

**FAG**



**FAG DTECT X1**  
**Continuous monitoring of**  
**plant and machinery**  
Technical Product Information

**SCHAEFFLER GROUP**  
INDUSTRIAL



# Reliable machine protection through vibration diagnosis · FAG DTECT X1 Areas of application

## Machine monitoring with vibration diagnosis

Optimum utilisation of equipment is only possible if it is available to its maximum extent.

The increasing complexity of machinery requires measurement methods that allow objective assessment.

Vibration diagnosis is one such method. It helps to diagnose damage reliably and at an early stage and implement suitable measures.

The risk of unplanned downtime is significantly reduced.

In this method, machine noise is detected using a sensor and evaluated in a vibration measurement device. Defects or damage affecting machine parts generally lead to modified vibration levels. Discrete damage to a rolling bearing, such as pitting of the raceways, leads during overrolling motion to a periodic sequence of individual shocks. The frequencies of the impulse sequence or the damage frequencies depend on the bearing geometry and are proportional to the speed.

Conventional vibration measurement devices normally give a total level. This is compared with a limit value. An alarm is triggered if the limit is exceeded. That method is not adequate for monitoring the condition of complex machinery. Furthermore, it is not effective in the case of varying speeds.

## Digital, frequency-selective vibration monitoring

Monitoring of individual machine parts and detection of damage at an early stage can only be achieved through frequency-selective monitoring, since small instances of damage or defects cause an increase in the amplitude of individual characteristic frequencies. Envelope analysis plays an important role in this. It can be used to detect periodic shock impulses in the vibration signal of a machine, such as those that occur in gearbox and rolling bearing damage. Damage can be detected at an early stage through characteristic patterns in the frequency spectra of the machine vibration.

By means of defined, narrow frequency bands, the amplitudes of individual components can be specifically monitored.

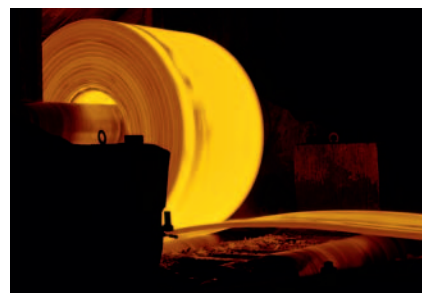
## FAG DTECT X1

FAG DTECT X1 is an economical vibration monitoring system for permanent frequency-selective monitoring.

## Areas of application

FAG DTECT X1 can be used in almost all sectors. Typical areas of application are:

- fans
- gearboxes
- compressors
- rolling stands
- mills
- drive systems.



FAG DTECT X1 Examples of sectors and applications

# Digital vibration monitoring with FAG DTECT X1

## Digital vibration monitoring with FAG DTECT X1

FAG DTECT X1 allows connection of all common acceleration, speed and travel sensors. The signal from these sensors is recorded and broken down into its frequency components by means of Fast Fourier Transformation (FFT). It is thus possible to monitor amplitudes within fixed and very narrow frequency bands for specified limit values. An alarm is triggered if these are exceeded.

With FAG DTECT X1, two different parameter types can be recorded from the vibration acceleration signal. Firstly, the RMS value, which is detected from the spectrum of the raw signal and secondly, the LDZ value (bearing diagnostic parameter) which is generated from the envelope signal.

Depending on the width of the frequency components which are used for calculation out of the relevant spectrum, these are referred to as broadband or frequency-selective parameters. In the case of broadband parameter monitoring, the overall vibration behaviour of a machine is determined.

The condition of the individual components can be analysed precisely by means of narrowband, frequency-selective monitoring.



Device with various pickups

FAG DTECT X1 calculates various parameters:

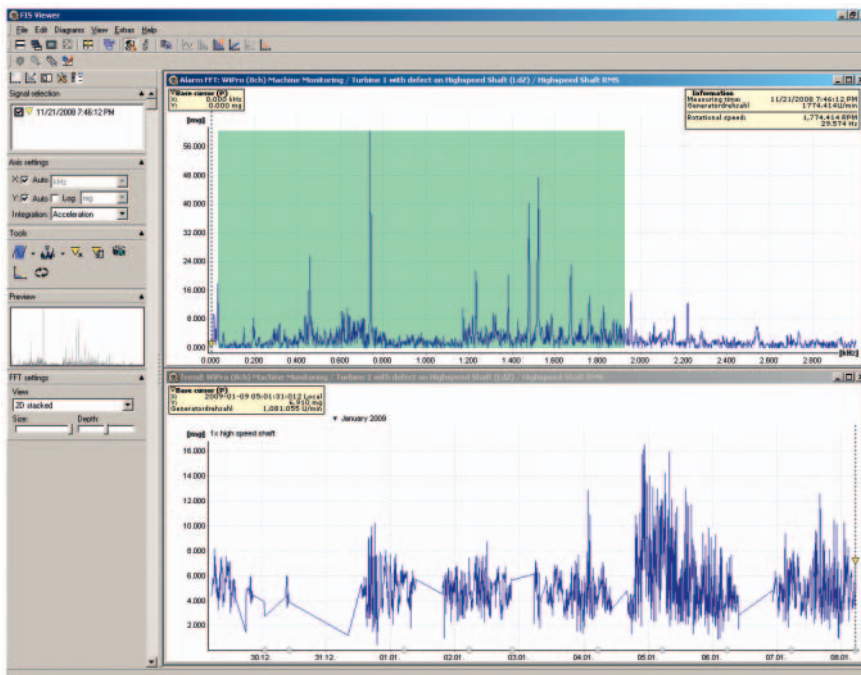
- RMS
- peak value
- peak-to-peak value
- steady component
- crest factor.

FAG DTECT X1 has two additional channels, which can be used to record process variables such as

- speed
- torque
- temperature
- pressure

and can be used for validation of the parameters.

In practice, this method is used to achieve, for example the speed-dependent tracking of the frequency bands and the setting of load-dependent and speed-dependent alarm limits.



Broadband monitoring

# Alarm warnings · Remote monitoring with FAG DTECT X1

## Alarm warnings

In terms of adjustable limit values, a distinction is drawn between prealarm and main alarm thresholds. Each alarm can trigger a switching relay.

To avoid false alarms, a delay can be set on the main alarm.

FAG DTECT X1 has two analogue outputs and two relay outputs. If the limit value is exceeded, the analogue outputs can relay the parameters to a higher level control system (PLC system).

With the relay outputs, machines are controlled directly.

A “traffic light” display on the front panel of the housing with red, yellow and green lights gives a permanent indication of the monitoring condition.

The user is given further information on a two line LCD display.

## Remote monitoring with FAG DTECT X1

FAG DTECT X1 allows remote monitoring of plant and machinery.

Changes to components are reliably detected by the monitoring system and can be reported by various communication channels to various recipients:

- operator
- plant manufacturer
- service provider.

## Advantages of remote monitoring

- Increased machine availability
- Prevention of unplanned downtime
- Worldwide, economical plant monitoring
- No vibration expert required on site
- Permanent availability of monitoring data
- Immediate alerting via telecommunications systems
- User administration and password protection.

Measurement data can be remotely retrieved at any time and assessed by the actual customer or by the F'IS Teleservice Center.

This allows changes to the parametrisation at each site which may, for example, be required in order to carry out further measurements appropriate to a current problem.

The FAG DTECT X1 is supplied as standard in a top hat rail housing for installation in switch cabinets. On request, the customer also receives the system in a housing with IP66 protection and the additional individual components required, e.g. communication assemblies.



“Traffic light” display

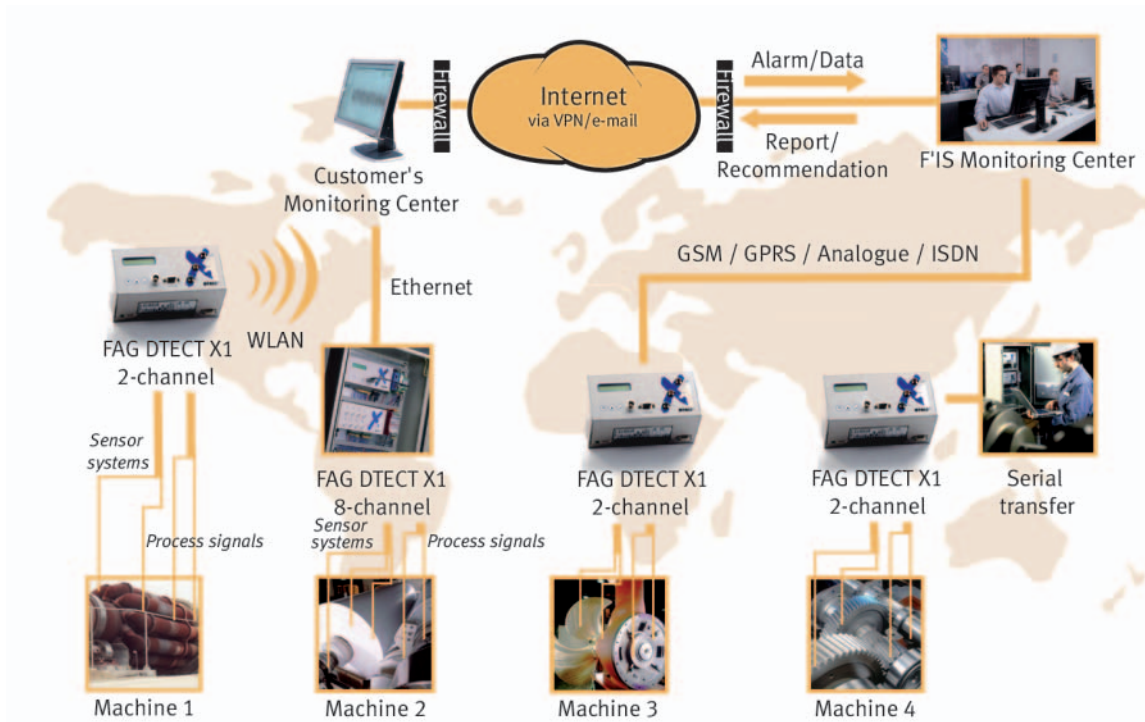


F'IS Teleservice Center



System in housing with IP66 protection

# Variable system · Monitoring configuration · Storage concept



Communication channels between FAG DTECT X1 and Monitoring Center

## FAG DTECT X1 – a variable system

FAG DTECT X1 is available in two designs:

- 2-channel system for direct connection of sensors
- 8-channel system with multiplexer, for indirect connection of sensors.

Signals with an output voltage of  $\pm 10$  V can be connected, irrespective of the number of channels.

The recorded signals are transmitted to the device's signal-processing elements via an internal multiplexer.

## Monitoring configuration

Establishing a monitoring configuration provides the basis for the subsequent evaluation.

A monitoring configuration defines:

- channel
- value to be measured
- type of characteristic value
- size of the characteristic value
- frequency bands (max. 12)
- alarm thresholds.

It is possible to define several monitoring configurations for an input channel.

For each of these configurations, the FAG DTECT X1 determines characteristic values from the time and frequency signals and saves them in the configuration's ring buffer.

For speed-tracked characteristic values, the speed is also recorded as a separate trend.

## Storage concept

Large data quantities do not pose a problem for FAG DTECT X1. The flexible storage concept allows the user to decide what data he wishes to store and the corresponding frequency of storage.

# Communication · Software

## Communication with a higher level system

For communication with a higher level system, various inputs and outputs are available. Additional signals can be recorded using analogue inputs and used in the measurement. These signals can thus be used as reference variables for dependent signal analysis such as alarm threshold control. They can also be used to initiate measurement tasks and thus facilitate automation of data logging in certain applications. Furthermore, information such as alarm status can be transferred to a higher level system and held there for further processing.

Communication with FAG DTECT X1 can be carried out via the following channels:

- network (TCP/IP)
- GSM/GPRS/analogue/ISDN
- WLAN
- serial.

## Software

Successful vibration monitoring is dependent to a large extent on the software used. In addition to simple configuration and use of the software, the various data presentation and analysis options are of decisive importance. In order to fulfil this requirement as well as possible, the software F'IS Administrator for FAG DTECT X1 is divided into the following components:

- F'IS Configuration Manager
- F'IS Remote Server
- F'IS Data Link
- F'IS E-Mail Link



Process of monitoring plant with FAG DTECT X1

# Software · Functionality

## F'IS Configuration Manager

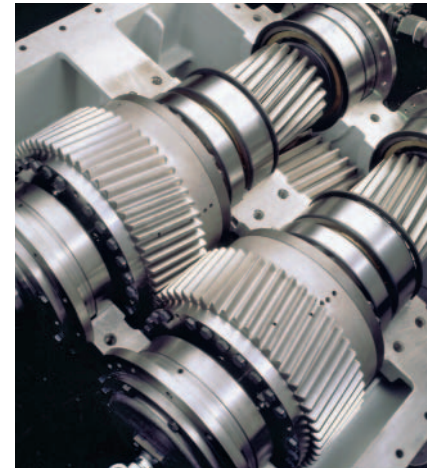
- Allocation of connected sensors to particular monitoring configurations
- Allocation of additional channels (inputs/outputs) to existing configurations
- Definition of the frequency bands to be monitored
- Definition of the alarm thresholds.

## User administration

- Installation and administration of users
- Allocation of access rights
- Allocation of rights to individual program functions (Edit, Start Services, Import and Export...).

## Bearing database

- Contains 20 000 bearings from various manufacturers
- Reduces data analysis
- Simplifies the process for determining the cause of damage in conjunction with F'IS Viewer
- Facilitates the diagnosis of multiple bearing overrolling frequencies for a monitoring configuration, as a bearing list can be stored for each monitoring configuration
- Can be extended to individual requirements.



## Alarm list

- Protocol of all status changes in F'IS Configuration Manager.

[ID]	Measuring time	Alarm	Reset	FFT	Alarm FFT	Time sign	Character/Attribute	Comment	Speed/RPM	Alarm state of the related windows
1	1/5/2009 5:01:36 AM	✓	✓	✓	✓	✓			0	1080.0791 25
2	1/6/2009 4:26:59 AM	✓	✓	✓	✓	✓			0	1080.0791 25
3	1/7/2009 4:17:20 AM	✓	✓	✓	✓	✓			0	1336.9140625
4	1/6/2009 3:48:33 AM	✓	✓	✓	✓	✓			0	1758.7890625
5	1/5/2009 3:27:27 AM	✓	✓	✓	✓	✓			0	1081.0546875
6	1/3/2009 6:59:34 PM	✓	✓	✓	✓	✓			0	1251.9531 25
7	1/3/2009 2:29:00 AM	✓	✓	✓	✓	✓			0	1081.0546875
8	1/2/2009 2:08:49 AM	✓	✓	✓	✓	✓			0	1080.0791 25
9	12/31/2008 9:30:02 f	✓	✓	✓	✓	✓			0	1080.0791 25
10	12/30/2008 9:19:24 f	✓	✓	✓	✓	✓			0	1191.40625

F'IS Configuration Manager: Alarm list

# Software · Functionality

## F'IS Viewer

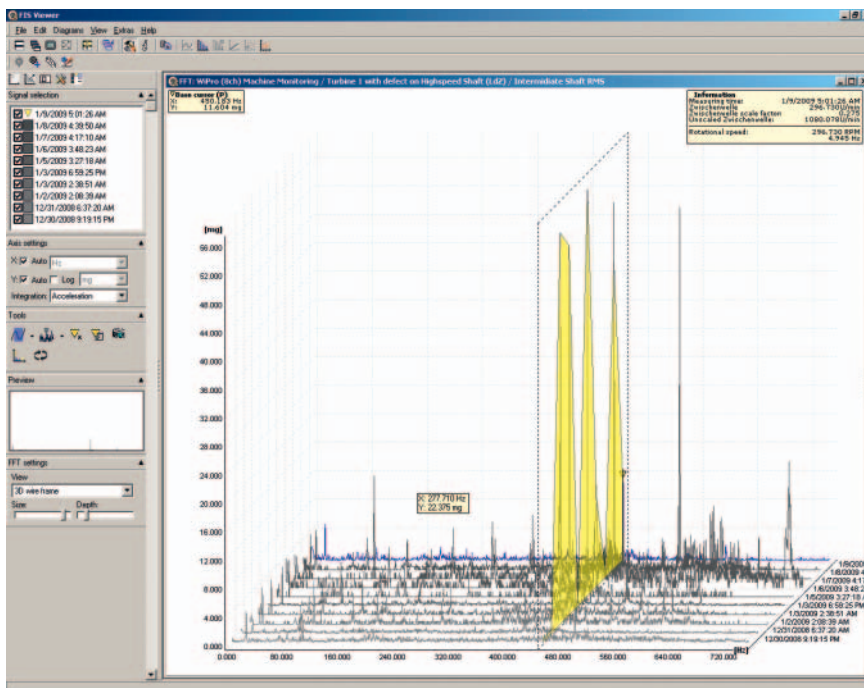
- Diagrammatic preparation of the measured data
- Extensive analytical options and presentation options facilitate the assessment and analysis of measurement data
- Intuitive operation, also owing to various zoom and cursor functions
- Simple comparison of process data and vibration data (temperature and vibration curve)
- Unique range of services in spite of simple operation.

## – Trend analysis

Trend analysis is a simple and reliable method for detecting changes in the vibration behaviour of machinery at an early stage, allowing action to be taken quickly. The trends can be based on parameters in broadband monitoring as well as on narrowband parameters of individual components such as a rolling bearing outer ring or a gear tooth set. For example, monitoring of an outer ring may be carried out by bringing together several narrowband frequency bands for overrolling frequency and the harmonics to form one parameter. Incipient damage or a forthcoming problem becomes apparent in an increase in the trend values for a monitored component or machine.

## – FFT analysis

FFT analysis subdivides the recorded signals into their individual frequency components. It is therefore possible to monitor the amplitudes of individual frequencies within narrow bands for specified limit values and trigger an alarm if these are exceeded. It is possible to precisely allocate the frequencies to particular components such as bearing rings, gear teeth or to phenomena such as misalignment, imbalance etc.



F'IS Viewer: Waterfall diagram

## – Waterfall diagram and sonogram

The waterfall diagram is a presentation method in which the individual FFTs are presented behind each other “spatially” to give a three-dimensional image. In the sonogram, the development of the spectrum over time is presented by means of colour. The two display options also allow beginners to gain a quick diagrammatic overview of the temporal development in vibration behaviour.

# Software · Functionality · Server variants

## – Expanded analysis

- Automatic detection of defective components
- Provides authoritative parameters (spectral flatness, kurtosis, ISO 10816, RMS, LDZ)
- Assists beginners and experts in data analysis.

## F'IS Remote Server/F'IS Data Link/F'IS E-Mail Link

- The F'IS Remote Server allows the flexible, time-controlled and event-controlled transfer of data from FAG DTECT X1 to the F'IS Administrator software. Time-controlled means that the transfer of data takes place at a predetermined time or time interval (e.g. every 24 hours). In the case of event-controlled data transfer, the F'IS Remote Server initiates the transfer of data at a specific event, e.g. if the (pre-)alarm is activated or there is a lack of storage space.
- The F'IS Data Link ensures seamless data management. All selected data (time signals, frequency spectra or trend values) are stored in a central database.
- The transfer of stored data to any number of people is controlled by F'IS E-Mail Link. In order that these can be examined or analysed, the modules of the F'IS Administrator Software must be installed on the recipient PC.

## F'IS DB Cleaner

The F'IS DB Cleaner is used to delete data from the database or reduce these data. As a result, the 4 GB memory capacity of the SQL database, which is supplied as standard with the F'IS Administrator, is optimised.

Data can be deleted in accordance with predefined or individually defined rules, e.g. deletion of all data which are more than six months old. The F'IS DB Cleaner also includes various selection criteria. The implementation date can be selected as a fixed time or a time period.

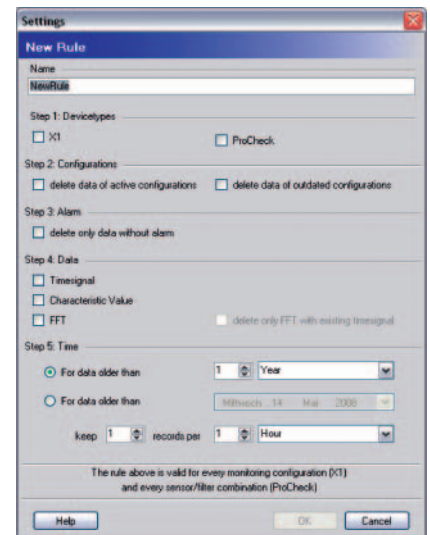
### Advantages:

- The database's access properties can be improved
- Data management is more efficient.

The first version of the F'IS DB Cleaner is only compatible with the database in F'IS Administrator 4.4.

## Server variants

From software version 4.4, F'IS Administrator is supplied with Microsoft® SQL Server® 2005 Express. This gives the user 4 GB of memory capacity in place of the previous 2 GB.



F'IS DB Cleaner

## Versions and ordering designations

FAG DTECT X1 versions and ordering designations		
	DTECTX1-2CH*	DTECTX1-8CH**
IEPE channels	2	8
Configurations	4	16
Frequency windows	12	12
Others	Speed tracking of frequency windows, envelope detector	Speed tracking of frequency windows, envelope detector, external 8-channel multiplexer

### Ordering designations for countries outside Europe:

\* FIS.X1.K2.BASIC

\*\* FIS.X1.K8.BASIC

# Options

FAG DTECT X1 options	
Switch cabinet for 2-channel FAG DTECT X1	Switch cabinet incl. mains power supply and wiring, IP66, steel sheet, powder coated, for 2-channel FAG DTECT X1 + accessories. Dimensions in mm: 400×400×210 (W×H×D) <b>Ordering designation:</b> DTECTX1.CABINET-2CH <sup>1</sup>
Switch cabinet for 8-channel FAG DTECT X1	Switch cabinet incl. mains power supply and wiring, IP66, steel sheet, powder coated, for 8-channel FAG DTECT X1 + accessories. Dimensions in mm: 400×600×210 (W×H×D) <b>Ordering designation:</b> DTECTX1.CABINET-8CH <sup>2</sup>
COM server	Server for transferring serial data stream to Ethernet/TCP-IP <b>Ordering designation:</b> DTECTX1.ADAPTER-TCPIP-RS232 <sup>3</sup>
GSM modem	Modem for mounting in switch cabinet <b>Ordering designation:</b> DTECTX1.MODEM-GSM-900-1800MHZ <sup>4</sup> FIS.X1.GSM.1900.FAL (USA)
Frequency-voltage converter	0–25 kHz <b>Ordering designation:</b> DTECTX1.FU <sup>5</sup>
Switch	5-port TCP/IP – Switch <b>Ordering designation:</b> DTECTX1.SWITCH-5PORT <sup>6</sup>

### Ordering designations for countries outside Europe:

- <sup>1</sup> FIS.X1.ENCLOSURE.IP66.2CH
- <sup>2</sup> FIS.X1.ENCLOSURE.IP66.4-8CH
- <sup>3</sup> FIS.X1.TCPIP.COM.100
- <sup>4</sup> FIS.X1.GSM.900.1800.FAL
- <sup>5</sup> FIS.X1.FU.3000HZ
- <sup>6</sup> FIS.X1.TCPIP.SWITCH.5PORT



COM server



Frequency-voltage converter

# Technical data

## Technical data

The FAG DTECT X1 is supplied in numerous variants. Not every variant has all the equipment features listed.

### Measurement values and characteristic values

Measurement value for vibration pickups: acceleration, convertible to the values vibration speed and vibration displacement.

Calculation of characteristic values over time range:

- RMS, peak, peak to peak, steady component and crest factor.

Calculation of characteristic values over frequency range:

- Effective value (RMS value) of acceleration, vibration speed and vibration displacement in broadband to ISO 10816 1-3 (formerly VDI 2056/ISO 2372) or selectively
- Bearing diagnostic value (LDZ value) in broadband or selectively
- Speed-dependent adjustment of frequency bands in position and width.

### Number of channels

FAG DTECT X1 base device, 2 channels or 8 channels with external multiplexer

### Sensors

Conventional piezoelectric acceleration pickups and inductive vibration sensors as well as other sensors (temperature, pressure, force, current, power) with voltage supply  $\pm 10$  V max. Measurement ranges dependent on pickup.

### Filters

- 1 analogue antialiasing filter, Butterworth 24 dB/octave, adjustable via software from 5 Hz to 20 kHz
- Envelope detector with switchable HP 750 Hz/2 kHz (standard)
- Low-pass module (12 frequency ranges: 5 Hz, 10 Hz, 20 Hz, 50 Hz, 100 Hz, 200 Hz, 500 Hz, 1 kHz, 2 kHz, 5 kHz, 10 kHz, 20 kHz).

### Signal amplification

Adjustable from 1 to 1024 or autoranging.

### A/D converter

Resolution 12 bit, sampling rate up to 80 kHz maximum.

### Memory

SRAM (immutable) ring buffer for diagnostic characteristic values, spectrum and time signal, flash EPROM program memory.

### FFT

Resolution of 2048 lines in the frequency spectrum.

### Inputs

Sensor inputs with ICP standard and 0,1 Hz high-pass filter, either DC input or AC input with  $\pm 10$  V.

### Outputs

2 switching outputs (relay, change-over contact 30 V/5 A) for main alarm and prealarm, 2 analogue outputs: standard 4–20 mA, optionally 0–20 mA, 0–5 V or 0 to 10 V, raw sensor signal unamplified and buffered to BNC jack.

### Additional inputs

Quantity 2 (0–10 V), these are entered in separate ring buffer for validation of measurement data, e.g. speed and power.

### Display

LCD display: alphanumeric, 2 lines of 16 characters each,  
LED traffic light:  
green: everything in working order  
yellow: prealarm  
red: main alarm.

### Setting keys

Three keys on front panel for parametrising of device and setting display during operation and alarm reset.

### System test

Automatic system test after switch-on.

### Interfaces

RS232

### Temperature range

Standard: 0 °C to +50 °C  
Option: –20 °C to +70 °C.

### Housings

Top hat rail to DIN 50022-35  
Dimensions:  
205×120×130 mm (W×H×D)  
Mass:  $\approx 1,5$  kg  
Power supply: 24 VDC/500 mA.

# Everything from a single source – Customised monitoring solutions for everyone

## Everything from a single source – Customised monitoring solutions for everyone

FAG Industrial Services (F'IS) is a full service supplier in the field of condition-based maintenance. With the sourcing of high quality FAG products, the customer thus gains access to a range of product-related services (see diagram). Based on many years' experience, F'IS knows that customers wishing to change to the concept of continuous condition monitoring have differing needs and requirements.

Therefore, F'IS has a comprehensive portfolio of products and services containing both standard and customer-specific solutions that are always developed in close partnership with the customer. The F'IS service portfolio for continuous condition monitoring covers the following areas:

- consultancy
- installation
- initial operation
- system support
- continuous and regular measurement.

It is, of course, the customer who decides which of the available services he wishes to use. For example, he can choose complete monitoring of his plant by F'IS or to have his employees qualified for independent monitoring at their own responsibility through training. Whichever service is selected, the team of F'IS experts is available at any time. If you have any further questions on our services, please contact us directly or visit our website.



For remote configuration and analysis of measurement data

Teleservice



Free support hotline



Training

Free software updates



Services provided with FAG DTECT X1



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