Configure and activate validator | ● | – | ○ |
| Configure and activate trigger | ● | – | ○ |
| Configure user administration | ● | – | ○ |
| Display input signals in real time | ● | – | ○ |
| Configure TCP/IP settings | – | ● | ● |
| Update firmware | – | ● | ● |
| Download and save data | – | ● | ● |
| Analyse data | – | – | ● |
| Manage all FAG SmartCheck devices in the network | – | – | ● |
| Load and send configurations | – | – | ● |

- Executed by this software
- Not supported by this software
- Can be called up, will be executed by FAG SmartWeb

The use of FAG SmartUtility light and FAG SmartUtility requires a Windows PC, see hardware requirements in table, page 15.

Data analysis FAG SmartCheck offers extensive possibilities for analysing measurement data and assessing the condition of the machine being monitored.

The following general characteristic values are determined from the acceleration and acceleration envelope signal:

- RMS, broadband
- RMS, frequency-selective
- peak-to-peak value
- crest factor
- periodic value
- W-count
- temperature.

FAG SmartCheck does not, however, only calculate the general characteristic values. In addition, the component templates integrated in the device offer frequency-selective monitoring matched to various components.

Characteristic patterns in components such as shafts, belt pulleys or fan wheels indicate incipient damage at an early stage.

In conjunction with process parameters such as torque, load or speed, it is possible to make precise statements relating to the damage progress.

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Presentation of trends

Presentation of trends is a simple and authoritative presentation of characteristic values. A change in the vibration behaviour can be detected at a glance. Even slight changes are visible in the trend pattern, *Figure 5*.



① Presentation of trends and signals over 5 months

Figure 5
Viewer presentation

In-depth analysis

For this analysis, the Viewer function in FAG SmartUtility is used. The Viewer offers numerous tools that assist the experienced user in carrying out analysis.

Alarm threshold adjustment

In the delivered condition, FAG SmartCheck uses preset alarm thresholds. The vibrations in a machine are decisively influenced by the specific operating condition. In order to adjust the alarm thresholds to match the specific machine, FAG SmartCheck has an automatic teach mode.

The user must start the teach mode at the time of first operation. The associated vibration value is then measured and allocated for each operating condition of the machine. Based on the measurement data for vibrations and process values, FAG SmartCheck determines the correct alarm thresholds itself. The dependence of vibrations on several process values is also taken into consideration.

As soon as sufficient measurement data are available, FAG SmartCheck automatically substitutes the newly determined alarm thresholds for the preset values.

Through the multi-dimensional adaptation of alarm thresholds, critical machine conditions are identified and reliable alarm operation in every machine condition is ensured.

- Service** Schaeffler offers extensive services ranging from strategy development through first operation to remote monitoring.
- First operation** In partnership with the customer, the suitable monitoring strategy is determined, devices are mounted and reference measurements are carried out.
- Training courses** Employees are trained as a function of their prior knowledge and requirements. The training covers handling of the device and use of the software.
- Operation** We are pleased to offer our experience at any time. For example, our experts can assist in the assessment of measurement results. If the measurement results indicate any damage, they can provide advice on further action.
- Remote monitoring** If the necessary expert knowledge is not available or trained employees are not present on site, remote monitoring may be advantageous, *Figure 6*.



Figure 6
Remote monitoring
with data evaluation by Schaeffler

If Schaeffler is tasked with remote monitoring, the customer receives regular reports on the machine condition and recommended actions for improving plant availability. If FAG SmartCheck detects incipient damage, the customer is informed immediately. Repair can then be planned and replacement parts sourced in good time. Further information can be found at www.FAG-SmartCheck.com or by simply contacting us.

FAG SmartCheck

| FAG SmartCheck | |
|--|--|
| Features | Description |
| Size (W×H×D) | 44 mm×57 mm×55 mm |
| Mass | ≈ 210 g |
| Housing material | Glass fibre reinforced plastic |
| Fixing method | Screw M6 |
| | Contact surface on the machine: ∅ 25 mm |
| Protection class | IP 67 |
| Power supply | DC 11 V to DC 32 V |
| | Power over Ethernet |
| Maximum power consumption | 200 mA at 24 V |
| Operating temperature | -20 °C to +70 °C |
| Operating system | Embedded Linux |
| Software (languages: German, English, Chinese) | FAG SmartWeb (Internet Explorer, Firefox) |
| | FAG SmartUtility light |

Memory

| Features | Description |
|-------------------------|-------------------------|
| Program and data memory | 64 MB RAM, 128 MB Flash |

Interfaces

| Features | Description |
|------------------------|---|
| Control elements | 2 keys for teach mode, alarm reset, restart, default settings |
| Display elements | 1 LED for status and alarm display |
| | 1 LED for confirmation of keys |
| | 2 LEDs for communication display |
| Communication | Ethernet 100 MB/s RS485 |
| Electrical connections | 3 polarity protected M12 push-fit connectors for power supply, RS485, analogue and digital inputs and outputs, Ethernet |

| Internal vibration sensors | |
|-----------------------------|------------------|
| Features | Description |
| Piezoelectric accelerometer | 25 mV/g |
| Frequency range | 0,8 Hz to 10 kHz |
| Measurement range | ± 50 g |
| Resolution | 200 µg |

Measurements

| Features | Description |
|---|---|
| Measurement functions | Acceleration, velocity and displacement by integration |
| | Temperature and process parameters such as speed, load and pressure |
| Diagnostic methods | Time signal, envelope curve |
| | Speed and frequency tracking |
| | Spectrum and trend analysis |
| Characteristic values in time and frequency range | Defined characteristic values: DIN ISO 10816 |
| | Calculated characteristic values: RMS, frequency-selective RMS, DC, peak, peak-to-peak, crest factor, W count, condition guard |
| Special features | Other user-defined characteristic values are possible |

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| Signal processing | |
|---------------------------------------|--|
| Features | Description |
| Frequency resolution | 1 600 lines, 3 200 lines, 6 400 lines, 12 800 lines |
| Measurement accuracy | 24 Bit, A/D converter |
| Frequency range | 0,8 Hz to 10 kHz |
| Low pass filter | 50 Hz to 10 kHz Stages: 50 Hz, 100 Hz, 200 Hz, 500 Hz, 1 kHz, 2 kHz, 5 kHz, 10 kHz |
| High pass filter, envelope curve only | 750 Hz, 1 kHz, 2 kHz |
| Special features | Other filters available by agreement |

| Inputs and outputs | |
|---------------------|--|
| Features | Description |
| Inputs | 2 analogue inputs, 12 Bit, frequency range 0 Hz to 500 Hz: |
| | Voltage: 0 V to 10 V, 0 V to 24 V |
| | Input resistance: 10 k Ω |
| | Current: 0 mA to 20 mA, 4 mA to 20 mA |
| | Input resistance: 500 Ω |
| 1 pulse input: | 0 V to 30 V, 0,1 Hz to 50 kHz |
| Outputs | 1 analogue output, 12 Bit: |
| | Voltage: 0 V to 10 V |
| | Minimum load resistance: 1000 Ω |
| | Current: 0 mA to 20 mA, 4 mA to 20 mA |
| | Maximum load resistance: 250 Ω |
| 1 switching output: | Open collector, max. 1 A, 30 V |
| Special features | Electroplated separation between inputs and outputs |

| Accessories | |
|---|--|
| Ordering designations | Description |
| SMART-CHECK.CABLE-POW-P-M12-OE-10M | Power cable: 10 m, 8 pin, M12 socket on free connection end |
| SMART-CHECK.CABLE-ETH-P-M12-RJ45-10M | Ethernet cable: 10 m, M12 plug on RJ45 |
| SMART-CHECK.CABLE-IO-P-M12-OE-10M | Input/output cable: 10 m, 8 pin, M12 plug on free connection end |
| Special features | Other accessories available by agreement |

| Software | |
|----------------------|--|
| Features | Description |
| SMART.UTILITY | Paid-for PC software for system management |

| Hardware for use of FAG SmartUtility and FAG SmartUtility light | |
|---|--------------------------------------|
| Features | Description |
| System architecture | Windows |
| Processor | Pentium III or higher |
| Processor speed | 600 MHz (recommended 1 GHz) |
| RAM | 2 GB (recommended 4 GB) |
| Screen resolution | At least 1 024×768, font size normal |
| Free space on hard disk | 40 MB |

FAG SmartCheck

| Product variants | |
|----------------------------|--|
| Ordering designations | Description |
| SMART-CHECK | FAG SmartCheck including Web interface, FAG SmartWeb and PC software, FAG SmartUtility light |
| SMART-CHECK-KIT-003 | 1×FAG SmartCheck with accessories (starter configuration, cable and basic manual) |
| SMART-CHECK-KIT-005 | End customer starter kit: 5×FAG SmartCheck including accessories |
| SMART-CHECK-KIT-008 | OEM/OES starter kit: 5×FAG SmartCheck including accessories |
| Special features | Other product variants available by agreement |

| Services | |
|--------------------------------|--|
| Ordering designations | Description |
| SMART-CHECK-SERVICE-001 | Preparation of application-specific or machine-specific monitoring strategy in consultation with customer |
| SMART-CHECK-SERVICE-002 | Preparation of monitoring configuration based on templates in FAG SmartCheck |
| SMART-CHECK-SERVICE-005 | Mounting and first operation of FAG SmartCheck |
| SMART-CHECK-SERVICE-006 | Data collection from FAG SmartCheck, analysis and reporting including recommended actions |
| SMART-CHECK-SERVICE-014 | E-service including evaluation of conspicuous measurement data and reporting including recommended actions |
| SMART-CHECK-SERVICE-007 | Starter kit service for end customers: 16 service hours, content to be selected individually, for example general advice, system instruction, local support and other services |
| SMART-CHECK-SERVICE-009 | Starter kit service for OEM/OES: 24 service hours, content to be selected individually |
| Special features | Other services available by agreement |

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