SONOTEC

Operating Manual

BS20

Broadband structure-borne sound & temperature sensor for the SONAPHONE handheld unit

Translation of the German Original
Revision: 2.1 | 2023-04-27

Content

1 Introduction

This section is intended to explain function, structure and representations of this documentation to simplify handling of this documentation.

1.1 Notes on this documentation

Purpose

This documentation constitutes an integral part of the product and contains important advice on safe operation as well as all information on intended and efficient use. Thus, any person using the product must have read and understood this documentation.

Accessibility

The staff working with this product must have constant access to this documentation to prevent handling errors and guarantee trouble-free operation.

Up-to-dateness

Every effort has been made to ensure that the information contained in this documentation is complete and correct at the time of release. This documentation describes all units and functions known at the current point of time.

1.2 Representations in this documentation

Illustrations

Illustrations used in this documentation do not always contain all details or special cases. They only represent the relevant information.

Tips

Tips are marked as follows:

> ⓘ Tips describe specific information or particular features that might not be evident, even for experienced users. The neglect of a tip poses no direct safety risk. However, it can lead to workflow disruptions.

General icons

The following general icons are used for visual emphasis:

Icon	Function
	Indicates a link to external content.

1.3 Identification of warning instructions

Classes of danger, signal words and colors

This documentation contains warnings regarding hazards of different classifications. These classes are characterized by signal words and colors. They include the following:

⚠ WARNING

Warns of possible immediate danger, which, if ignored, may lead to lasting damage to health and/or property – including financial losses due to operational impairment.

⚠ CAUTION

Warns of dangers, which, if ignored, may lead to injury or damage to property – including damage to property due to operational interruptions.

ATTENTION

Warns of dangers, which, if ignored, may lead to damage to property – including damage to property due to operational interruptions.

2 Safety instructions

This section contains safety information relating to the protection of persons as well as safe and fault-free operation. All user groups of the product must be aware of and follow these safety provisions.

2.1 Introduction

Reliable and safe operation of the product depends on the careful handling and execution of operational and setting tasks.

Ignoring these safety instructions and warning information may lead to serious injury with lasting health consequences for personnel as well as damage or destruction of product components.

During handling of the product, please observe all safety instructions and warning information in all parts of this user documentation as well as the related codes of practice. Ensure that all those working with the product are also aware of these instructions.

Generally applicable safety regulations (such as accident prevention and environmental protection regulations, etc.) must also be observed.

2.2 Basic hazards

Definition

Basic hazards are residual risks that remain even with safety-conscious intended use.

State of the art

The product meets the current state of the art and applicable safety rules. All components of the product are tested thoroughly before they leave the factory and are delivered in a condition for safe operation.

⚠ WARNING

Danger of injury!

Improper use of the product may lead to injuries.

- Do not open the product.
- Protect the product against extreme heat (excessive sunlight, immediate vicinity of open fire or heating devices) during operation and storage.
- Avoid strong impacts that could damage the device and/or its components.

2.3 Personnel and qualifications

Basic requirements

The product must only be used by operators that have completely read and understood the safety instructions and all documents of the user documentation.

Personnel undergoing training or instructions or persons taking part in general vocational training programs may only operate the device under the continuous supervision of operating or technical personnel.

Responsibility of the operating company

Regarding the personnel authorized and/or trained by the operating company, the operating company carries the following responsibilities:

- The necessary training and instruction of personnel must be guaranteed.
- All personnel's competences and responsibilities must be clearly stated and documented.
- All user information on the product (operating manual, user documentation etc.) must be kept in the immediate vicinity of the product and must be accessible at all times.

2.4 Safety-conscious working practices

Accident prevention and environmental protection

In addition to the instructions in this operating manual, please mind the generally applicable legal and other regulations on accident prevention and environmental protection.

This may include, for example:

- Handling of hazardous materials
- Wearing the required and mandatory personal protective clothing and safety equipment
- Observing of and complying with all national and regional industrial safety regulations
- Observing of and complying with all internal working, operating and safety regulations

2.5 Use of the product

Measures for personal safety

Improper use of the product may lead to injuries of operating personnel.

- Always make sure that both hands are free for self-protection, if necessary.
- Always make sure to keep your hands, the product and/or connected equipment within your field of vision.
- Use the torchlight functionality (LED light) of the product and/or additional lighting to illuminate test sites with poor visibility.
- Always use the product without distraction. Do not read messages on the display and/or operate the product while walking.

Measures for protection of the product and/or equipment

Improper use of the product may lead to product damage. Damaged components may affect or distort the measurement result quality.

- During use, charging and storage, protect the device against extreme, unusual heat (excessive sunlight, storage in heated cars or immediate vicinity of open fire or heating devices). It is critical to stay within the temperature ranges given in the technical specification.
- Do not use the product and its accessories if they display functional errors and/or visible damage.
- Only connect the product to approved equipment received from SONOTEC GmbH or its sales partners.
- The product adheres to the protection class given in the technical specification and is not protected against water. Do not submerge the product in liquids. Protect the product against moisture penetration.
- Handle the product with care and protect it against major shocks.
- When using the product, always make sure that cables cannot get stuck and/or caught in moving parts.
- Do not use the product within strong electromagnetic fields.

2.6 Modifications and alterations

No modifications on the product and/or accessories

The product and/or its accessories must not be opened or disassembled. The product does not contain any components to be cleaned, maintained or repaired by operators.

Unauthorized modifications of the product and/or its accessories are prohibited and lead to exclusion of liability by the manufacturer for resulting damage and consequences.

Spare parts and accessories

Spare parts and accessories must comply with the technical requirements specified by SONOTEC GmbH and its suppliers. Whenever original parts are used, compliance is given.

3 Description of the sensor

This section describes use, function, structure and accessories of the sensor.

3.1 Intended use

The Broadband structure-borne sound & temperature sensor BS20 is used for structure-borne sound detection in the ultrasonic range. Used in connection with the SONAPHONE digital ultrasonic testing device and exchangeable waveguides, the sensor has been designed for the following test tasks:

- Status monitoring of machines and systems
- Function testing of steam traps and valves
- Monitoring of wear and malfunctions, e. g. in roller and slide bearings
- Monitoring of lubrication conditions

The sensor's function keys may be used for starting and stopping measurement value recordings and to control the acoustic playback volume.

An integrated contactless infrared temperature sensor enhances the possibilities for measurement data rating, e. g. for steam trap function tests. Integrated LED lights facilitate locating test sites.

3.2 Prohibited use

Any use not approved by SONOTEC GmbH is prohibited and may lead to injury or damage to property.

SONOTEC GmbH accepts no liability for damage caused by prohibited use of the product.

Prohibited are in particular:

- Use of equipment and/or accessories with visible damage
- Use in wet rooms
- Use in potentially explosive environments
- Use in environmental conditions that do not adhere to the stipulated requirements
- Unauthorized modifications of the equipment, the software and/or accessories
- Use of unauthorized spare parts and/or unauthorized accessories

3.3 Working principle

The waveguide conducts ultrasonic waves from the test point to the ultrasonic transducer.

The ultrasonic transducer converts structure-borne sound (vibrations) to an electrical signal over a wide frequency range. This electrical signal is amplified and digitalized within the sensor. Further data processing and output takes place in the testing device.

The integrated infrared temperature sensor allows for quick and contactless recording of the test object's surface temperature. The size of the visual recording field depends on the distance between the sensor and the test object.

The LED lights act as a torch light, making it easier to couple the sensor with test points in poorly lit environments.

3.4 Sensor construction

Operating elements

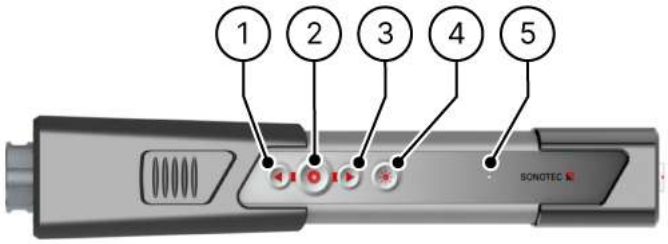


Figure 1: Operating elements of the BS20

No.	Description/function
1	Increases the volume of the acoustic playback.
2	Starts/stops a measurement value recording.
3	Decreases the volume of the acoustic playback.
4	Switches the LED light (torch light) on or off
5	Status LED • Constantly lit: sensor is activated • Flashing: sensor is in boot mode ⓘ Boot mode is required for sensor firmware updates. (see Updating sensor firmware with the SONAPHONE Hardware Manager app)

Sensor elements

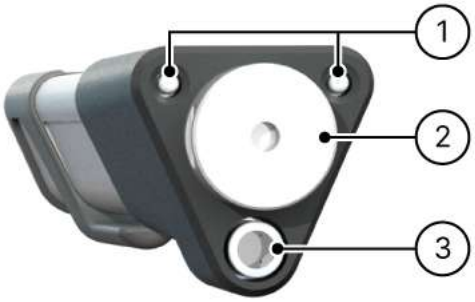


Figure 2: Sensor elements of the BS20

No.	Description/function
1	LED lights (torch light)
2	Ultrasonic transducer – coupling surface with internal thread M5
3	Infrared temperature sensor

Connections

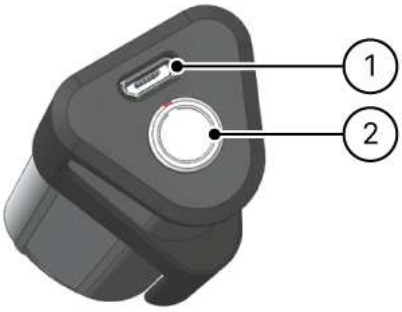


Figure 3: Connections of the BS20

No.	Description/function
1	USB port • Type: Micro-USB socket, type B • for service purposes only
2	Sensor cable socket • Type: LEMO 0B (4-pin) • with marked plug-in position

3.5 Sensor identification

Identification plate

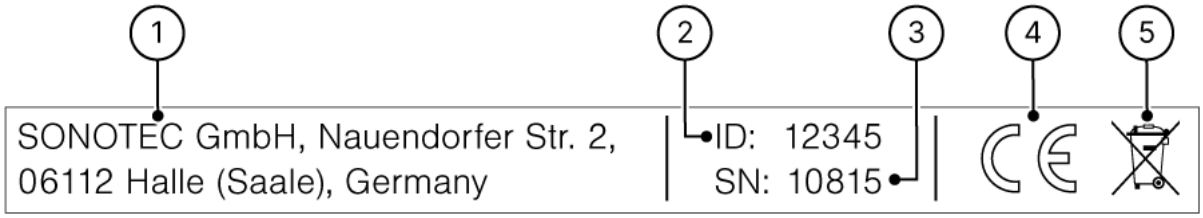


Figure 4: Identification plate with its components

No.	Identification
1	Manufacturer's address
2	Sensor ID
3	Serial number
4	CE marking
5	Disposal symbol (see "7 Disposal", page 28)

3.6 Accessories

Intensity and behavior of ultrasonic signals depend on factors such as the process during which they are generated. Measurement value recordings with high signal quality are necessary for valid conclusions on system conditions. Signal quality also depends on a number of factors.

To record high-quality signals for processing in the sensor, waveguides for differing applications are available.

ⓘ The frequency characteristic varies depending on the used equipment and/or the coupling mode. Always use the same equipment and/or coupling mode for recurring comparison measurements.

3.6.1 Long waveguide 150 mm BS20-4

Application	Tests at test points that are hard to reach and on hot surfaces
Article number	300 01 0098

Description

The long waveguide allows for ultrasonic signal tests at test points that are hard to reach and tests on hot surfaces.

ⓘ Its rod-shaped geometry provides a resonating body to the long waveguide. Multiples of its natural resonance are within the ultrasonic range. Please consider this for evaluation of the measurement results.

3.6.2 Magnetic waveguide BS20-3

Application	For coupling the sensor at the test site during long term testing For ensuring uniform contact pressure
Article number	300 01 0097

Description

In order to ensure usable measurement results for long-term or comparative measurements, a uniform contact pressure is required. The magnetic waveguide BS20-3 is available for this application. After coupling at the measurement point, the magnetic coupling ensures uniform recording of the ultrasonic signals.

3.6.3 Set of wrenches

Application	For mounting or removing the waveguides on/from the sensor
Article number	500 01 0097

4 Operation of the sensor

This section contains descriptions and instructions for operating the sensor and using it in combination with the SONAPHONE handheld unit.

⚠ WARNING

Risk of injury during use of the long waveguide!

The tip of the long waveguide may cause serious injuries.

- Never point the tip of the long waveguide to other people.
- Use the sensor carefully whenever the long waveguide is mounted.

4.1 Mounting and removing waveguides

ATTENTION

Risk of device damage and/or faulty measurement values!

Incorrect mounting and removal of the waveguides may cause damage on the sensor or the waveguides and lead to faulty measurement values.

- Always use the wrench set BS20 for mounting and removal of the waveguides.
- When mounting a waveguide, make sure to securely screw and tighten den waveguide in the sensor mount.

ⓘ Damage on sensor and waveguides that results from mounting and removal without the use of the wrench set BS20 is excluded from warranty and guarantee.

Mounting

1. Insert the sensor in the sensor mounting with the sensor buttons pointing downwards.

2. Screw the required waveguide in the sensor's ultrasonic transducer.

3. Tighten the waveguide on the sensor by using the open-end wrench.

Removal

1. Insert the sensor in the sensor mounting with the sensor buttons pointing downwards.

2. Loosen the waveguide on the sensor by using the open-end wrench.

3. Unscrew the waveguide from the sensor's ultrasonic transducer.

4.2 Connecting the sensor

ATTENTION

Risk of damage to sensor and/or sensor cable!

When connecting the sensor, always mind the red markings on the sockets of the sensor and the SONAPHONE handheld unit as well as the sensor cable.

1. Connect the sensor to the SONAPHONE handheld unit via the sensor cable.

→ The SONAPHONE handheld unit provides power to the sensor.

→ As soon as the status LED of the sensor is constantly lit, the sensor is ready for use.

ⓘ During measurements, the measurement data will be transferred automatically from the sensor to the SONAPHONE handheld unit.

4.3 Operation via sensor buttons

Measurements may be controlled either via the touch screen of the SONAPHONE handheld unit or the sensor buttons. The sensor buttons provide the following functions:

- Increasing the acoustic playback volume

- Starting or stopping the measurement value recording

- Decreasing the acoustic playback volume

- Switching the LED lights on and off

4.4 Using the sensor for measurements

Correct and reproducible measurement results depend on:

- selection of an appropriate point of measurement,
- selection of the appropriate waveguide and equipment,
- correct alignment and positioning of the sensor depending on the used waveguide as well as
- consistent contact pressure of the sensor during measurement value recording.

This section contains descriptions and instructions for using the sensor with the respective waveguides during ultrasound and temperature measurements.

ⓘ The frequency characteristic varies depending on the used equipment and/or the coupling mode. Always use the same equipment and/or coupling mode for recurring comparison measurements.

4.4.1 Requirements on the point of measurement

A point of measurement suited for ultrasonic measurement has to satisfy the following requirements:

- The surface must be level, without dust and grease and free of scratches.
- The point of measurement should not be covered by paint layers.

For satisfaction of these requirements and high reproducibility of the measurement results, we recommend to mark and prepare the point of measurement.

ⓘ Attaching mounting pads (article number: 300 01 0104) allows for consistently comparable coupling conditions.

4.4.2 Ultrasonic measurements

With long waveguide

1. Position the sensor as vertically as possible on the surface of the test object.

2. Press the sensor against the object with sufficient and consistent pressure.

   ⓘ Maintain position and contact pressure of the sensor for the whole measurement value recording. The quality of position and contact pressure will be visible in the signal pattern (spectrogram or level graph) of the corresponding measurement app.

3. Start the measurement value recording by pressing the sensor button or in the corresponding measurement app.

With magnetic waveguide

⚠ CAUTION

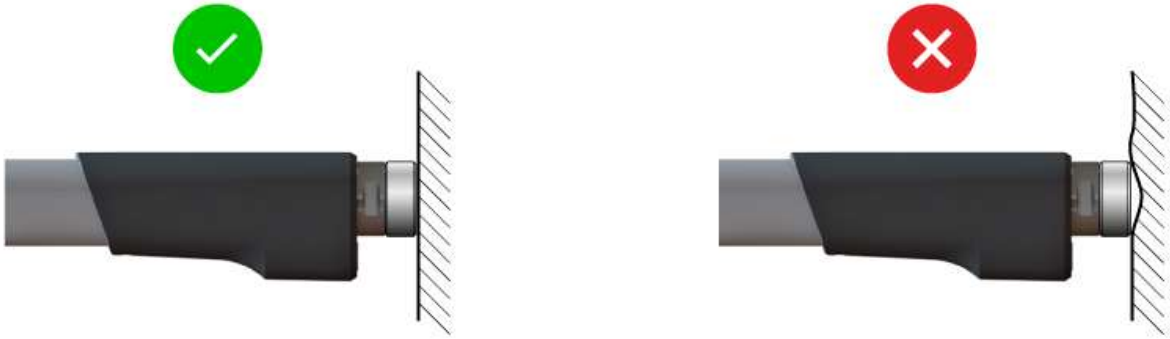
Risk of crushing by magnetic waveguide!

The magnetic waveguide exhibits a very strong magnetic force. This may cause crushing injuries on the hands during sensor coupling.

- Make sure that your fingers are not positioned between the magnetic waveguide and the surface of the point of measurement.
- Only transport the sensor including magnetic waveguide with mounted protective pad. The protective pad may only be removed from the magnetic waveguide during measurements.
- Always position the sensor with magnetic waveguide inclined and with care on the point of measurement.

Coupling

1. Select a suited point of measurement on the object (see "4.4.1 Requirements on the point of measurement", page 19).



ⓘ On uneven surfaces, a mounting pad (article number: 300 01 0104) may be glued to the point of measurement for coupling the sensor.

2. Push the protective pad sideways to remove it from the magnetic waveguide.
3. Carefully position the sensor on the point of measurement by placing the edge of the magnetic waveguide.

4. Carefully tilt the sensor on the point of measurement until the magnetic waveguide rests on the point of measurement with its complete surface.

Uncoupling

ATTENTION

Risk of sensor damage/destruction by incorrect uncoupling!

Always uncouple the sensor according to the following instructions.

1. Carefully tilt the sensor from the point of measurement.

2. Carefully pull the sensor from the point of measurement.

3. Carefully push the protective pad sideways on the magnetic waveguide.

Further information

For recording ultrasonic measurements, please also see the following descriptions and/or instructions:

Within this user documentation

- Operation via sensor buttons

Within the user documentation of the corresponding measurement application

- "Measurement value recording" screen of the SONAPHONE LevelMeter App
- "Measurement value recording" screen of the SONAPHONE SteamExpert App
- Recording measurement values with the SONAPHONE LevelMeter App
- Recording measurement values with the SONAPHONE SteamExpert App

4.4.3 Temperature measurements

Emissivity

The temperature sensor has been calibrated on a black body emitting the maximum possible temperature (100 % radiation → emissivity ε = 1). As the emission characteristics of the measuring objects' surfaces differ, this must be considered for contactless temperature measurement.

Painted or oxidized surfaces usually exhibit an emissivity of 0.9. This setting is suitable for many measuring tasks. Further values for frequently used materials may be found in emissivity tables.

Positioning the sensor

ATTENTION

Risk of faulty measurement results by contaminated temperature sensor!

Before starting temperature measurements, please make sure that the temperature sensor's surface is clean.

⚠ CAUTION

Risk of crushing by magnetic waveguide!

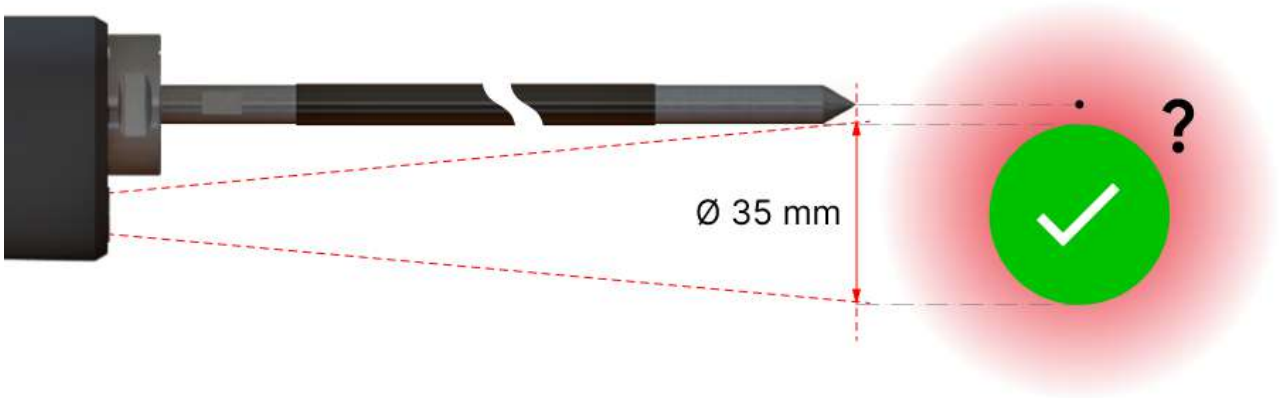
The magnetic waveguide exhibits a very strong magnetic force. This may cause crushing injuries on the hands during sensor coupling.

- Make sure that your fingers are not positioned between the magnetic waveguide and the surface of the point of measurement.
- Only transport the sensor including magnetic waveguide with mounted protective pad. The protective pad may only be removed from the magnetic waveguide during measurements.
- Always position the sensor with magnetic waveguide inclined and with care on the point of measurement.

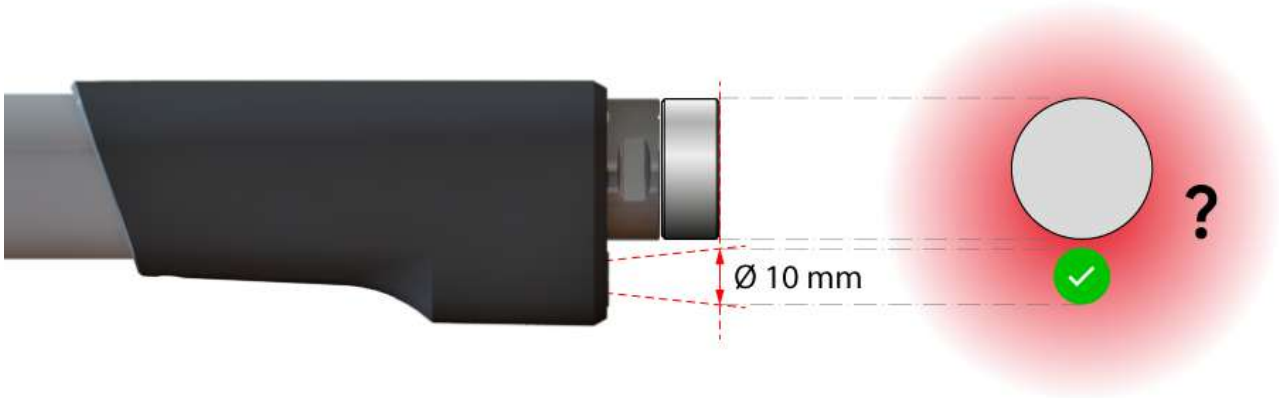
1. Check the temperature sensor to make sure it is clean.
2. Position the sensor on the object with the measuring area of the temperature sensor completely on the object's surface.

   ⓘ The measuring area of the temperature sensor is confined and depends on the installed waveguide (see the following images).

Measuring area with long waveguide



Measuring area with magnetic waveguide



Further information

For recording temperature measurements, please also see the following descriptions and/or instructions:

Within this user documentation

- Operation via sensor buttons

Within the user documentation of the corresponding measurement application

- "Measurement value recording" screen of the SONAPHONE LevelMeter App
- "Measurement value recording" screen of the SONAPHONE SteamExpert App
- "Settings" screen of the SONAPHONE SteamExpert App
- Recording measurement values with the SONAPHONE LevelMeter App
- Configuring settings in the SONAPHONE LevelMeter App
- Recording measurement values with the SONAPHONE SteamExpert App

5 Cleaning and maintenance

5.1 Cleaning

Guidelines

Do not open the product! The product contains no parts to be cleaned by the operator.

Suitable cleaning products

Only clean the product on the outside with soft, lint-free cloth.

ATTENTION

Check the compatibility of used cleaning agents!

The compatibility of all cleaning agents with used materials and colors must be confirmed and approved by SONOTEC GmbH or the respective supplier.

Unsuitable cleaning agents

Do not clean the product with:

- scratchy, aggressive, solvent-containing or benzine-containing cleaning agents,
- pressured air, high-pressure cleaner or other kinds of cleaning machine.

After cleaning

After cleaning the device, make sure that:

- cables, connectors and fittings are free of cleaning agents and
- cables, wires, connectors and electrical components are dry.

5.2 Maintenance

Guidelines

Do not open the device! The device contains no parts to be maintained or repaired by the operator.

6 Technical data

General data	
Article number	200 01 0300
Dimensions (L × W × H)	see technical drawing
Weight	140 g (without accessories)
Electrical connection	LEMO 0B (4-pole)

Acoustic data	
Frequency range	15 … 100 kHz
Measurement resolution	1 dB

Thermodynamic data	
Temperature measurement range	Object temperature -70 … +380 °C
Measurement resolution	1 K

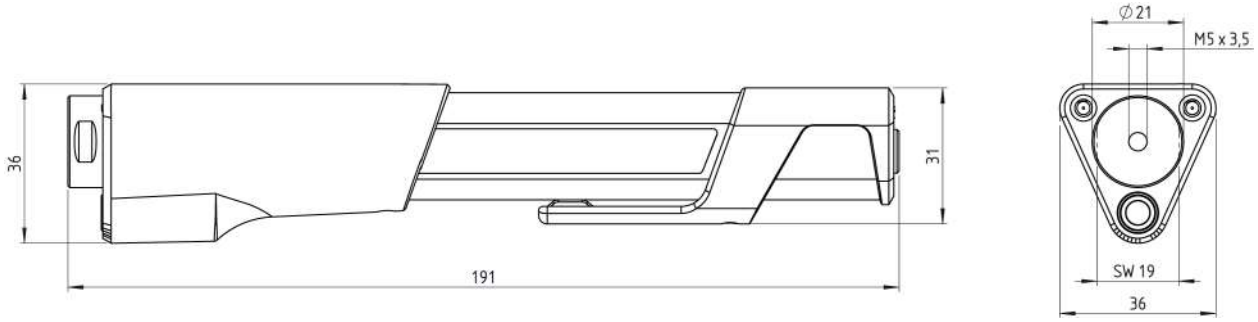
Materials	
Housing material	Polycarbonate/ABS

Ambient conditions	
Operating temperature	-10 … +65 °C (according DIN EN 60068-2-2:2008-05)
Storage temperature	-20 … +65 °C (up to 40 °C at 90 % humidity according to DIN EN 60068-2-78:2014-02)
Protection type	IP40

Order details

Scope of delivery	• Broadband structure-borne sound & temperature sensor BS20 • Calibration certificate

Technical drawing



7 Disposal

Recycling and taking back of used equipment

Electrical and electronic devices may pose a risk to health and the environment if disposed of incorrectly. They cannot therefore be disposed of as domestic waste according to WEEE Directive 2012/19/EU (Waste Electrical and Electronic Equipment Directive). Instead they must be taken to designated collecting points or returned to the manufacturer.

The following symbol indicates the legal duty to dispose of electronic devices as stipulated.

They must undergo specified recycling processes (e. g., with respect to batteries or circuit boards) which enable safe, environmentally compatible re-use or separate disposal of different device elements.

The return of used devices is regulated differently in different places. Find out from your local council about the return conditions for commercially used electronic devices. The device, including rechargeable battery, contains no toxic substances requiring separate identification for disposal such as mercury (Hg), cadmium (Cd), lead (Pb) or chrome 6 (e. g., in plated parts or circuit boards).

8 Warranty

Condition at delivery

All products and accessories have been tested thoroughly before they leave the factory, are state-of-the-art products at the time of delivery and adhere to all applicable safety regulations.

Warranty

During the warranty period, SONOTEC GmbH will eliminate all deficiencies caused by material or manufacturing faults free of charge. SONOTEC GmbH will at its own discretion offer warranty by reparation or replacement of faulty products.

Exceptions

Internal accumulators as well as damage caused by unintended use, by wear or by manipulation of the product are exempt from warranty. The warranty also does not cover those faults that affect value or usability of the product to a negligible amount.

Responsibility of the user/operator

It lies within the responsibility of the users to ensure that the product has been installed and set-up properly and is used in a manner that does not impair safe operation.

Operating errors

Operating errors can never be completely ruled out by the manufacturer. SONOTEC GmbH is in no way liable for any direct or indirect damage caused by operating errors (e.g. damage on software and/or hardware, damage by downtime, damage by malfunction as well as damage or loss of measurement and test data).

Quality of captured data

The determination of valid test results, their interpretation and the actions derived therefrom are exclusively subject to the personal responsibility of the users. SONOTEC GmbH does not guarantee the correctness of determined test values and/or test results. SONOTEC GmbH does not assume liability for any faults or damages that might occur due to further use of determined test and measurement values.

9 Manufacturer information

Copyright

Certifications and registrations

- Quality management according to ISO 9001:2015
  (Certificate Registration No.: 091006014)
- Registration according to ElektroG at the ‘stiftung elektro-altgeräte register’ (ear):
  WEEE Reg. No. DE 22125904

Contact

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