

# CONDITION MONITORING SENSORS

Intelligent vibration analysis  
for machine monitoring



# An alarm that promises good things

Less unplanned downtime and  
more productivity



*„Our Condition Monitoring Sensors represent a completely new generation of intelligent sensors. Measuring vibrations and processing them directly on the device using special algorithms is a turning point in predictive maintenance.“*

---

Christian Seyfried, Product Manager

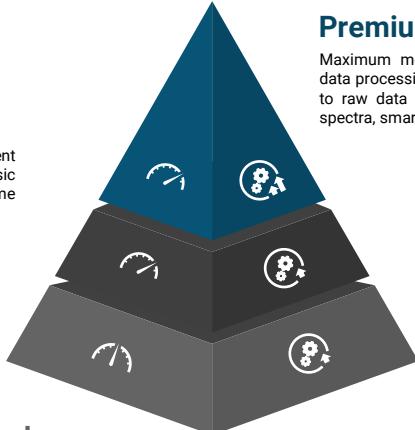


**BCM Family**

# Always find the right solution

**Advanced**

Maximum measurement performance and basic data processing: time domain analysis

**Standard**

Basic measurement performance and basic data processing: Time domain analysis

**Premium**

Maximum measurement performance and data processing: frequency analysis, access to raw data and high-resolution frequency spectra, smart RPM input



2...1,800 Hz ( $\pm 10\%$ )  
2...2,500 Hz (3 dB)

-25...70 °C

Vibration analysis in time domain

Get BCM0001

2...4,500 Hz ( $\pm 10\%$ )  
2...6,000 Hz (3 dB)

-40...80 °C

Vibration analysis in time domain

Get BCM0004

2...4,500 Hz ( $\pm 10\%$ )  
2...6,000 Hz (3 dB)

-40...80 °C

Vibration analysis in time domain

Vibration analysis in frequency domain  
Smart RPM input

Access to raw acceleration data and frequency spectra

Get BCM0003

## BCM Family

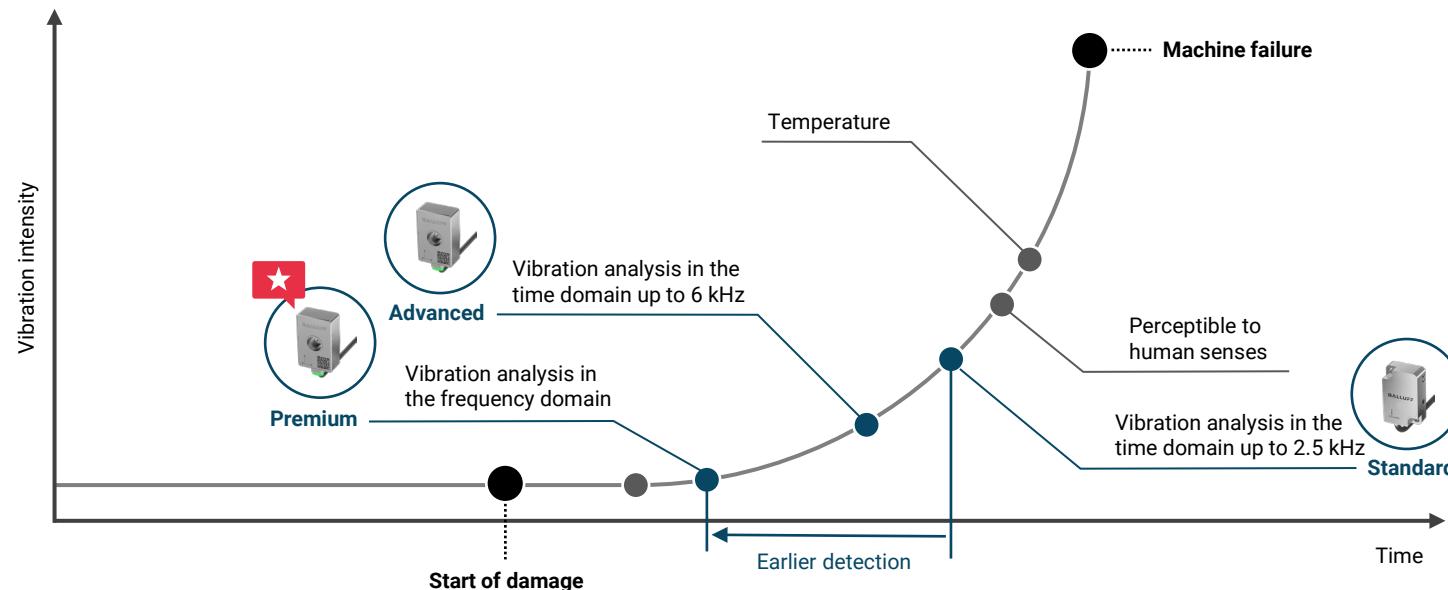
## Key points at a glance

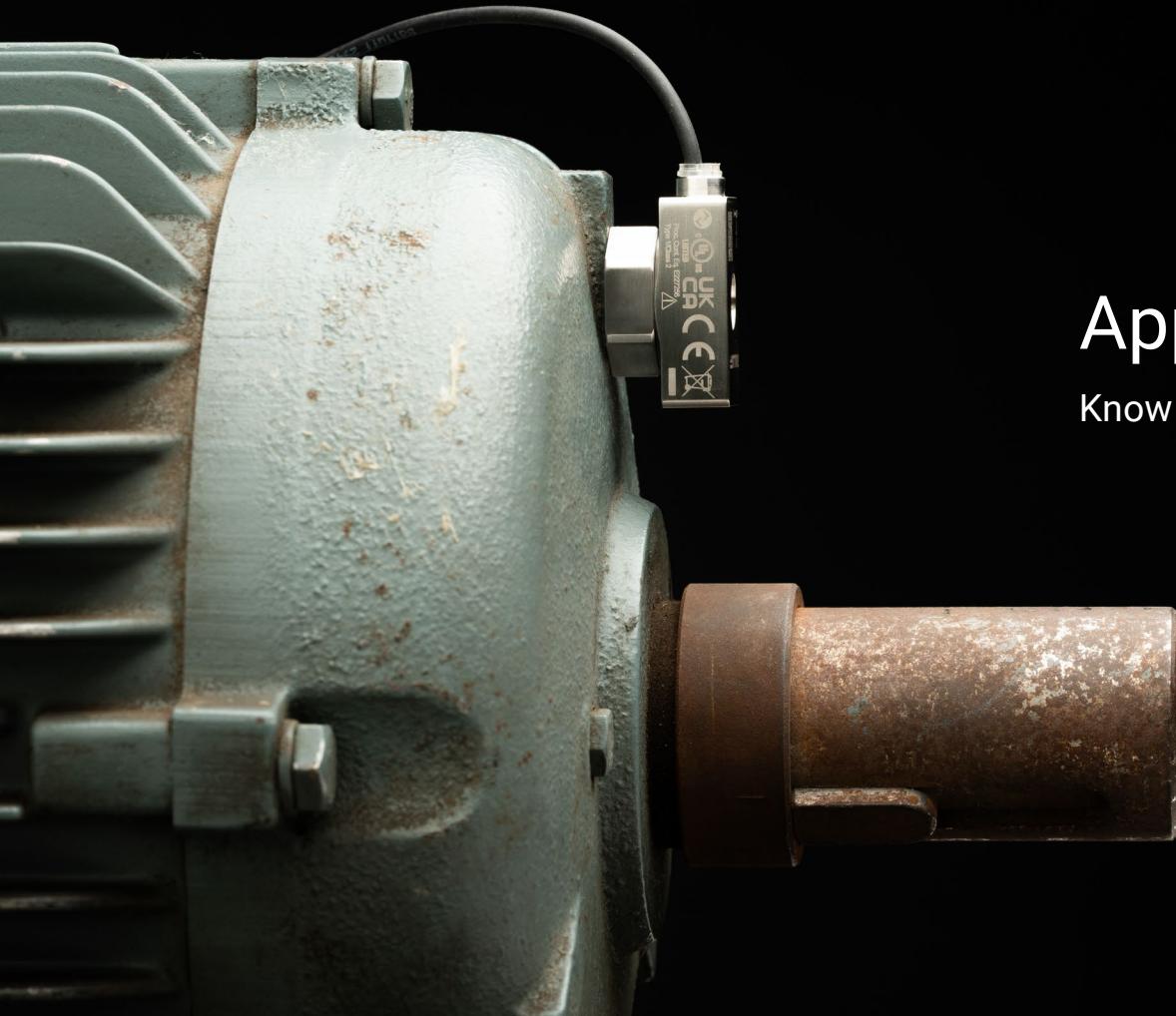
Properties	Advanced / Premium	Standard
 <b>Measurement performance</b>	2...4,500 Hz ( $\pm 10\%$ ) 2...6,000 Hz (3 dB) 	2...1,800 Hz ( $\pm 10\%$ ) 2...2,500 Hz (3 dB) 
 <b>Operating temperature</b>	-40...80 °C 	-25...70 °C 
 <b>Communication interface</b>	IO-Link + SIO 	IO-Link 
 <b>Data transmission</b>	Up to 24 process values simultaneously 	4 process values simultaneously 
 <b>Data preprocessing</b>	RMS, Peak, Max, Crest Factor, Skewness, Kurtosis 	RMS, Peak, Max, Crest Factor, Skewness, Kurtosis 
	Amplitude spectrum, envelope spectrum 	
	15 s acceleration raw data, amplitude and envelope spectra for all 3 measurement axes 	
 <b>*Raw recording</b>		

## BCM Family

## Detect bearing damage early and accurately

Bearing damage can be detected early and reliably through vibration analysis in the frequency domain – long before values rise in the time domain. For high precision bearing requirements, long replacement part lead times, or high failure costs, the BCM Premium Line is the ideal option.



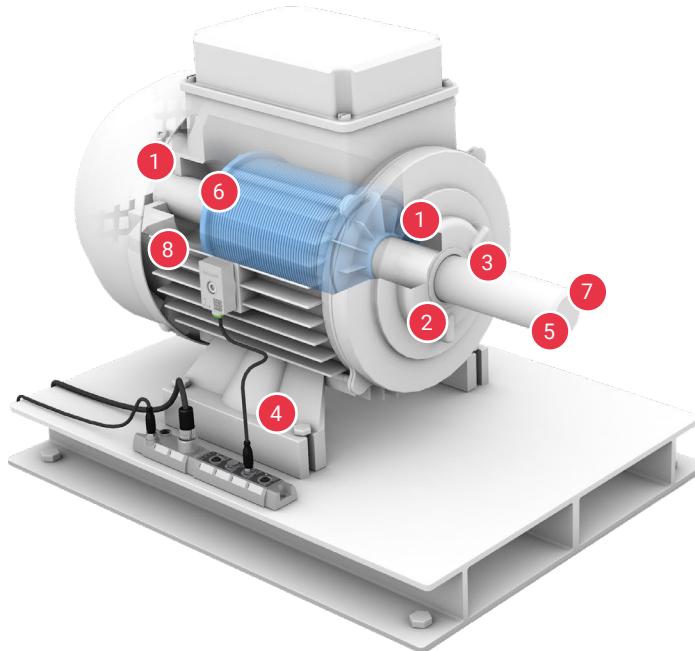


# Applications

Know the condition of your equipment

## BCM Family

## Stay on top of your motor's condition



- 1 Bearing damage (a-Peak, Crest Factor, \*bearing frequencies)
- 2 Lack of lubrication, friction (a-RMS, temperature)
- 3 Imbalance (v-RMS, \*rotation frequency)
- 4 Loosening (v-RMS)
- 5 Misalignment (v-RMS)
- 6 Electrical failures (rotor/stator) (v-RMS, temperature)
- 7 Coupling wear (v-RMS)
- 8 Resonance (v-RMS, \*resonant frequencies)

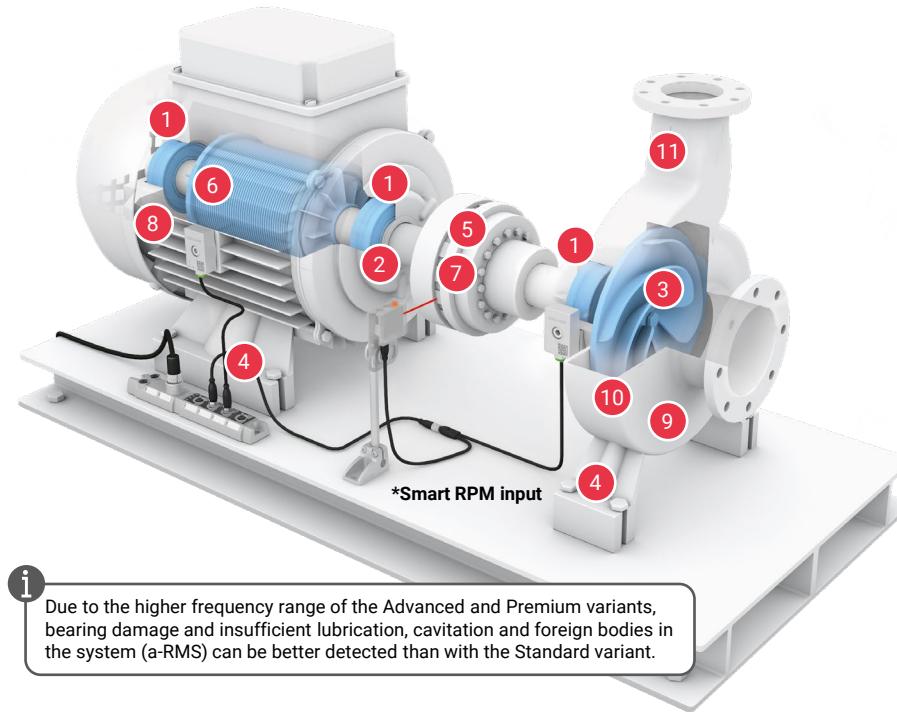


Due to the higher frequency range of the Advanced and Premium variants, bearing damage and insufficient lubrication (a-RMS) can be better detected than with the Standard variant.

## BCM Family

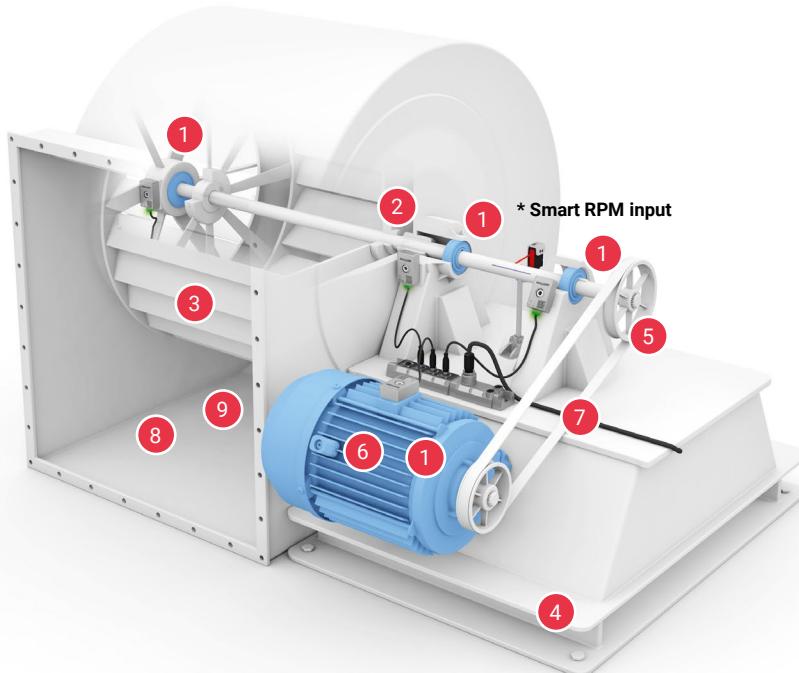
## Keep your pump's performance in check

- 1 Bearing damage (a-Peak, Crest Factor, **\*bearing frequencies**)
- 2 Lack of lubrication, friction (a-RMS, temperature)
- 3 Imbalance (v-RMS, **\*rotation frequency**)
- 4 Loosening (v-RMS)
- 5 Misalignment (v-RMS)
- 6 Electrical failures (rotor/stator) (v-RMS, temperature)
- 7 Coupling wear (v-RMS)
- 8 Resonance (v-RMS)
- 9 Cavitation (a-Peak, Crest Factor, **\*frequency analysis**)
- 10 Flow fluctuation (v-RMS, **\*resonant frequencies**)
- 11 Contamination (a-Peak)



## BCM Family

## Track your fan's health with ease



- 1 Bearing damage (a-Peak, Crest Factor, \*bearing frequencies)
- 2 Lack of lubrication, friction (a-RMS, temperature)
- 3 Imbalance (v-RMS, \*rotation frequency)
- 4 Loosening (v-RMS)
- 5 Misalignment (v-RMS)
- 6 Electrical failures (rotor/stator) (v-RMS, temperature)
- 7 Belt damage (v-RMS)
- 8 Flow fluctuation (v-RMS, \*resonant frequencies)
- 9 Contamination (a-Peak)



Due to the higher frequency range of the Advanced and Premium variants, bearing damage, insufficient lubrication and contamination (a-RMS) can be better detected than with the Standard variant.

# Product highlights

BCM Advanced / Premium



# BCM Advanced / Premium

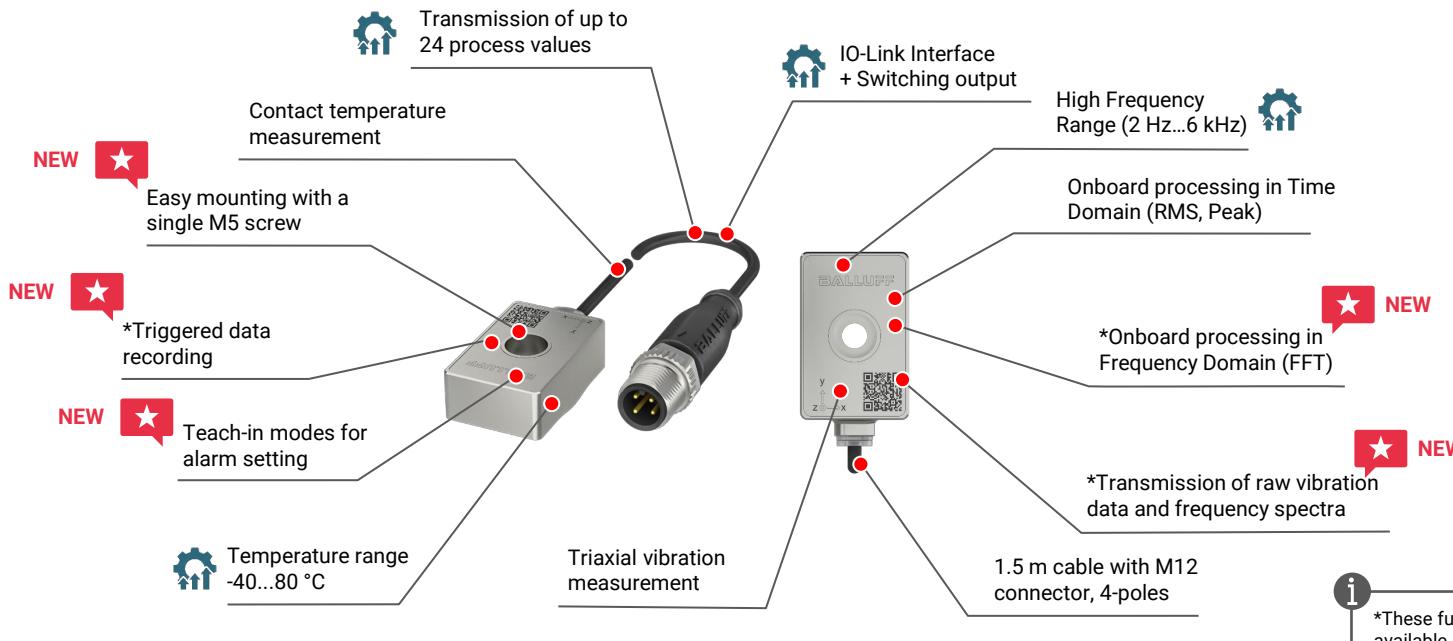
## Sets new standards for condition monitoring

-  Detect potential machine downtimes at the earliest possible stage.
-  Utilize specialized algorithms, such as frequency analysis (FFT) for bearing diagnostics, to reliably identify critical conditions.
-  Benefit from the high performance of vibration measurement to better detect high-frequency critical phenomena.
-  The innovative housing concept allows for easy, quick, and safe installation – especially as a retrofit solution.
-  Take advantage of access to raw acceleration data and high-resolution frequency spectra for individual analysis.



## BCM Advanced / Premium

# All functions at a glance

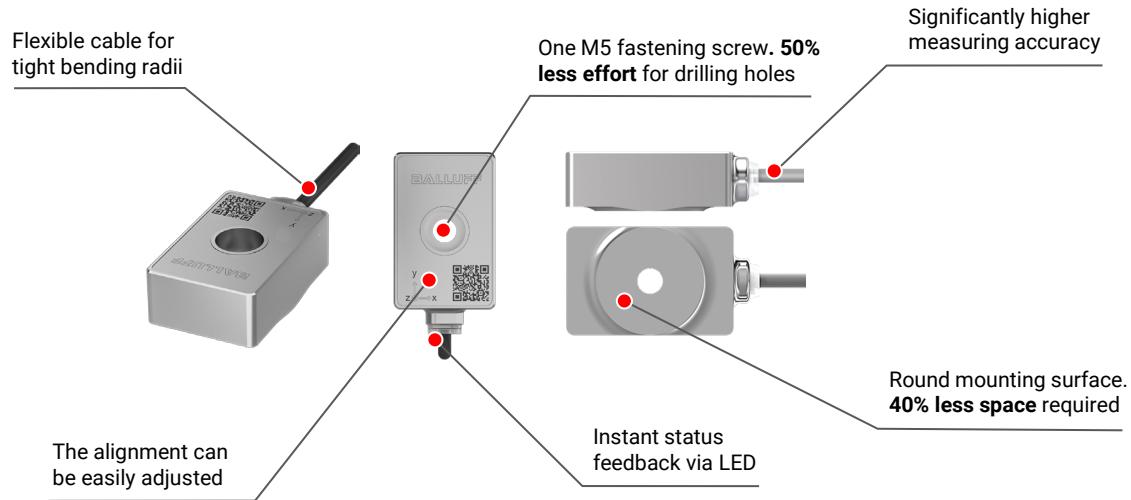


**BCM Advanced / Premium**

# Designed for simplicity – installed in no time



Click here for  
more details!



# Deep Dive

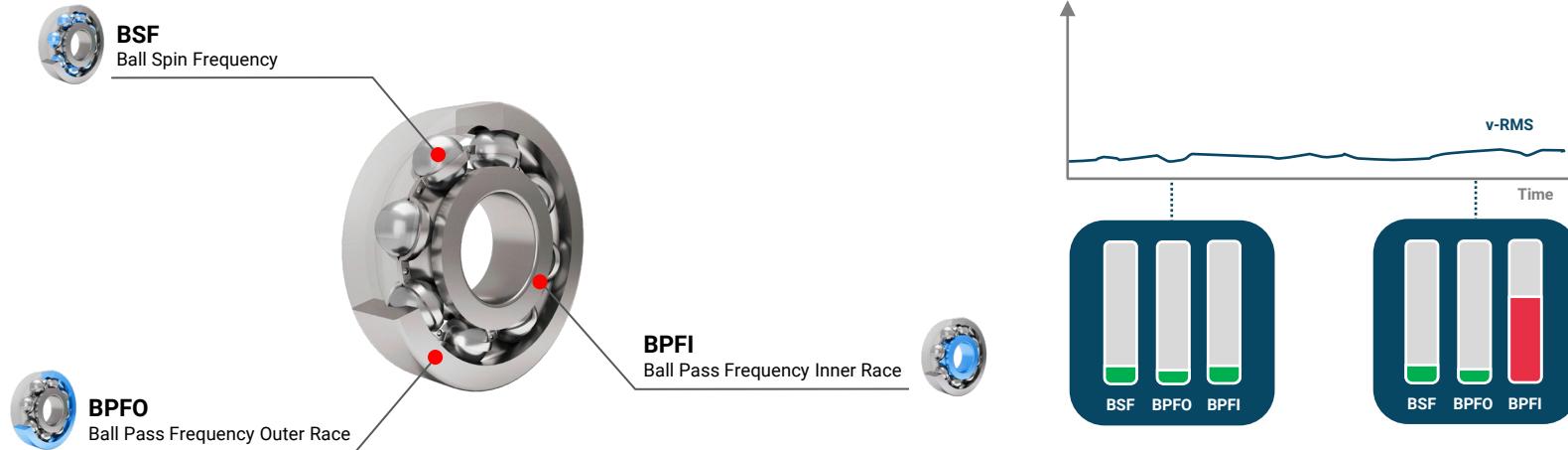
Bearing monitoring  
with BCM Premium



**BCM Premium**

# Keeping Track of Bearing Frequencies

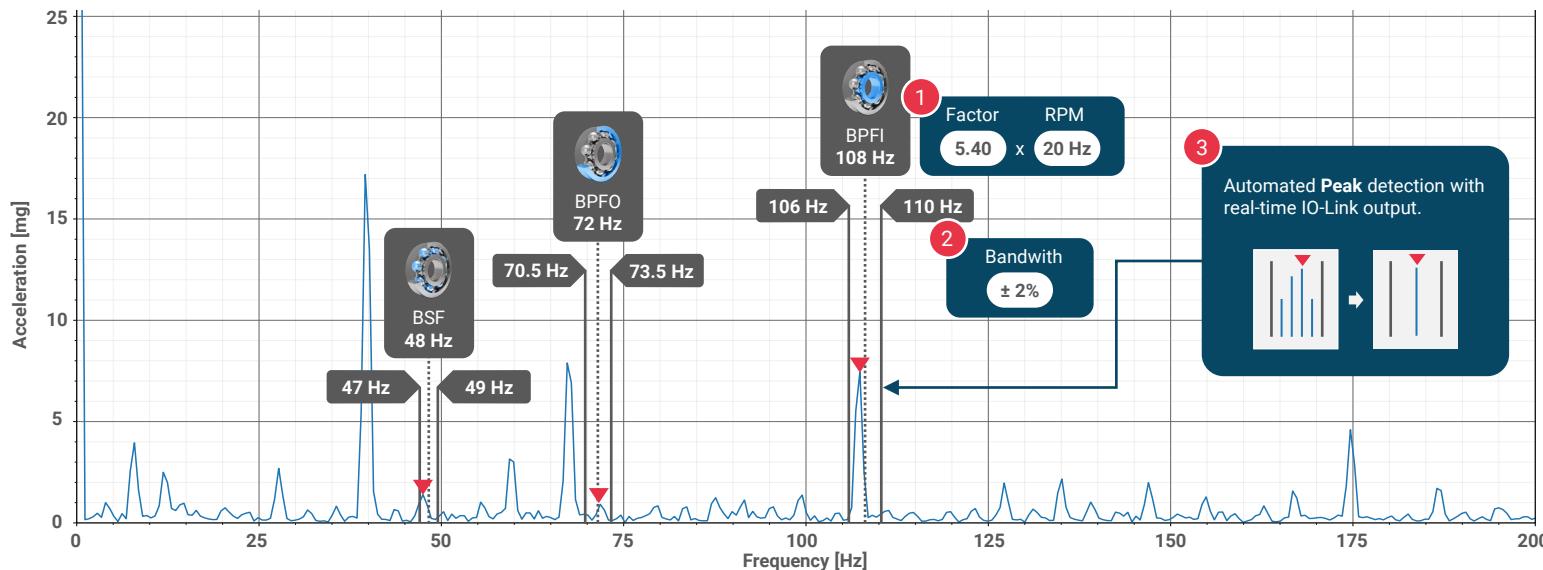
When a rolling bearing rotates, the various bearing components rotate at different frequencies. A ball, for example, completes several full rotations during one complete revolution of the inner race. The relevant frequencies are continuously monitored and if one of the characteristic values changes over time, bearing damage can be clearly identified – and long before it has serious consequences.



## BCM Premium

## Evaluation of the envelope spectrum (e-FFT)

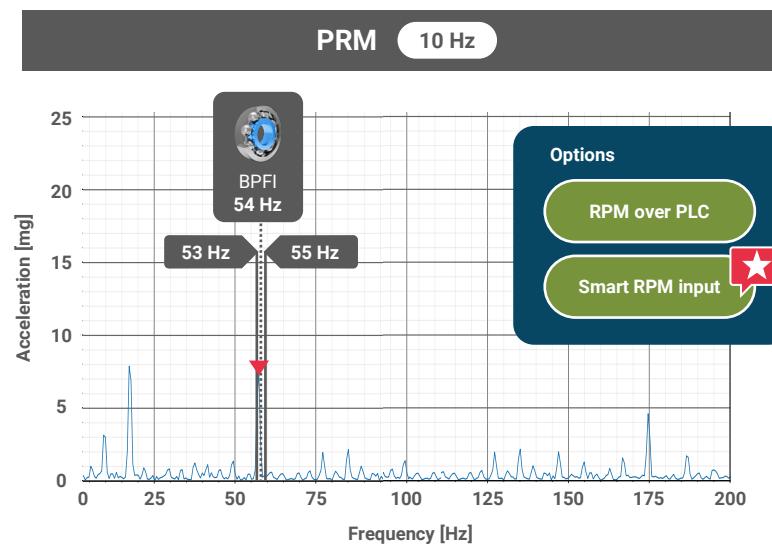
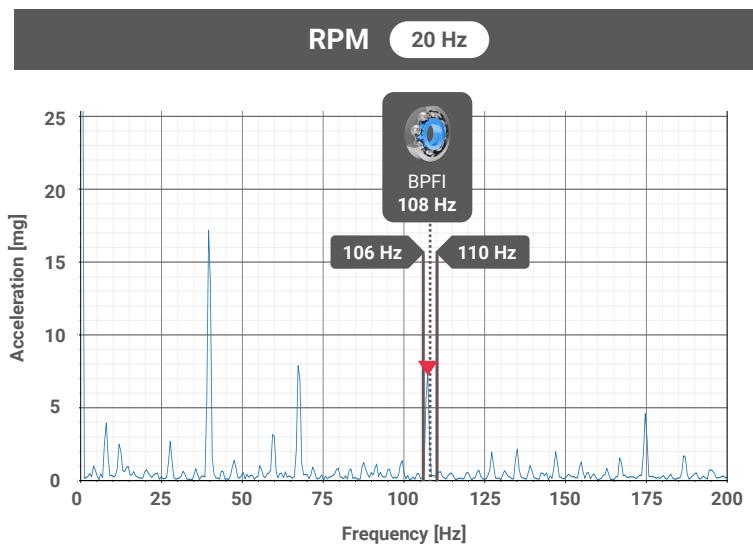
The frequency factors for BSF, BPFI, and BPFO are derived from the bearing geometry and can be uploaded to the sensor. By combining them with the current rotational speed, the bearing frequencies are dynamically calculated. These frequency factors can be configured using our BCM Assistant, which features a comprehensive bearing database with more than 160,000 entries.



## BCM Premium

# Automatic adjustment of frequency bands

To ensure the sensor always monitors the correct frequencies, it must know the current rotational speed. With this information, the sensor can dynamically adjust the frequency bands, ensuring that valid data is continuously provided.

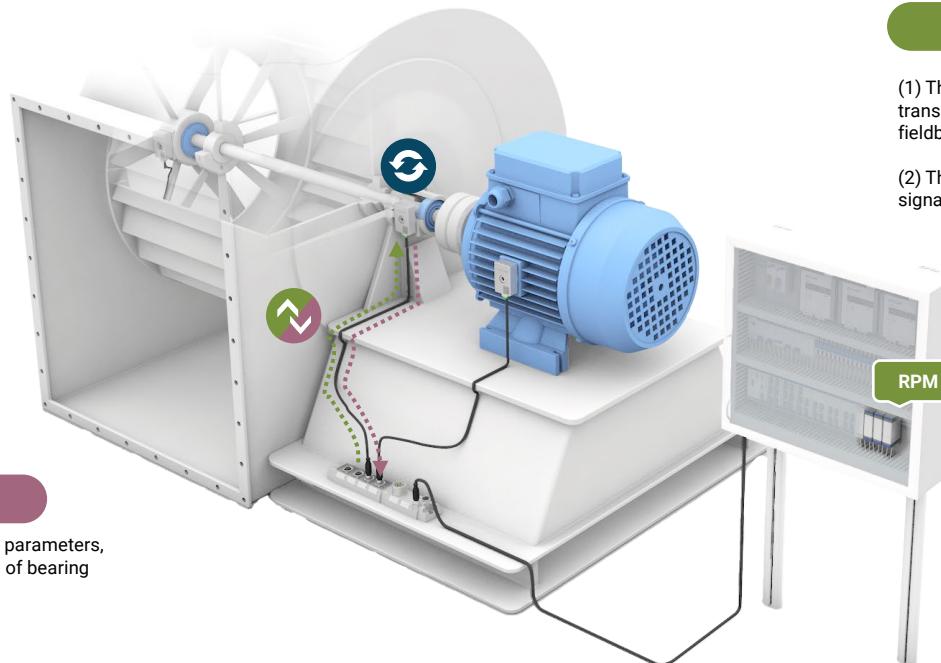


## BCM Premium

## The PLC sets the pace – RPM input via IO-Link

## Onboard processing

(3) The BCM performs RPM-dependent data processing



## External RPM input

(1) The PLC provides the RPM, which is transmitted to the IO-Link master over the fieldbus

(2) The IO-Link master transmits the RPM signal to the BCM over IO-Link

## IO-Link communication

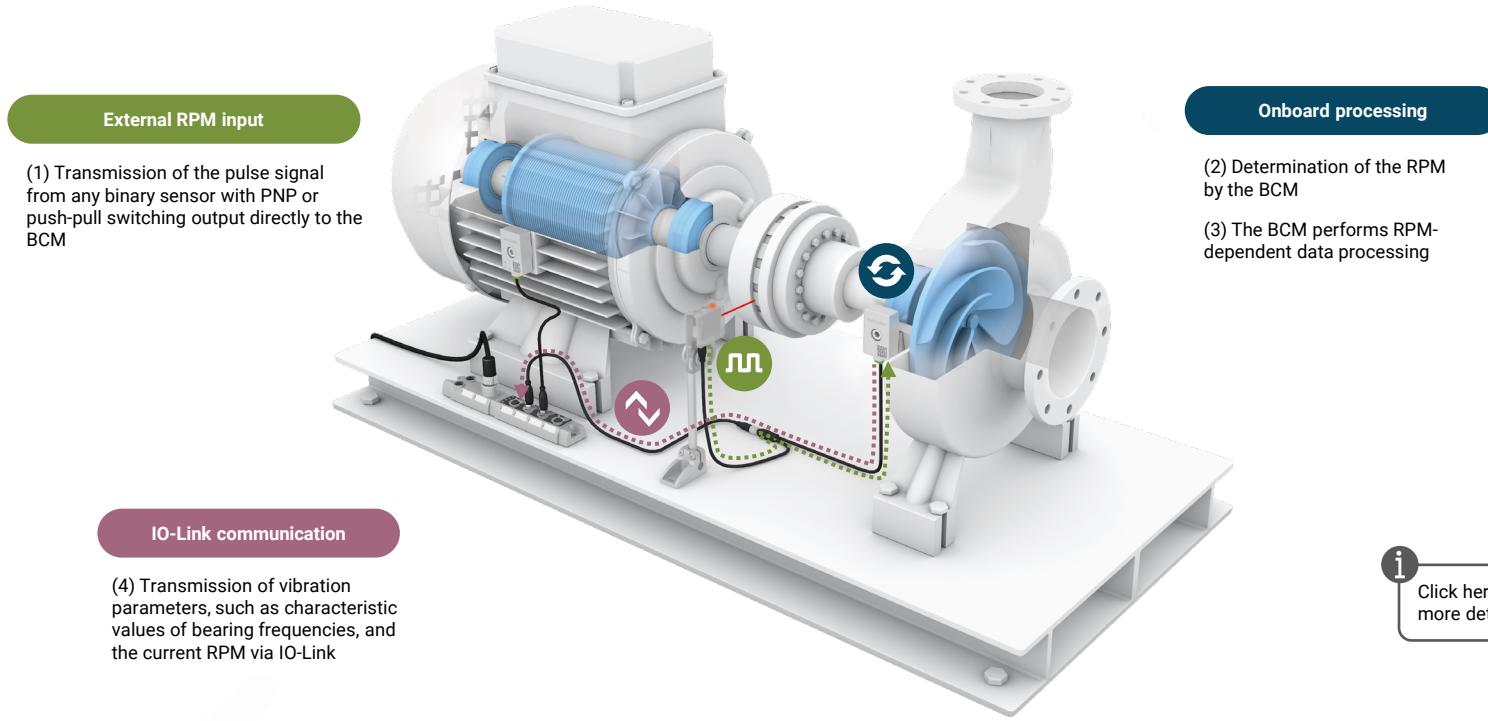
(4) Transmission of vibration parameters, such as characteristic values of bearing frequencies, via IO-Link



Click here for more details!

## BCM Premium

## Sensors work together – Smart RPM input

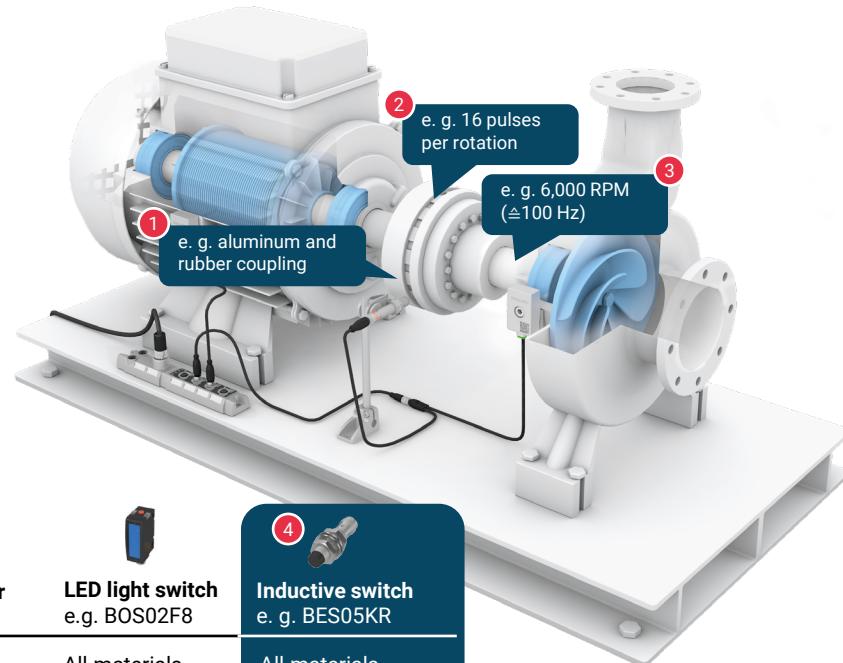


# BCM Advanced / Premium

## Smart RPM input

### – find the right sensor

- 1 Identify a suitable position on the drive shaft of the bearing to generate an RPM-dependent pulse signal.  
**Note:** couplings, shafts, gears, impellers, fan wheels
- 2 Define the number of switching pulses per revolution.  
e. g. 16 pulses per rotation
- 3 Determine the maximum rotational speed of the drive shaft.  
e. g. 6,000 RPM ( $\pm 100$  Hz)
- 4 Check the conditions of the specific installation situation and select a suitable sensor technology.



	Contrast sensor e. g. BOS02EM	LED light switch e.g. BOS02F8	Inductive switch e. g. BES05KR
<b>Target</b>	All materials	All materials	All materials
<b>Range</b>	$\leq 250$ mm	$\leq 200$ mm	$\leq 8$ mm
<b>Rate</b>	4,000 Hz	700 Hz	2,000 Hz

16 pulses  $\times$  100 Hz  
Min. measuring rate = 1,600 Hz



# Ordering Information

Sensors, mounting accessories,  
network technology



## BCM Family

## Mounting made easy – Find the right accessory

Criteria	Screw mounting	Screw-in adapter	Adhesive mounting	Adhesive adapter	Cooling fin adapter	Magnetic mounts
No additional threaded mounting hole required	✗	✓	✓	✓	✓	✓
Uneven mounting surfaces acceptable	✗	✗	✓	✓	✓	✗
Easy to apply on curved surfaces	✗	✗	✓	✓	✗	✓
Re-alignment of measurement axes possible afterwards	✓	✓	✗	✓	✓	✓
Non-destructive removal in case of replacement	✓	✓	✗	✓	✓	✓
No impact on measurement accuracy	✓	✓	✓	✓	✗	✗
No additional mounting accessories required	✓	✓	✗	✗	✗	✓

## BCM Family

## Mounting Accessories for Standard Line

Choose the appropriate mounting accessories for your sensors.

**BCM – Condition Monitoring Sensors**

**BCM0001:** Standard version with vibration and temperature



**BCM0004:** Advanced version with vibration and temperature



**BCM0003:** Premium version with integrated frequency analysis

**1 Magnetic mounts**

- **BAM03FA:** Magnetic mount for flat surfaces

**2 Screw-in adapters**

- **BAM04A1:** Adapter to M5
- **BAM04A2:** Adapter to M6
- **BAM04A3:** Adapter to M8
- **BAM04A4:** Adapter to M10

**3 Adhesive adapters**

- **BAM03HF:** Adapter for flat surfaces
- **BAM04K4:** Cooling fins S
- **BAM04K5:** Cooling fins M
- **BAM04K6:** Cooling fins L



## BCM Family

## Mounting Accessories for Advanced &amp; Premium Line

Choose the appropriate mounting accessories for your sensors.

**BCM – Condition Monitoring Sensors**

**BCM0001:** Standard version with vibration and temperature



**BCM0004:** Advanced version with vibration and temperature



**BCM0003:** Premium version with integrated frequency analysis

**1 Magnetic mounts**

- **BAM049U:** Magnetic mount for flat surfaces
- **BAM04L6:** Magnetic mount for curved surfaces

**2 Screw-in Adapters**

- **BAM049N:** Adapter to M6
- **BAM049P:** Adapter to M8
- **BAM049R:** Adapter to M10
- **BAM049T:** Adapter to M12

**3 Adhesive adapters**

- **BAM049J:** Adapter for flat surfaces
- **BAM049K:** Cooling fins S
- **BAM049L:** Cooling fins M
- **BAM049M:** Cooling fins L



## BCM Family

# Accessories for Smart RPM input

Use the following accessories for Smart RPM input.

### BCM – Condition Monitoring Sensors



**BCM0001:** Standard version with vibration and temperature



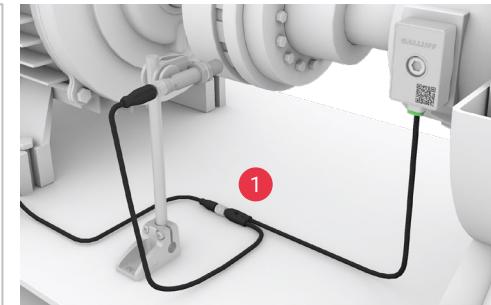
**BCM0004:** Advanced version with vibration and temperature



**BCM0003:** Premium version with integrated frequency analysis

### ① Y-connector for RPM input

- **BCC0K6M:** 0.3m/0.6m
- **BCC0K6N:** 0.3m/1.0m
- **BCC0K6P:** 0.6m/1.0m
- **BCC0K6R:** 1.0m/2.0m



### ② Sensors for RPM measurement

- **BES05KR:** Inductive switch (2,000 Hz)
- **BOS02F8:** Photoelectric sensor (700 Hz)
- **BOS02EM:** Contrast sensor (4,000 Hz)



## BCM Family

## Integration made easy – The perfect network solution

## BCM – Condition Monitoring Sensors



Standard

**BCM0001:** Standard version with vibration and temperature



Advanced

**BCM0004:** Advanced version with vibration and temperature



Premium

**BCM0003:** Premium version with integrated frequency analysis

Choose a network solution that fits your application.

1 **IO-Link Master for integration into control systems**

- **Black Line:** The core solution with a strong price-performance ratio.  
e.g., **BNI00L3**
- **Silver Line:** Focused on specialized applications requiring extra robustness.  
e.g., **BNI00K6**
- **Washdown Line:** Designed for applications in IP69K environments.  
e.g., **BNI00HZ**



2 **CMTK – Condition Monitoring Toolkit for IT integration**

- **BNI00L2:** Edge gateway with 4x IO-Link, expandable up to 40x IO-Link via a maximum of 5 IO-Link Masters.

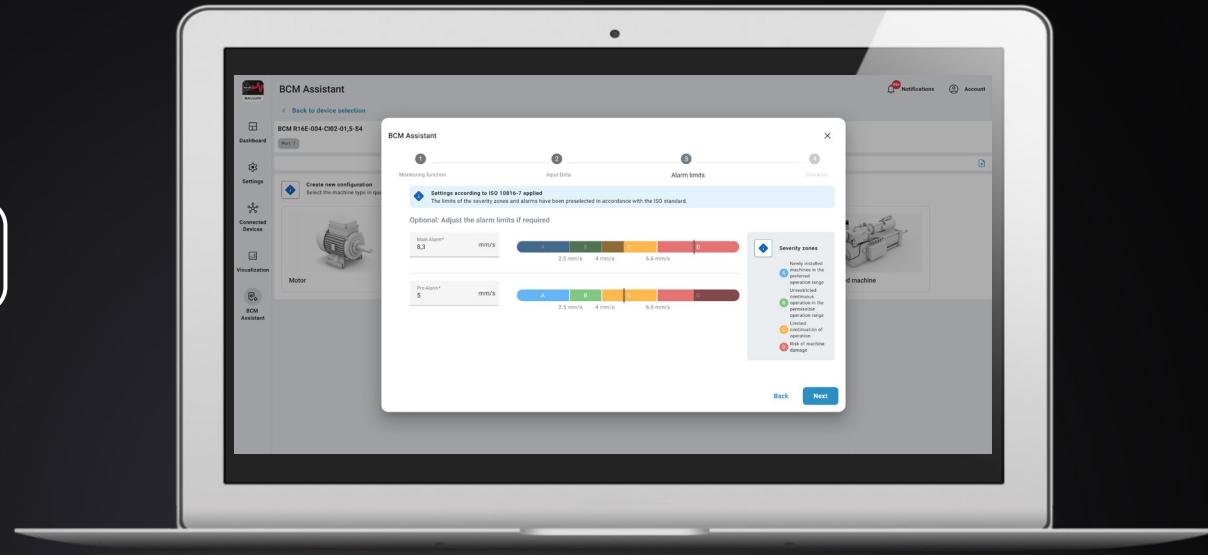


Can be combined with 1. Choose between Black, Silver, and Washdown Line.

# BCM ASSISTANT



Always perfectly configured





## BCM Assistant

Configure precisely for your needs with minimal effort



### Perfectly configured

Customize your BCM sensors perfectly to your individual application.



### Convenient to use

The intuitive user interface allows you to achieve your set-up quickly and conveniently.



### Quick to implement

Complete the configuration of your BCM sensors in just a few minutes.



### Versatile in use

In addition to various ISO standards for a wide range of machine types, you also have access to an extensive bearing database with more than 160,000 types.





## BCM Assistant

Configure precisely for your  
needs with minimal effort

BCM Assistant

BCM R16E-004-CI02-01,5-S4

Port 1

Dashboard

Settings

Connected Devices

Visualization

BCM Assistant

Back to device selection

Notifications

Account

Create new configuration

Select the machine type in question to start the assistant for configuring the sensor. The machine type can only be selected for the initial configuration and cannot be changed for additional configurations.

Motor

Pump

Fan

Compressor

User-defined machine

1 Start the assistant and select which machine type (e.g., pump) you want to monitor.



## BCM Assistant

Configure precisely for your needs  
with minimal effort

The screenshot shows the BCM Assistant software interface. On the left is a sidebar with icons for Dashboard, Settings, Connected Devices, Visualization, and BCM Assistant. The main area shows a device configuration for 'BCM R16E-004-CI02-01,5-S4' with 'Port 1' and 'Machine type: Pump'. A central modal window is open, titled 'BCM Assistant' with a progress bar at the top. Step 1: 'Monitoring function' is selected. Step 2: 'Input Data' is the next step. Step 3: 'Alarm limits' is the third step. Step 4: 'Checklist' is the final step. The modal contains a list of monitoring functions:

- ISO 10816-7: For monitoring centrifugal pumps in accordance with ISO 10816-7.
- Temperature: For monitoring the temperature at the contact surface of the sensor.
- Bearing frequencies**: For monitoring bearing frequencies using FFT analysis. This option is selected.
- User-defined peak: For individual monitoring of peak values, e.g., for detecting shocks.
- User-defined RMS: For individual monitoring of RMS values, e.g., to detect imbalances, misalignments or belt damages.

A 'Next' button is at the bottom right of the modal. At the bottom of the main window, a callout box indicates: '② Select a monitoring function (e.g., bearing frequencies) that the sensor should perform.'



## BCM Assistant

Configure precisely for your needs  
with minimal effort

The screenshot shows the BCM Assistant software interface. On the left, there is a sidebar with icons for Dashboard, Settings, Connected Devices, Visualization, and BCM Assistant. The main area is titled 'BCM Assistant' and shows a device configuration for 'BCM R16E-004-CI02-01,5-S4'. A sub-menu is open for 'BCM Assistant' with steps 1 through 4. Step 1 is 'Monitoring function', Step 2 is 'Input Data', Step 3 is 'Alarm limits', and Step 4 is 'Checklist'. Step 3 is currently active and shows a search interface for selecting a bearing. The search bar contains 'Bearing code 6002'. The results table has columns for 'Bearing code', 'Bearing type', 'Manufacturer', 'Outer', 'Width', 'Quantity of rolling elements', and a help icon. The results show various bearings from manufacturers like ZKL, KOYO, NTN, SKF, and FAG. The first result is '6002ARS' from KOYO. At the bottom of the search interface are 'Back' and 'Next' buttons. A callout at the bottom left points to the search interface with the text: '3 Select a bearing from our extensive database. With more than 160,000 types, you are sure to find the right one.'

3 Select a bearing from our extensive database. With more than 160,000 types, you are sure to find the right one.



## BCM Assistant

Configure precisely for your needs  
with minimal effort

BCM Assistant

BCM R16E-004-CI02-01,5-S4

Monitoring function

Input Data

Alarm limits

Checklist

Bearing 6002 from SKF was selected from database. You have selected a bearing from the database. This means that the frequency factors have been automatically applied and can no longer be changed.

Optional: If required, you can adjust the frequency window ⓘ

**Inner race**

Frequency factor\* 5,4119

Frequency window  $\pm 5$  %

**Outer race**

Frequency factor\* 3,5881

Frequency window  $\pm 5$  %

**Rolling elements**

Frequency factor\* 2,3661

Frequency window  $\pm 5$  %

Back Next

4 You will receive an overview of the automatically set bearing frequencies (BPFI, BPFO, BSF).



## BCM Assistant

Configure precisely for your  
needs with minimal effort

The screenshot shows the BCM Assistant software interface. On the left is a sidebar with icons for Dashboard, Settings, Connected Devices, Visualization, and BCM Assistant. The main area shows a device configuration for 'BCM R16E-004-CI02-01,5-S4' with 'Port: 1' and 'Machine type: Pump'. A central modal window is open, titled 'BCM Assistant' with a progress bar at the top. The progress bar has four steps: 1. Monitoring function (completed), 2. Input Data, 3. Alarm limits, and 4. Checklist. Step 1 is highlighted with a green checkmark and the text 'Setup of the monitoring function completed'. Below this, it says 'Assign a name to your monitoring function.' with a text input field containing 'Application name\*' and 'Bearing Pump'. It also says 'You can now upload your monitoring function directly to the sensor or create another monitoring function.' with a 'Upload monitoring function' button. Below that, it asks 'Would you like to create another monitoring function?' with a 'Create new monitoring function' link. At the bottom of the modal are 'Back' and 'Done' buttons. A large callout at the bottom left, labeled '5', points to the 'Done' button with the text 'The configuration of your monitoring function is complete and can be uploaded to the sensor with one click.'

5 The configuration of your monitoring function is complete and can be uploaded to the sensor with one click.



## BCM Assistant

Configure precisely for your needs  
with minimal effort

**Visualization**

[Reinitialize](#)

Switch to live view

**Alarms**

port1: Ball Pass Frequency Inner Race (BPFI) X [g] | Current rotational speed [RPM]

Firing for 2s  
> 1 instance

[View alert rule](#)

**Dashboards**

Master 1

**port1** ❤️

0.16 g  
0.14 g  
0.12 g  
0.10 g  
0.08 g  
0.06 g  
0.04 g  
0.02 g  
0 g

2500 RPM  
2000 RPM  
1500 RPM  
1000 RPM  
500 RPM

Ball Pass Frequency Inner Race (BPFI) X [g]  
Ball Pass Frequency Inner Race (BPFI) Y [g]  
Ball Pass Frequency Inner Race (BPFI) Z [g]  
Ball Pass Frequency Outer Race (BPFO) X [g]  
Ball Pass Frequency Outer Race (BPFO) Y [g]  
Ball Pass Frequency Outer Race (BPFO) Z [g]  
Ball Spin Frequency (BSF) X [g]  
Ball Spin Frequency (BSF) Y [g]  
Ball Spin Frequency (BSF) Z [g]  
Current rotational speed [RPM]

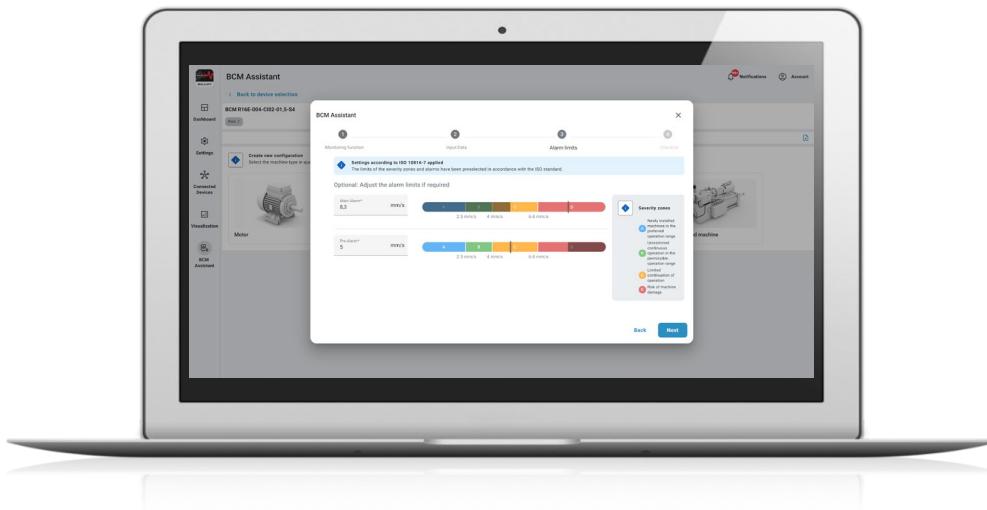
13:01:00 13:02:00 13:03:00 13:04:00 13:05:00 13:06:00 13:07:00 13:08:00 13:09:00 13:10:00

6 The sensor is perfectly configured for your application. Monitor the relevant vibration parameters.



## BCM Assistant

Configure precisely for your needs  
with minimal effort



## BCM Assistant now available!



CMTK – Condition  
Monitoring Toolkit



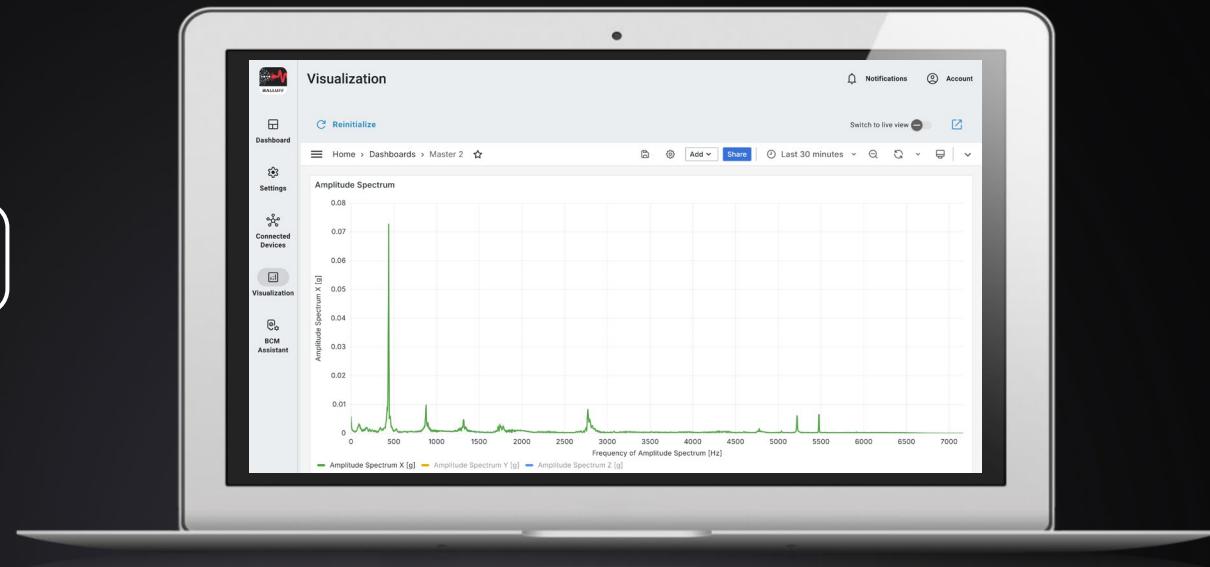
BET – Balluff  
Engineering Tool



# BCM VibExtract



VibExtract – Access to raw data and frequency spectra





## BCM VibExtract

For full access to raw acceleration data and frequency spectra



### Maximized data access

Decide for yourself which additional data should be recorded and provided by BCM Premium. Gain access to raw acceleration data and high-resolution frequency spectra.



### Flexible data request

Retrieve the data packets at regular intervals (e.g., every hour) or link this to specific events.



### Versatile in use

Analyze the data directly on the device or make the data packets available for downstream analyses, e.g., in the cloud.





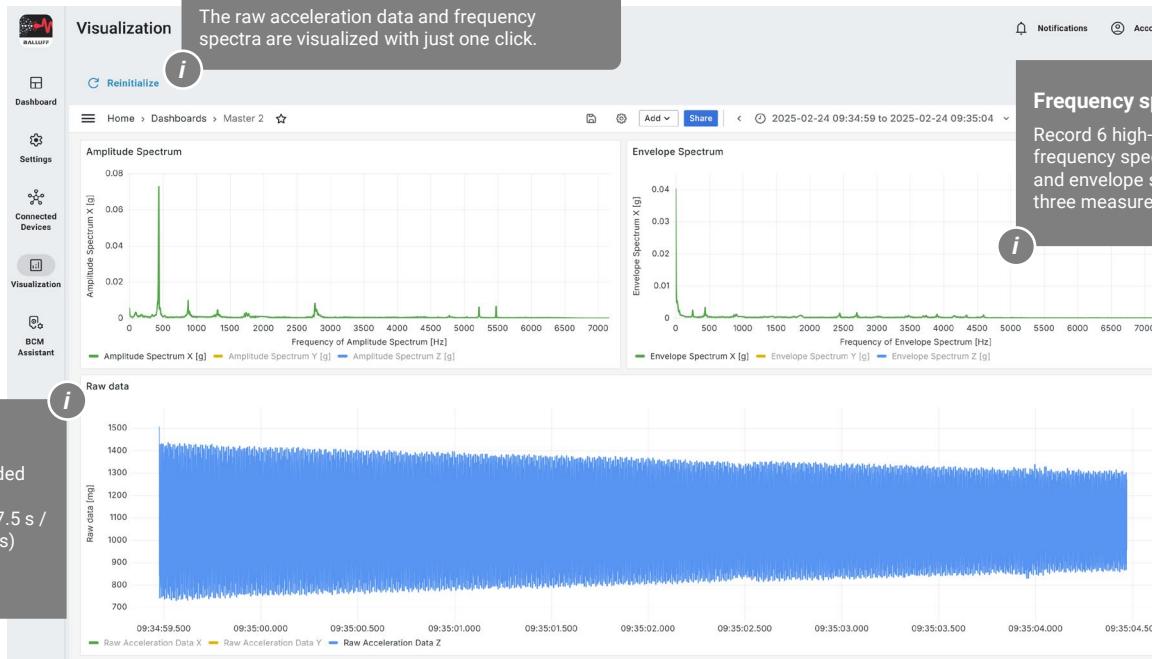
## BCM VibExtract

For full access to raw acceleration data and frequency spectra

**Visualization**  
The raw acceleration data and frequency spectra are visualized with just one click.

**Frequency spectra**  
Record 6 high-resolution frequency spectra (amplitude and envelope spectra) for all three measurement axes.

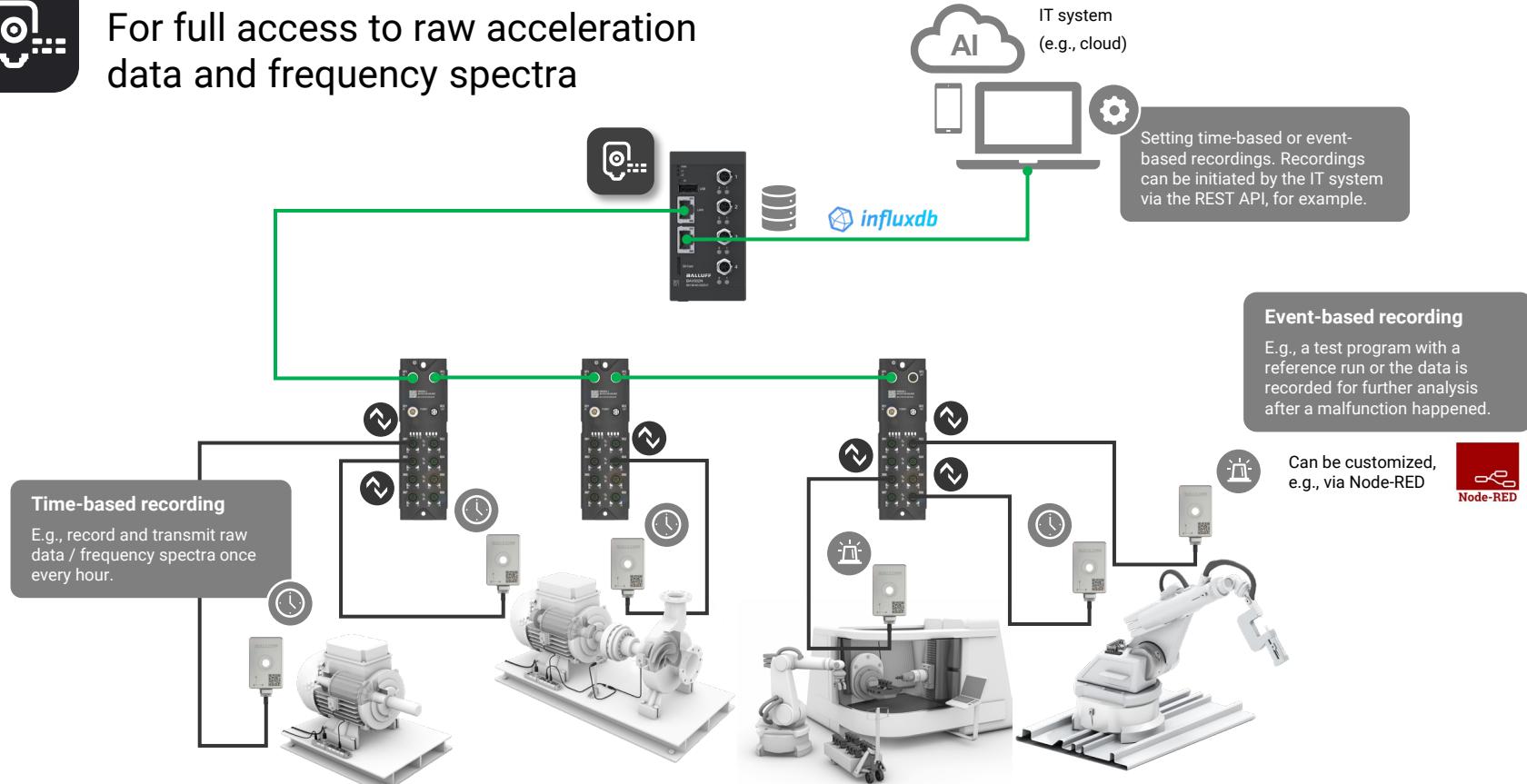
**Acceleration raw data**  
Raw data is always recorded for 15 s. You can decide whether one (15 s), two (7.5 s / axis) or all three (5 s / axis) measurement axes are recorded.





## BCM VibExtract

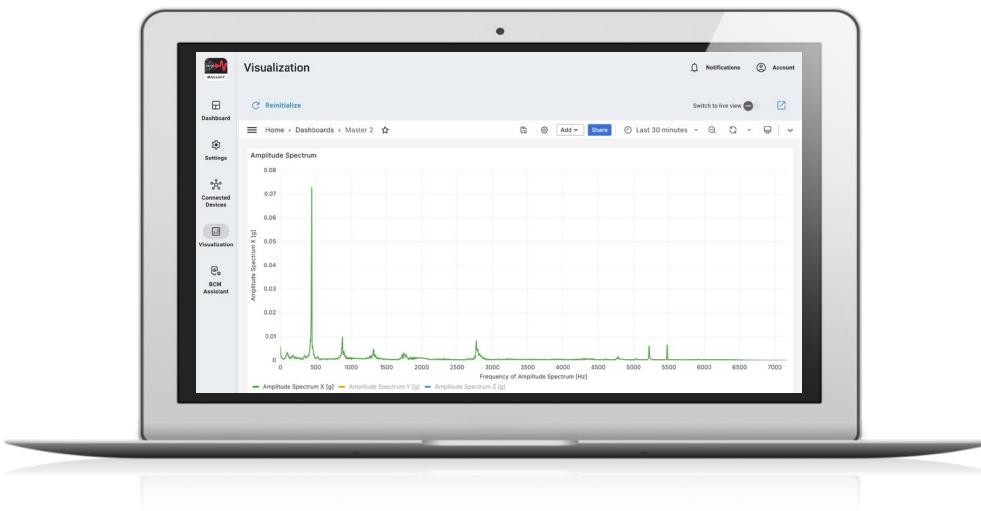
For full access to raw acceleration data and frequency spectra





## BCM VibExtract

For full access to raw acceleration data and frequency spectra



BCM VibExtract  
now available!



**BALLUFF**  
**A GLOBAL PROMISE.**



*innovating automation*

## BCM Family

## Comparison – Single and Dual Screw Design

[Back to overview](#)

## Single Screw Design (BCM Advanced &amp; Premium)

## ADVANTAGES

- + It's easier to drill only one hole.
- + Already known in the industry.
- + Tools already exist that can create a round contact surface with a centered hole in a single step.
- + It is sufficient if the screw is tightened strongly enough so that it cannot loosen.
- + The alignment of the measurement axes can be done during installation and adjusted if necessary.



## Dual Screw Design (BCM Standard)

## ADVANTAGES

- + Unwanted rotation due to a loose screw is significantly hindered.



## DISADVANTAGES

- Complicated manufacturing of the two holes, as nearly perfect alignment is necessary. Subsequent adjustment of the alignment is not possible.
- The screws must be tightened with exactly the same torque to avoid housing tension, which could lead to unwanted resonances in the measurement signal.
- A large rectangular mounting surface must be prepared. The larger the contact surface, the more difficult it is to ensure consistent flatness.

## BCM Premium

## Dynamic RPM input from the PLC

[Back to overview](#)

## Application / Sensors

## Network Technology

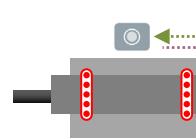


## BCM Premium

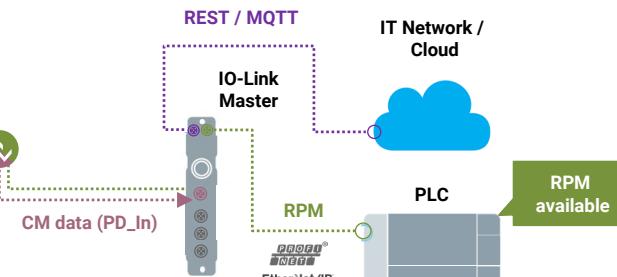
- Calculation of the envelope spectrum.
- Dynamic adjustment of frequency bands using the speed input via IO-Link (**PD\_OUT**).
- Provision of the calculated frequency characteristics via IO-Link (**PD\_IN**).



Front view



Side view



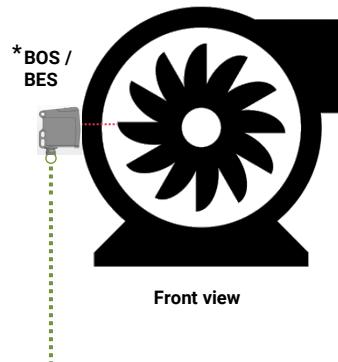
Provision of the RPM value in a specific data format (UINT16) as **PD\_OUT**.

## BCM Premium

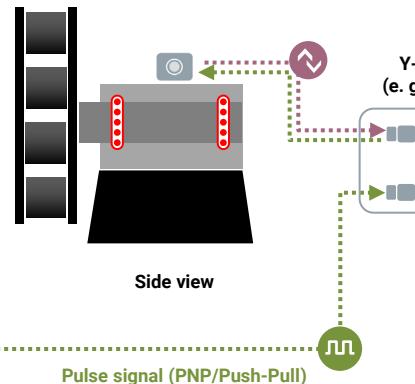
## Dynamic RPM input from binary Sensor

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## Application / Sensors



Front view



Side view

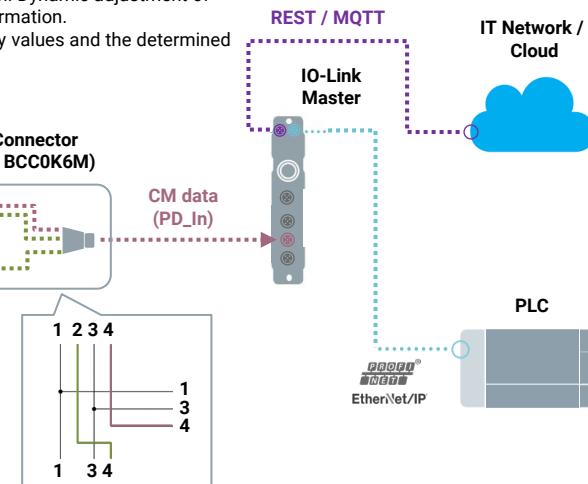
Pulse signal (PNP/Push-Pull)

## Network Technology



## BCM Premium

- Definition of a divider depending on the number of blades.
- Conversion of the pulse frequency received via **Pin 2** into RPM.
- Calculation of the envelope spectrum. Dynamic adjustment of frequency bands based on RPM information.
- Provision of the calculated frequency values and the determined speed via IO-Link (**Pin 4**).



\* Selection of the measurement principle according to the application.