

# Measure-, Documentation- and Monitoring System BodAS - BomAS





**Wireless monitoring and documentation system BodAS / BomAS for bolt connections**

## **BodAS**

As the first worldwide obtainable system in the market all data concerning high loaded screw connections can be collected and transferred wirelessly. Also all features of the corresponding hardware can be used wirelessly.

Until now it was not possible to document and storage elongation and force of a bolt connection during pretensioning.

All data had to be written manually with a high expenditure of time. They could be fudged and there was no possibility to control them. So the accuracy of documentation was of less quality.

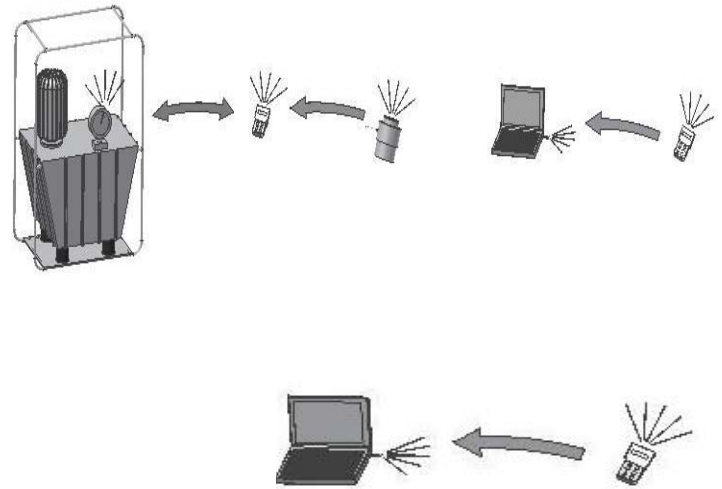
In the BodAS system you can measure the pressure with which the bolt is tensioned and also the elongation of the bolt. The BodAS extension sensor could be adapted to any bolt tensioning device as well as assembled directly inside a tensioner.

The wireless pressure sensor is adapted to your pressure generator or available as a separate measuring tool to connect it with every pump – autonomous to the type and the manufacturer.

At the site the radio remote control will be used as a receiver for the data send from the pressure-measuring transformer and the extension sensor as well as a controller for the electro-hydraulic pump.



From the resulted combination of the data (forces and extension of a screw connection), a characteristic curve for each case will be individually displayed and calculated in the BodAS II software parallel to the tensioning process. Later, exactly like in BodAS I, the whole tensioning process of all screws can be filed and documented.



Absolute advantage of these procedure is the quickness and the convenience of the complete system. Up to now you have to make a lot of prearrangement work before starting measuring. In addition to this the measured values were of less accuracy.

Now you can do the whole measuring process just by pressurizing your tensioner.

The wireless remote control is coeval the centre of the BodAS system and works as a mobile and high-capacity control unit.

All data, which are stored in the wireless remote control, can be send to a computer via an USB-dongle – also wireless.

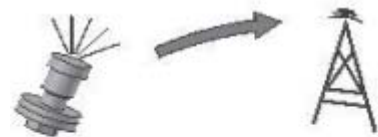
With this system AS Tech now gives you the possibility to calculate and display all rest pretensioning forces automatically and quick.

Particularly the wireless implementation of all tools inside the complete system makes the handling at the most different location easy and safe.

## BomAS

The BomAS software can be demonstrated in the identically template to the BodAS II software.

BomAS allows by a special extension measuring head - its battery capacity allows a working time of 2 years-, a continuous monitoring of the screw connections since its initial operation.



This option allows particularly in hard reachable places (offshore-plants) as well as in high safety plants (Nuclear power station) a future oriented option to monitor screw connections without a big loss of time and so it is very profitable.



So AS Tech follows the trend to control plants by a Condition-Monitoring-System and supplies this now for high loaded bolt connections.

### Wireless network for pressure and temperature sensors

With the already described pressure sensors it is also possible to monitor all kind of hydraulic components concerning their pressure and their temperature.

Typical applications therefore are rotating devices at plants or heavy accessible locations, where wire controlled sensors means a risk of danger - if even possible.

Additional to the already described BodAS system is this the perfect solution, if the assignment is to install the wireless system at a stationary plant (e.g. hydraulically clamping at machine tools).



The configuration can be done on customers demand and consist next to the sensors of a remote receiving station and a central control unit. In this unit you can control and adjust all parameters.

## Software – Systems





# BodAS I – Bolt Documentation System

## Documentation of pretensioning force during the application of force with hydraulic bolt tensioning devices

In order to fulfill the optimum requirements of machines and ensure long lifetimes as well as minimum down-times, it is of great interest for every manufacturer, certifier, insurer as well as for the operator of the machinery, how and with which quality the relevant bolt connections were fastened.

Documentation of these connections is therefore indispensable.

### What does BodAS I exactly do?

With BodAS I all relevant connections, or all **bolted connections under tension**, can be **automatically documented** over the entire screw process.

All the inputs of the tensioning procedure are registered in a tensioning protocol for the operator.

**BodAS I does everything else.**

BodAS I is equipped with a **radio signal processor** and stores all measured data during use in a **wireless handheld controller**.

The measured data is then transferred to a PC via a USB radio stick at the simple press of a button at the end of the day.

The BodAS I –software enters the data into the prepared tensioning protocol.

The final resulting tensioning protocol can be saved and printed.

Through the clever combination of expert–knowhow and information about the plant it is possible to keep the amount of transferred data very small; this is especially important when a large amount of plants have to be installed or maintenance work have to be performed.

## The advantages at a glance

- Automatic generation of protocol and screw order	- PC-Software with a user-friendly interface
- Wireless (no trip falls)	- As text- and diagram- file
- Automatic logging of measurements	- Automatic archiving
- Real time documentation	- Analysis of each tensioning process
- Storage capacity for up to 4000 screw processes	- Excel export of recorded data

## Example of a bolt connection

- Input mask of the software and a print out of the tensioning protocol

**BODAS I - v1.0.2 B. BODAS II und BOMAS Demonstration**

Location / Site: Aachen  
 Installation, Machine: Part 1  
 Part / Device: Screw 1

Screw Type:  Shaft Screw  Tension Screw

Thread Diameter [in]: 2.5   
 Thread Lead: 8   
 Screw Length [in]: 50  
 Screw Durability: 10.9  
 Elastic Limit [N/mm<sup>2</sup>]: 900 Tension is 28% of Limit.  
 Pretension Force Fv [kN]: 610  
 Kerndurchmesser [mm]: 53.69  
 Spannungsquerschnitt [mm<sup>2</sup>]: 2462.52 Tension [N/mm<sup>2</sup>]: 248  
 Number of Screws: 24  
 Number of Tools: 6

Tool / Manufacturer: AS Tech  
 Tool Number / Type: HWS 25 212 034  
 Max. Fv [kN] / Max. Pressure p [bar]: 650 / 942  
 Piston Area of Tool Ak [mm<sup>2</sup>]: 6900

Table: Pressure / Force / Elongation			
%	Fv [kN]	p [bar]	Elongation (Mathematical)
70	427	619	
90	549	796	
100	610	884	

Location / Date: Geilenkirchen Today [Mi, 06.09.2006]  
 Name: Smith  
 Comments / Remarks:

**Tension Protocol** Page 1/4

Location: Geilenkirchen NA, 06.09.2006  
 Name: Smith  
 Location / Site: Aachen  
 Installation, Machine: Part 1  
 Part / Device: Screw 1  
 Job completed on:  
 Signature: \_\_\_\_\_

Irrtum und technische Änderung vorbehalten.

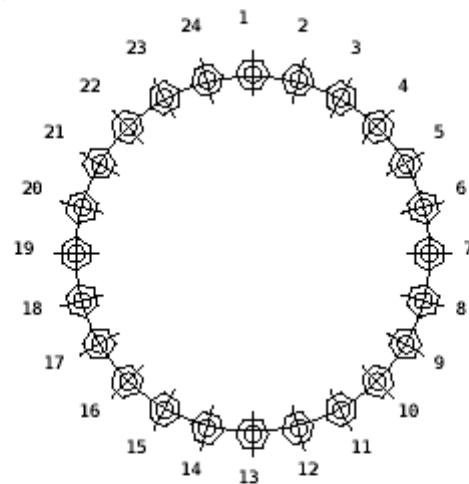
## Technical data:

### USB Stick:

- Range: up to 300m
- 868/915 MHz ISM frequency band (Operating license is not required)
- Maximum sending power: <10dB
- Power supply over USB (No other connections are necessary)
- Current consumption <50 mA
- Electronic water and dust protection according to IP 67
- Compatible with Windows 2000 (SP4) and Windows XP

### PC-Software:

- System requirements: Windows 2000 (SP4) or Windows XP
- 1 available USB port
- Minimum of 128 MB RAM and 150 MB free disk space
- Screen resolution of at least 1024x768



Tool / Manufacturer: AS Tech  
 Tool Number / Type: HWS 25 212 034  
 Tool Specs: Max. Tension Fv: 650 kN  
 Max. Pressure: 942 bar  
 Tool Area: 6900 mm<sup>2</sup>

Table: Pressure / Force / Elongation			
% of Fv	Fv [kN]	p [bar]	Elongation [mm]
70	427	619	
90	549	796	
100	610	884	

### Screw Specifications

Type: Shaft Screw  
 Diameter Ø [in]: 2.5  
 Thread Lead: 8  
 Screw Length [in]: 50  
 Screw Durability: 10.9  
 Elastic Limit [N/mm<sup>2</sup>]: 900  
 Pretension Fv [kN]: 610  
 Core Ø [mm]: 53.69  
 Core Cross Section [mm<sup>2</sup>]: 2462.52  
 Tension [N/mm<sup>2</sup>]: 248

### Group Sequence:

1	4, 8, 12, 16, 20, 24
2	6, 10, 14, 18, 22, 2
3	5, 9, 13, 17, 21, 1
4	7, 11, 15, 19, 23, 3

# BodAS II – Bolt Documentation System

## Measuring of the pretensioning force at existing screw connections with hydraulic bolt tensioning devices

At existing screw connections it is possible to determine the pretensioning force without loosening the connection.

It is only necessary to screw on a bolt tensioning device to the end of the bolt and to pressurize these tensioner up to the given force.

### What does BodAS II exactly do?

With BodAS II all relevant connections - or all bolted connections under tension - can be controlled, if their rest pretensioning force is okay every time.

The target data are known from the first pretensioning or is new calculated by experience values.

To identify each screw connection it is possible to take all data from your BodAS I table.

So there isn't any additional work.

In addition to the wireless pressure sensor - also used in the BodAS I system - in the BodAS II system is a wireless extension sensor, too. This one is mounted at the tensioner.

All data measured during pressurizing the tensioner are shown directly in a diagram on the monitor of a notebook.

In the same data sheet, that was used in the BodAS I software, you can now store all the new measured and calculated data (see graphic next site) and so deposit a complete bolt documentation.

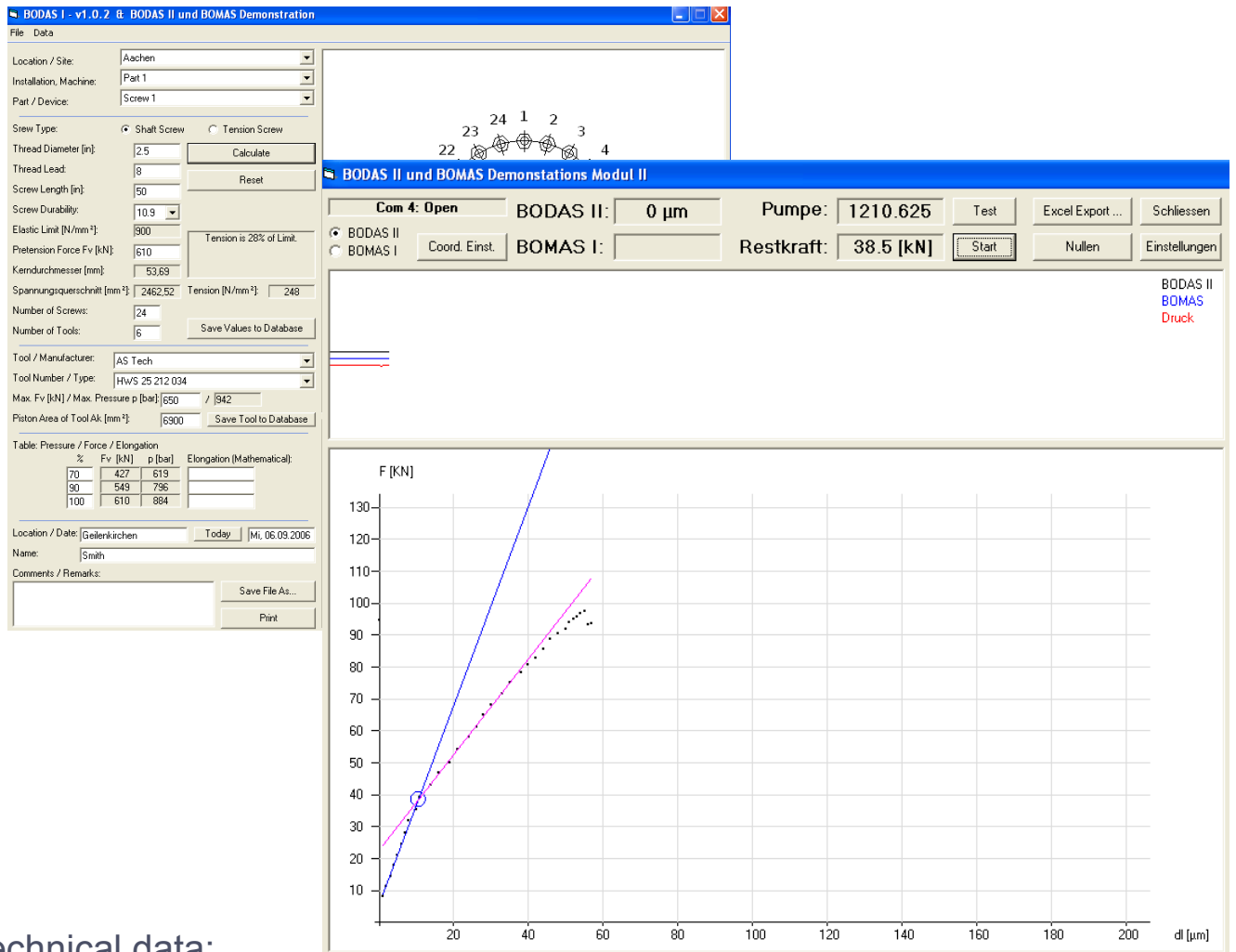
By the combination of expert knowledge and specialised information about the plant it is possible to get a very small rate of data. That becomes more important, as bigger as your plant get.

## The advantages at a glance

- Control the rest pretensioning forces without loosen the connection	- PC-Software with a user-friendly interface
- Wireless (no trip falls)	- Archiving as text- and diagram- file
- Automatic logging of measurements	- Automatic archiving
- Real time documentation	- Analysis of each tensioning process
- Storage capacity for up to 4000 screw processes	- Excel export of recorded data

## Example of a bolt connection

- Graphic output of the rest pretensioning force in the BodAS II mask



Irrtum und technische Änderung vorbehalten.

### Technical data:

#### USB Stick:

- Range: up to 300m
- 868/915 MHz ISM frequency band (Operating license is not required)
- Maximum sending power: <10dB
- Power supply over USB (No other connections are necessary)
- Current consumption <50 mA
- Electronic water and dust protection according to IP 67
- Compatible with Windows 2000 (SP4) and Windows XP

#### PC-Software:

- System requirements: Windows 2000 (SP4) or Windows XP
- 1 available USB port
- Minimum of 128 MB RAM and 150 MB free disk space
- Screen resolution of at least 1024x768

BODASII\_BDS\_2-1.doc

## BomAS – Bolt Monitoring System

### The highest possible operational availability is our highest mission

To reach this goal we develop comprehensive service–concepts.

The advantages for the customer are:

- Plant availability improvement through predictive service plans
- Malfunction security by continuous monitoring
- Output maximization with optimization concepts

A worldwide applicable condition monitoring was created with an online and offline bolt diagnostic system.

### What does BomAS exactly do?

With BomAS all relevant connections, or all Bolted connections under tension, can automatically be monitored.

BomAS is equipped with a radio signal processor and analyses all measured signals in the gondola. Through clever combination of expert know-how and information about the plant it is possible to keep the amount of transferred data very small. This is especially important when a larger amount of machinery have to be monitored permanently. With BOMAS's different communication capabilities, it is possible to find an optimal solution for any park.

### Custom – made monitoring system BOMAS for bolt connections

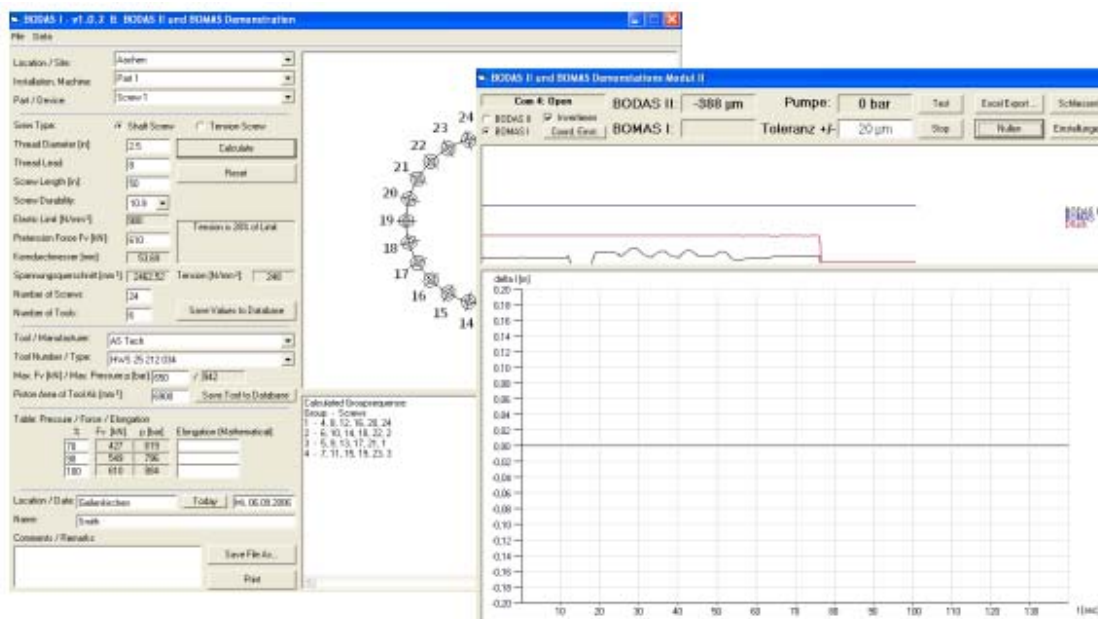
The monitoring system has to reduce the maintenance work and thus costs in all branches of industry. Special advantages of the monitoring system are to be mentioned with locally separated and frequently difficult accessible plants or if the construction units are positioned in a considerable height. Additionally, plants which require a production time of several months can be favourably supervised with a monitoring system. If damage occurs, the repair, for reasons mentioned, is complex and expensive.

Regarding this problem, AS Tech has developed the BOMAS monitoring system particularly for the requirements of bolt connections.

With BOMAS and therefore permanent remote supervision of the plant, the cost of the necessary maintenance measures are lowered and at the same time increasing the availability of the plant.

## The advantages at a glance

- |   |  |
|---|--|
| - Measurement of the physical values with a wireless sensor | - PC-Software with a user-friendly interface |
| - Wireless (no trip-falls)                                  | - As text and diagram file                   |
| - Measurement on rotating components possible               | - Automatic archiving                        |
| - Automatic logging of the measurements                     | - Analysis of each tensioning process        |
| - Real time documentation                                   | - Data transmission with GPS is possible     |
| - Output of warnings, on tension loss                       | - Excel export of recorded data              |



Irrtum und technische Änderung vorbehalten.

### Technical data:

#### Measuring sensor:

- Resolution: 1/100mm by 10mm (higher resolutions on demand)
- Range: up to 300m
- 868/915 Mhz ISM Frequency band (no license required)
- Maximum transmit power: <10dB
- Voltage supply: 1 Lithium Battery, Type CR-P2 (or compatible)
- Battery life expectancy: > 2 years, with one measurant per second
- Internal log memory up to 2 years, with a resolution of 1 value / s.
- Operating temperature: -20 to +70° Celsius
- Environmentally protected according to IP67, temperature – steadily up to 90 degrees Celsius, oil and acid – resistant

#### USB Stick:

- Range: up to 300m
- 868/915 Mhz ISM Frequency band (no license required)
- Maximum sending power: <10dB
- Power supply over USB (No other connections are necessary)
- Current consumption <50 mA
- Environmental water and dust protection in consideration to IP 67
- Compatible with Windows 2000 (SP4) and Windows XP

#### PC-Software:

- System requirements: Windows 2000 (SP4) or Windows XP
- 1 available USB Port
- At least 128 MB RAM and 150 MB free disk space
- Screen resolution of at least 1024x768

BOMAS BMS.doc

## Data processing





# Wireless remote control EZB 25 001 001

usable in the BodAS/BomAS systems

## Transmit- and receive station of the BodAS Hardware and wireless remote control of the AS Tech electro-hydraulic aggregate

The BodAS wireless remote control EZB 25 001 001 is the central part of all BodAS hard- and software components. It works as a transceiver and at the same time as a memory for all measured system values. The memory is constantly logging, documenting every step of the way and transmits this data on demand including the date and time of measurement to a PC running the BodAS software.

As a control unit the wireless remote control displays the current pressure and allows the user to apply as well as release the pressure of the AS Tech electro hydraulic pump EDP wirelessly - up to 2500 bar! The unit is environmentally protected and made for use with gloves.

### What exactly does the wireless remote control EZB 25 001 001 do?

With the wireless remote control all measured data of the last 24h of actual working time (3 working days) is stored. The data is collected from all BodAS components that were in use, such as pressure transducers and extension measuring systems.

The stored data in the wireless remote control is downloaded to the BodAS software through a radio interface in form of a USB-stick and can be used to generate automatic documentation of the procedures.

In the BodAS Software, data can be saved as a bod. file (BodAS – Software) for archiving as well as exported as a csv. file for further analysis (Excel, Access,... compatible).

The backlit screen of the wireless remote control displays the current pressure and length (extension), the battery level and signal strength continuously.

An internal code insures that multiple systems in range of one another will not interfere with each other and the highest measures of safety were kept throughout the design of the system.

## The advantages at a glance

- Automatic generation of protocol and screw order	- Memory unit of the BodAS software and control unit of the EDP in one
- Wireless (no trip-falls)	- Integrated Rechargeable Battery
- Automatic logging of measured data	- Automatic archiving
- Real time documentation	- Analysis of each tensioning process
- Storage capacity for up to 4000 screw processes	- Excel export of the recorded data

BodAS\_wireless remote control 2-1.doc

## Wireless remote control EZB 25 001 001

Irrtum und technische Änderung vorbehalten.



### Technical data:

- Environment protection: water and dust protection according to IP 67, oil and acid-proof, shock resistant
- Operating temperature: -15° to +65°Celsius
- Display: 3-lines, Transreflective with white background lighting
- Ergonomic housing, 24mm button, conceived for one-handed, gloved operation
- Construction with retaining magnets and hooks
- Mech. dimensions: 110x190x85 mm, weight approx. 420g
- Wireless system: Frequency 896/915 MHz, ISM Band, license free
- Data transmission rate: 100000bits/sec., Manchester Encoded

# Wireless Network EZB 07 001 001

usable in the BodAS-/BomAS systems

## Functional description:

The system consists of the central unit with remote transceiver and the wireless pressure sensors. The central unit transmits time and control data to the wireless sensors and processes, logs and signalises the data that was acquired and transmitted by the sensors.

The remote transceiver can be assembled in a distance up to 2 km from the central unit and transparently transfers data between the central unit and the sensors. To achieve the data electrical signals are translated into optical signals, which are transmitted through the optical cable and the receiver translates these optical signals back into electrical signals for the wireless system.

The wireless pressure sensors measure ten times in every cycle and communicate with the central unit immediately after every tenth measurement. The length of this cycle is selectable by the user in the central unit. The sensors measure pressure, temperature and their own battery voltage. The analog signals are extracted, conditioned, filtered and digitised in the sensor after which they are analysed by the processor. If one or more parameters are out of the selected ranges, the wireless sensor reacts accordingly. Additionally the sensors react to the communication status.

Between measurements the sensor shuts down all non essential systems and places itself in a ultra low power standby mode until a new measurement or communication with the central unit is imminent.

If the communication fails at any point, the wireless sensors still function autonomously and set themselves into a low power standby mode. Alarm situations are then still indicated via the built in LED.

The central unit is also the central data processing unit of the system. All received data runs together and are concentrated in this unit where they are analysed and graphically displayed.

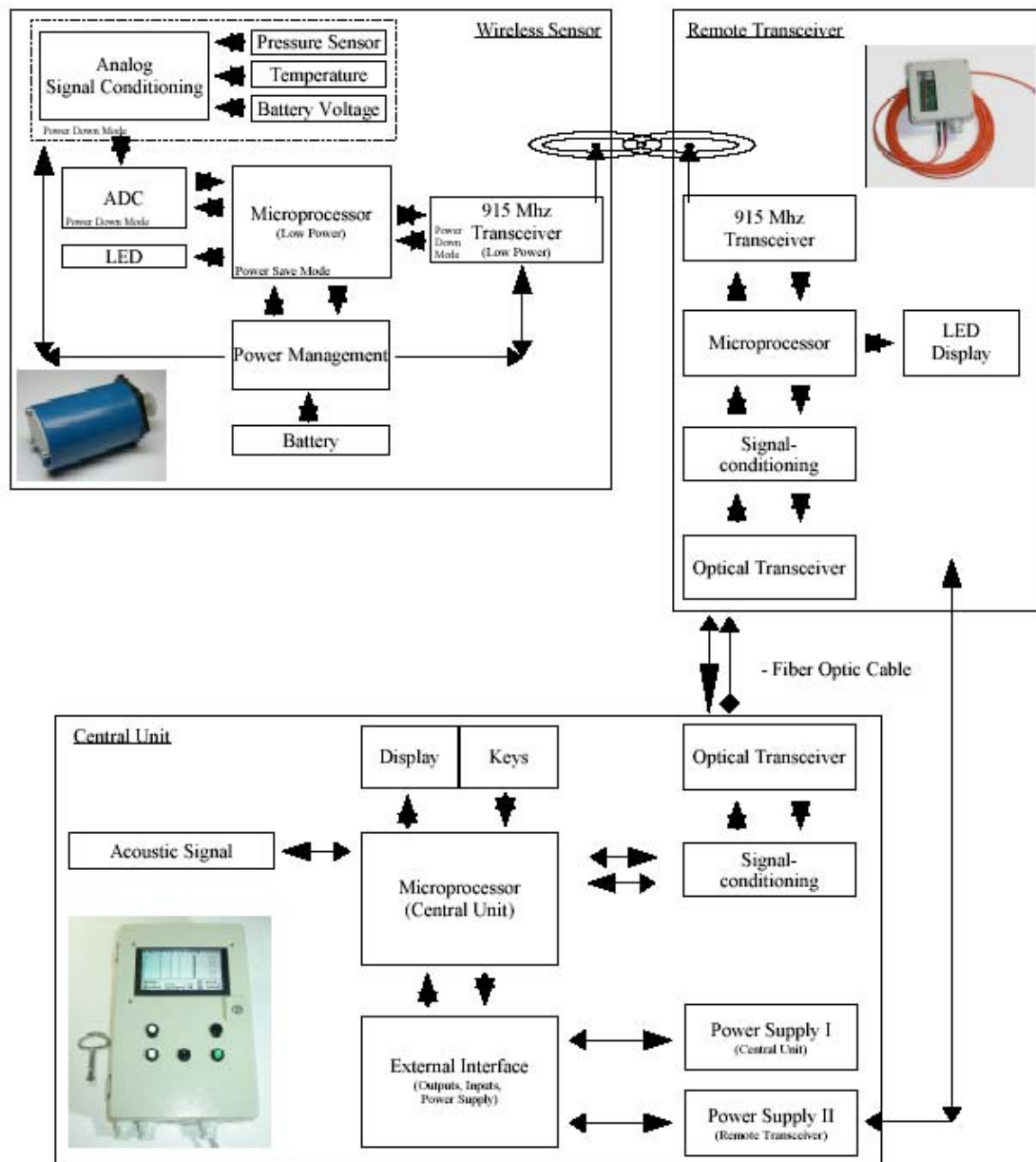
The system status information for all components is available at all times on the interface and are additionally sent to the remote transceiver.

The central unit also arbitrates the radio protocol.

## The advantages at a glance

- Control a lot of sensors at the same time with one central unit	- graphical software with a user-friendly interface
- Wireless (no trip falls)	- As text- and diagram-file
- Automatic logging of measurements	- Automatic archiving
- Real time documentation	- Analysis of all system data
- Easy to configure by the user	- Application in rough environment

## Wireless network for pressure and temperature sensors



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# Readings Recorder





# Pressure transducer EZB 25 001 004

usable in the BodAS/BomAS systems

## Digital pressure transducer for the BodAS hardware

The BodAS pressure transducer combines the highest accuracy with the unbeatable advantage of an independent power supply as well as wireless data transfer. Thereby pressure measurements on rotary construction units are problem-free possible.

BodAS Pressure transducers are the ideal pressure measurement instrument for anyone who wants to measure pressures independent of local conditions and existing tools very exactly and who require a documentation of the measured pressure data.

## What exactly does the pressure transducer EZB 25 001 004 do?

The digital pressure transducers of the BodAS– system measures hydraulic pressure up to 2500 bar. The form and size of the connections are selectable. All pressure transducers guarantee an accuracy class of 0,2 or better. The data registered by the pressure transducers is passed on directly to the interface of the BodAS system. All data exchange procedures function wirelessly via an ISM-Band radio link.

Due to the independent power supply of each pressure transducer detached operation from all other features is possible – also with already existing hydraulic aggregates.

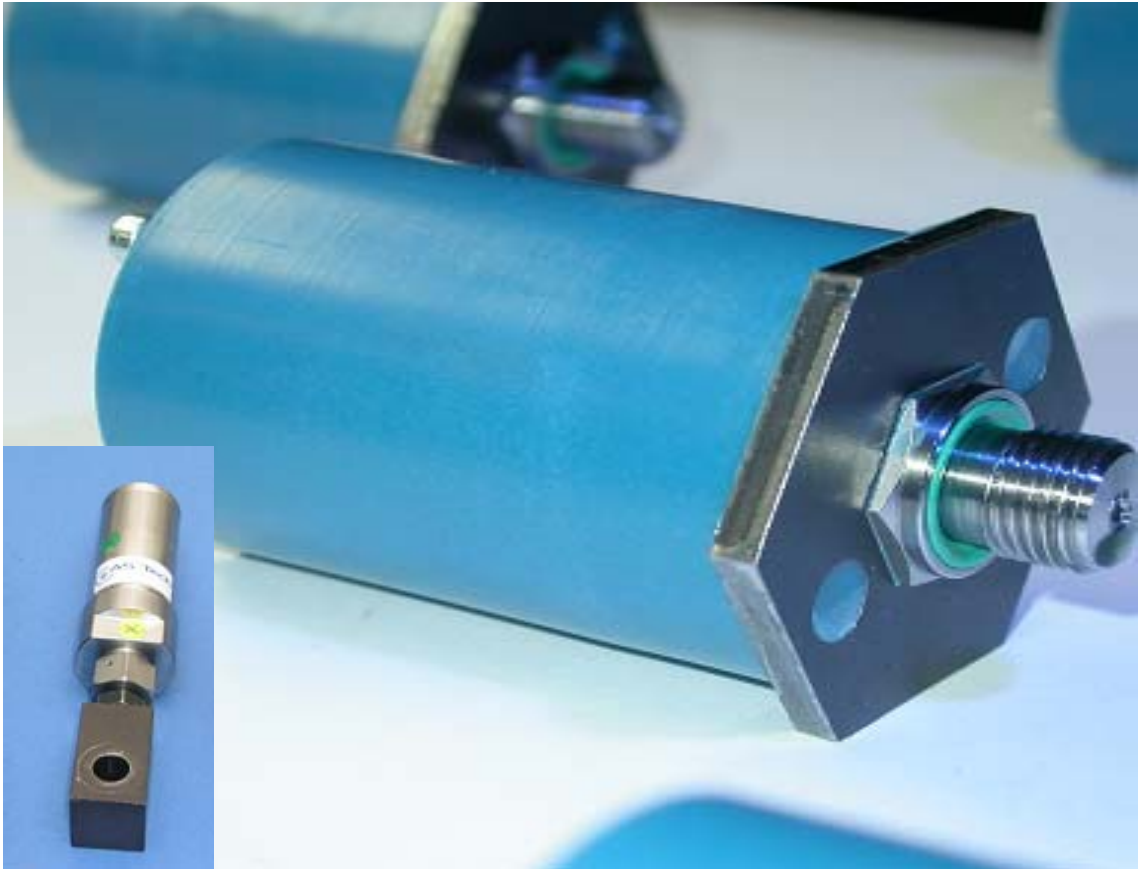
To adapt the pressure transducer to existing machines or aggregates, various connection types and threads are selectable.

## The advantages at a glance

- Independent operation by own power supply at any already existing plant / machine	- Various connecting threads and customized special solutions due to the independent interpretation are possible
- Wireless: measurement on rotary construction units possible	- Battery operation
- Automatic logging of measurements	- Automatic archiving
- Real time documentation	- High accuracy of measurement
- Highest pressures possible	- Excel export of the recorded data

## Pressure transducer EZB 25 001 004

Irrtum und technische Änderung vorbehalten.



### Technical data:

- Environmental protection: water and dust protection according to IP 67, oil and acid-proof, shock resistant
- Operating temperature: -20° to +70°Celsius
- Mechanical dimensions:  $\varnothing$  54 mm, height 90 mm
- Weight: approx. 270g with battery
- Measuring resolution: 12bit, corresponding to:
  - <0,2 bar in the 800 bar version
  - <0,7 bar in the 2500 bar version
- Total linear error: 0,5%, relative error 0,5 bar
- Power supply: integrated NiMH battery with intelligent electronic charging
- Battery charging time: 2h to 80%, approx. 4h to 100%, operating time approx. 20h
- Current consumption: 15mA during sending/receiving
  - 6mA during measurement
  - 25 $\mu$ A in standby

# Length/Extension Sensor EZB 25 002 001

usable in the BodAS/BomAS systems

## Digital length/extension sensor for BodAS hardware

**Available mounted in a screw tensioning device as well as an extra adaptive measurement equipment.**

The BodAS extension sensor joins the highest accuracy of measurement with the unbeatable advantage of an independent power supply as well as wireless data transfer.

The BodAS extension sensor is thus the ideal length measuring instrument for all which want to measure the elongation independent from the local conditions and the existing tools very exactly and which want to get a documentation of these measured data.

## What exactly does the extension sensor EZB 25 002 001 do?

The digital extension sensor of the BodAS–System measure elongation with an accuracy of 1/100mm over a total range of 10 mm. Higher resolutions and other ranges are available on customer requirement. The form and size of the extension sensor are adapted to the conditions and needs of respective application. The data registered by the extension sensor is passed on directly to the interface of the BodAS system. All data exchange procedures function wirelessly via an ISM-Band radio link.

Due to the individual power supply of each extension sensor an independent and detached operation of the device is possible – e.g. with already existing screw tensioning devices.

To adapt the extension sensor to different machines or aggregates, various connection types are available as shown exemplarily in the graphics on the following page.

Typical applications for the sensor are elongations of screw connections as well as strokes of hydraulic cylinder.

## The advantages at a glance

- Independent operation with own power supply at any already existing plant / machine	- Various measuring distances and accuracies as well as customized special solutions due to independent interpretation are possible
- Wireless (no trip-falls)	- Battery operation
- Automatic logging of measurements	- Automatic archiving
- Real time documentation	- High accuracy of measurement
- Measuring without additional expenses	- Excel export of the recorded data

BodAS extension sensor.doc

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## Extension Sensor EZB 25 002 001:

Examples / Variations :



Irrtum und technische Änderung vorbehalten.

## Technical data:

- Environmental : water and dust protection according to IP 67, oil and acid-resistant
- Operating temperature: -20° to +70°Celsius
- 868/915 MHz ISM frequency band, license-free
- Maximum transmitting power: <10dB
- Power supply: integrated NiMH battery with intelligent electronic charging
- Battery charging time: 2h to 80%, approx. 4h to 100%, operating time approx. 20h continuous operation
- Internal log memory up to 2 years with one measurand per second

BodAS extension sensor.doc

## Examples of use





## BodAS/BomAS examples of use

The AS Tech systems BodAS/BomAS are usable at most different documentation and monitoring application.

Caused by the modular build-up of the system the combination of all tools such as their quantity is free selectable on customers demand.

### Electric pressure generator

A pressure up to 2500 bar can be reached with the AS Tech electro hydraulic aggregate EDP at the same time achieving high flow rates.

Optionally the bi-directional wireless remote control EZB 25001001 allows you to build up and release pressure as well as continually display the current pressure – up to 300 m distance to the pump. That means a very save use of the high pressure tools.

Sensor information is automatically logged in the remote control unit, which can be downloaded to a PC for automatic generation of printout or electronic documentation. For further information check the product brochure for pressure generators.



### Pressure monitoring

Using the wireless pressure transducer, it is possible to monitor as many hydraulic components as you like to.

In the way the plant is configured the software out put appointed what has to be done (addicted to the pressure).

The picture shows a typical application at rotating components.



Irrtum und technische Änderung vorbehalten.

## Emergency stop

With the radio-controlled pressure sensors you can monitor and display the clamping forces, for example at a machine tool.

Is the actually pressure lower than a given minimum, the pressure sensor sends a alarm signal to the control system and the control unit is able to stop the machine.



## Documentation requirements

By assembling new plants it is necessary in a lot of sectors of industries to document the build-up.

With the digital actual values of pressure, force and elongation in the BodAS system it is possible to do this documentation business in a very easy way.

Measuring runs in the background without any kind of additional work. So it is a economic way, too.



## Didactics

It is self-evident that all sensors are also compatible to the AS Tech didactics series.

So it is possible to teach hydraulic knowledge at state of the art – and see simultaneous a visualization at the PC.

