# Sensor Test Device | Operating Instructions

WABCO

# Sensor test devices
# 884 907 014 0 (~230 V)
# 884 011 158 0 (~115 V)

## Operating instructions for testing WABCO height sensors

## 1ˢᵗ Edition

This publication is not subject to any update service.
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www.wabco-auto.com

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**Explanation of Symbols**

| **WARNING** | Potentially hazardous situation which, if not avoided, could result in death or serious injury. |
|---|---|

| **CAUTION** | Potentially hazardous situation which, if not avoided, may result in minor or moderate injury. |
|---|---|

**!**  Additional instructions, information or tips that you should always observe.

•    List

–    Step

# 1  Description of the sensor test device

## 1.1  Short description

The sensor test device is used for testing inductive height sensors **with** and **without** integrated temperature compensation in the development, production and quality assurance areas.

An analysis procedure developed specifically for measuring inductive height sensors is applied in the sensor test device.

Internally, the sensor test device is split into measured value recording and output. In the evaluation circuit, voltage is put on an inductive sensor in a cyclical measurement sequence and an evaluation signal is generated as soon as a certain reference voltage is reached. The time between creating the voltage and generating the output signal is a dimension for the variable inductance of the sensor. The thus generated height-proportional measured value is corrected with regard to its temperature error by means of a special compensation method and then shown in the display. The measured value can also be output via a serial interface RS232.

If changes are made, the sensor-specific parameters for temperature compensation can be imported via a serial interface and stored permanently in the EEProm memory of the device.
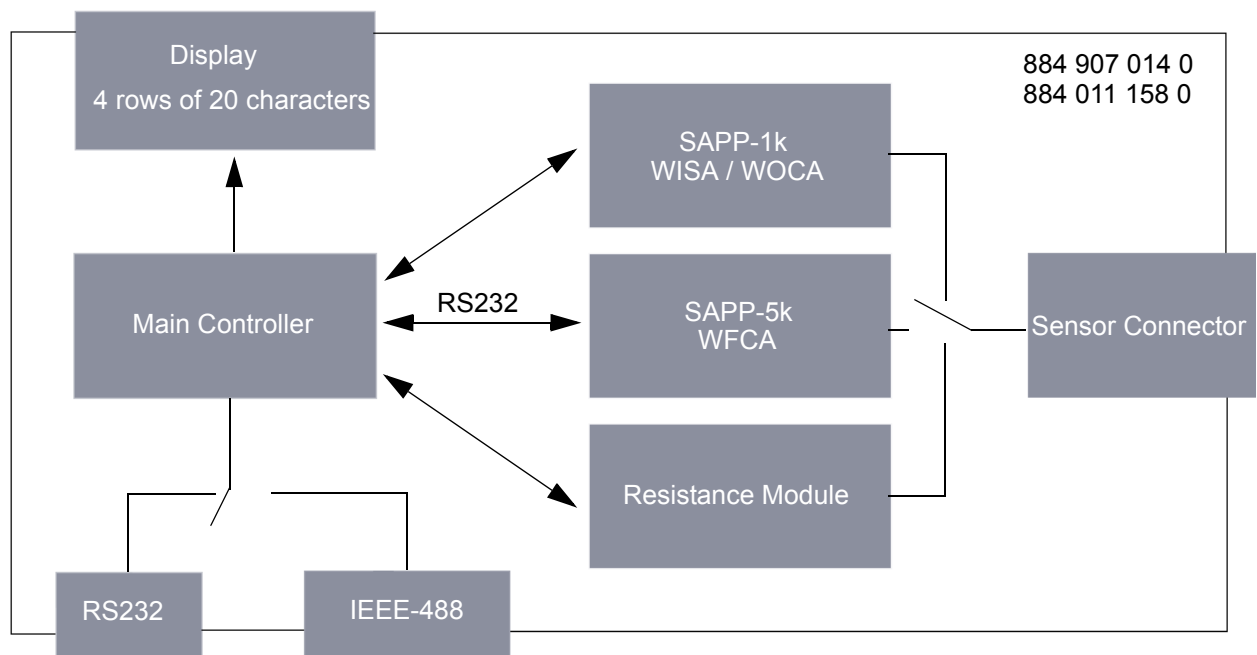


Fig. 1     Block diagram

## 1.2 Components of the front / back face

**Front face**
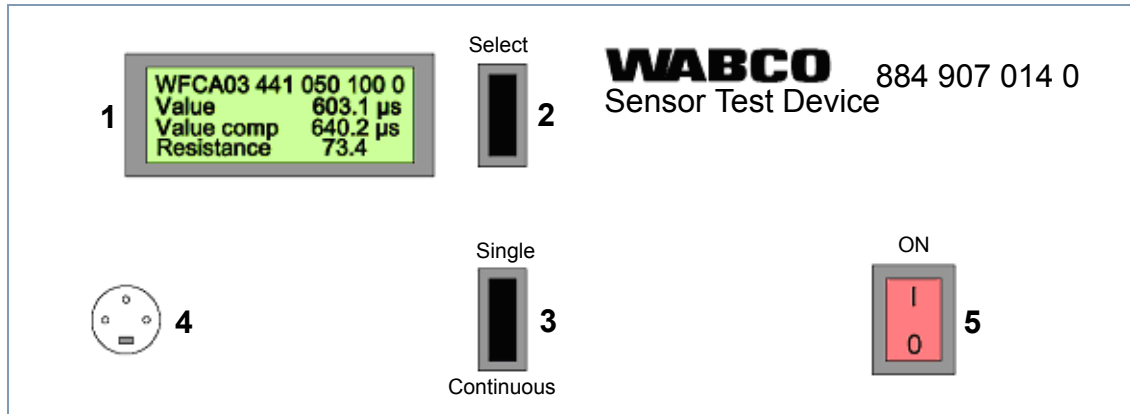


Fig. 2     Front face

**1**   LC text display: 4 rows of 20 characters

**2**   Rocker switch *Select*: Selection of the sensor to be tested

**3**   Rocker switch *Single/ Continuous*: Starting a single measurement (*Single*) or a continuous measurement (*Continuous*).

**4**   3-pin socket: Connection of the sensor (1: GND, 2: NC, 3: Signal)

**5**   Mains switch: Red illuminated

**Back face**
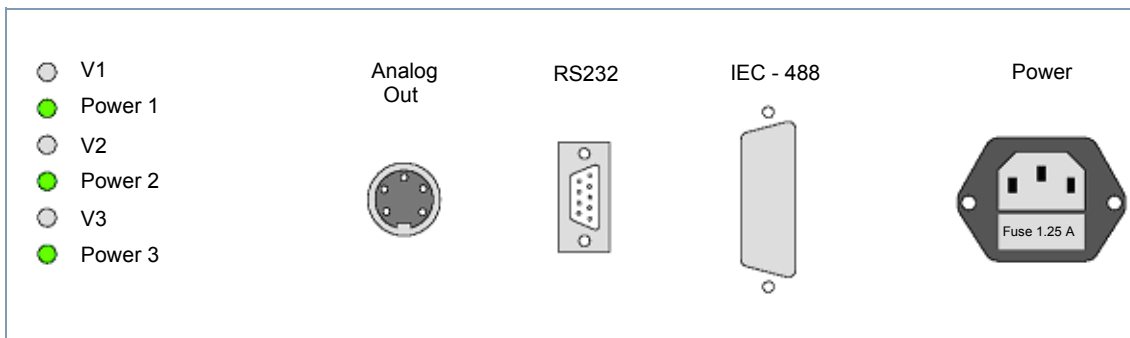


Fig. 3     Back face

**1**   Power unit: V1 = +5 V; V2 = +12 V; V3 = +15 V

**2**   5-pin socket *analogue output*: Analogue output of the measuring results (3: GND, 1: Signal)

**3**   9-pin Sub-D socket *RS232*: Serial interface

**4**   25-pin Amphenol socket *IEC-488*: IEC bus (optional, for laboratory use only)

**5**   Mains connection socket with micro-fuse *mains*: 1.25 A, medium time-lag

# 2 Function / operation

**Risk of injury**

Never open the sensor test device yourself because it is energised (230 V).

This could cause an electric shock.

Please contact your WABCO partner if you have any technical questions or problems.

```
SENSOR TEST DEVICE

  RS232   active
  Version: x.xx
```

After switching on the sensor test device, the selected interface and the software version are displayed for about 5 seconds.

```
SENSOR TEST DEVICE

  RS232   active
 Initialisation...
```

After the initialisation, communication is established with the resistance module and the SAPP-1K card.

```
SENSOR TEST DEVICE
 Hardware: RHxx.xx
 Software: RSxx.xx
```

The hardware and the software version of the SAPP-1K are displayed for about 2 seconds. If no errors occurred, the test program switches to normal measuring mode for sensor selection.

## 2.1 Sensor selection

❗ If a continuous measurement is currently in process, this must first be canceled by pressing the *Single* push-button.

- Press the *Select* push-button to select the sensor type.

The display immediately shows the product number of the selected sensor. The WABCO sensor development department generates an individual sensor selection list for each single case.

```
WFCA01 441 050 530 0
Value        ---.- µs
Value komp ----.- µs
Resistance  ---.-  Ω
```

You can manage a maximum of 255 sensors, with a maximum of 99 sensors for each sensor type (WFCA, WOCA, WISA).

## 2.2 Start measurement

Requirement: The sensor must be connected.

- Press the *Single* / *Continuous* push-buttons or start by means of a control signal vie the RS232 interface.

### 2.2.1 Single measurement

- Briefly press the *Single* push-button.

A single measurement is triggered.

The old measurement values (if there are any) are deleted, and the result of the new measurement is displayed after about 3-4 seconds.

### 2.2.2 Continuous measurement

- Briefly press the *Continuous* button.

A continuous measurement is triggered.

The measurements are updated in 1-second intervals. The resistance is not measured.

Return to single measurement:

- Press the *Continuous* button until the display changes.

### 2.2.3 Starting via the serial interface

The single/ continuous measurement can also be started by means of control signals via the RS232 interface.

The query must be sent in the following format. If the queried sensor type is not available in the compensation parameter file, measured value "0" is output.

**Example:**

WFCA02<CR>

WOCA07<CR>

WISA09<CR>

Refer to chapter 2.3.2 for a description of the interface.

## 2.3 Measured value output

### 2.3.1 Display

Immediately after the measurement, the measured values are displayed in the following format:

| | |
|---|---|
| W1= xxx.x | Height uncompensated in [μs] charge time |
| W2= xxx.x | Height uncompensated in [μs] discharge time or 000.0 for WFCA |
| W3= xxxx.x | Height compensated in [μs] |
| R= xxx.x | Resistance in [Ω] |

**Single measurement**

```
WFCA01 441 050 530 0   WISA01 441 100 539 0
Value          (W1) μs Value    (W2) (W1) μs
Value komp     (W3) μs Value komp    (W3) μs
Resistance     (R)  Ω  Resistance    (R)  Ω
```

**Continuous measurement**

```
WFCA01 441 050 530 0   WISA01 441 100 539 0
Value          (W1) μs Value    (W2) (W1) μs
Value komp     (W3) μs Value komp    (W3) μs
```

### 2.3.2 RS232 interface

In addition to appearing on the display, all determined measured values are output via the serial RS232 interface (device back face). The format of the response is the same for all sensor types. If values are not available, the value "0" is output.

The data can be logged with a monitor program (e. g. Terminal.exe by Windows).

Transfer rate / data bits/ stop bits / parity / log: 19200 / 8 / 1 / - / - /

**Data string**

All capital letters and numbers are fixed designations that cannot be changed.

aaaabb<TAB>ccc<SPACE>ccc<SPACE>ccc <SPACE>c<TAB>W1<TAB>xxx.x<TAB>W2<TAB> xxx.x<TAB>W3<TAB>xxx.x<TAB>R<TAB>xxxx.x <CR><LF>

**Meaning of the data string**

| | |
|---|---|
| aaaa | ASIC (WFCA, WOCA, WISA) |
| bb | Sequence number of the sensor that can be checked (00 - 99) |
| ccc ccc ccc c | WABCO number of the sensor |
| W1= xxx.x | Height uncompensated in [μs] charge time |
| W2= xxx.x | Height uncompensated in [μs] discharge time (000.0 for WFCA/ WOCA) |
| W3= xxxx.x | Height compensated in [μs] |
| R= xxx.x | Resistance in [Ω] |

**Example without control characters**

WFCA01 441 051 200 0 W1 452.3 W2 000.0 W3 0498.7 R 087.5
WOCA01 441 051 200 0 W1 452.3 W2 000.0 W3 0498.7 R 087.5
WISA01 441 051 200 0 W1 452.3 W2 012.6 W3 0498.7 R 087.5

**Incorrect measurement**

WISA04 441 051 200 0 W1 000.0 W2 000.0 W3 0000.0 R 000.0

**WABCO**

# 3 Special functions

The special functions described below are not designed for use in normal measuring operation. They are designed for setting up and calibrating the test device.

If one of the two push-buttons is pressed within one second of switching on the sensor test device, the device switches into a special mode.

| Push-button 1 *Select* Up | Output of the compensation parameter file via the RS232 interface |
|---|---|
| Push-button 1 *Select* Down | Importing a compensation parameter file via the RS232 interface |
| Push-button 2 *Single* | Calling up calibration routines |
| Push-button 2 *Continuous* | Selection of interface RS232 / IEC |

## 3.1 Importing a new compensation parameter file

(Push-button *Select* down)

A new compensation parameter file can be imported via the RS232 interface. The data is checked for validity and stored in the sensor test device. If an error is detected in the data, an error message is output.

! This mode can only be cancelled by switching the device off and then on again.

! A new compensation parameter file can only be generated in the WABCO development department.

```
Waiting for data...
```

## 3.2 Reading the saved compensation parameter file

(Push-button *Select* up)

The entire content of the compensation parameter file is output via the RS232 interface. The receipt of the data is not checked. After sending the data, the test device switches into normal measuring mode. The data can be received and displayed with a monitor program (e. g. Terminal.exe by Windows).

```
Send parameter P1
```

Transfer rate / data bits/ stop bits / parity / log: 19200 / 8 / 1 / - / - /

**Example of a file that contains data for all sensor types:**

```
0x0000 (checksum)
Sensor test device 884 907 014 0 parameter file V1.00
WFCA01W=4410505300U=407O=0699I=158Y=178R=087.5
WFCA02W=4410505310U=407O=0699I=158Y=178R=087.5
WOCA01W=0000000001U=999O=9999I=999Y=999R=999.9
WOCA02W=4411000010U=037O=0266I=098Y=200R=071.0
WISA01W=4411005390G=1.81A1=+0.020M1
=+0.600T1=9999A2=-0.000M2=-0.000T2
=0000A3=-0.000M3=-0.000T3=0000A4
=-0.000M4=-0.000T4=0000
WISA02W=4411000200G=1.58A1=-0.148M1
=+0.540T1=9999A2=-0.000M-0.000T2
=0000A3=-0.000M3=-0.000T3=0000A4=0.000M4
=-0.000T4=0000
```

## 3.3   Calibration mode SAPP-1K

(Push-button *Single*)

**!** The SAPP-1K card can only be calibrated after entering a password.

After connecting the reference coils, the calibration values are stored in the test device. The calibration values are protected against accidental overwriting. New calibration values are only permitted in a very narrow tolerance range.

You leave this mode by pressing the *Single* push-button.

```
Service routines
Wait for PW .....
Any key -> Exit
```

## 3.4   Interface selection RS232 / IEC

(Push-button *Continuous*)

After pressing the *Single* or *Continuous* push-button, the device switches back to normal measuring mode. The selected interface is displayed when the device is booted.

**!** The IEC interface is for laboratory operation only and is not offered optionally.

```
Interface P1

SINGLE: IEC
CONT: RS232
```

# 4 Error messages

## 4.1 Checking the parameter file

If a new parameter file is loaded to the sensor test device (see x.x), the plausibility of this file is checked during the load process. If an error occurs, the process is interrupted and an error message is output.

**Example:**

```
Waiting for data...
Error message: -32
Row:          101
```

Error -32 /101 indicates an error in the WOCA parameter set in row 101.

The last character indicates the error range (sensor type).

(0) = Undefined range

(1) = Error in WFCA range

(2) = Error in WOCA range

(3) = Error in WISA range

**List of all error messages**

| Test | WFCA | WOCA | WISA | Explanation |
|------|------|------|------|-------------|
| Check-sum | -00 | -00 | -00 | Checksum error |
| WFCA, WOCA, WISA | -10 | -10 | -10 | Unknown sensor type |
| = | -11 | -12 | -13 | = fixed character |
| W | -21 | -22 | -23 | W fixed character |
| U | -31 | -32 | - | U fixed character |
| O | -41 | -42 | - | O fixed error |
| I | -51 | -52 | - | I fixed character |
| Y | -61 | -62 | - | Y fixed character |
| R | -71 | -72 | - | R fixed character |

| Test | WFCA | WOCA | WISA | Explanation |
|------|------|------|------|-------------|
| '.' in the number | -81 | -82 | -82 | . Fixed character |
| <CR> | -91 | -92 | -93 | <CR> expected |
| Numbers in row | -101 | -102 | -103 | 0 - 9 expected |
| A | - | - | -113 | A fixed character |
| G | - | - | -123 | G fixed character |
| M | - | - | -133 | M fixed character |
| + - | - | - | -143 | + or - expected |

## 4.2 Checking the internal communication with the data logger

If the internal communication with the data logger does not work, the following error messages are output:

```
Sensor Test Device

  RS232    active
Error: Data logger
```

## 4.3 Error in measuring with SAPP-5K (WFCA)

If the internal communication with the SAPP-5K does not work, the following error messages are possible:

```
WFCA03 441 050 100 0
Open wire
```

**List of all error messages**

| Error messages | Explanation |
|---|---|
| Short circuit U battery | Test sample has a short circuit to the plus potential |
| Ground short circuit | Test sample has a short circuit to the minus potential |
| Glitch | Test sample is exposed to glitches |
| Excessive temperature | Test sample has excessive temperature |
| Line open | Test sample interrupted or cable broken |

## 4.4 Error in measuring with SAPP-1K (WOCA/ WISA)

If an error occurs in a single or continuous measurement, the following errors can be output.

```
WISA02 441 100 539 0

SAPP-1K-Error: -08
```
```
WISA02 441 100 539 0

SAPP-1K-Error: -2E
```

**List of all error messages**

| ErrorCode | Description |
|---|---|
| 00h | OK |
| 01h | Error in query format. |
| 02h | Function not supported. |

| ErrorCode | Description |
|---|---|
| 03h | Data cannot be stored in Flash memory. |
| 04h | Parameters exceed the specified range. |
| 05h | Buffer overrun |
| 06h | Timeout |
| 07h | Calibration value out of range |
| 08h | Checksum error |
| FEh | Internal fault |
| FFh | Internal fault |

Error messages of the PHYTEK controller:

x = Function call

1 = Read software version

2 = Read hardware version

3 = Start measurement

4 = Repeat measurement with the parameters of the last measurement

5 = Start calibration step 1 (WISA)

6 = Start calibration step 2 (WISA)

7 = Start calibration step 1 (WOCA)

8 = Start calibration step 2 (WOCA)

| ErrorCode | Description |
|---|---|
| xAh | CS error |
| xBh | CMD byte error |
| xCh | Wasic no. error |
| xDh | Version unknown, is not supported |
| xEh | Timeout |
| xFh | Receipt buffer overrun |

# 5 Technical data

## 5.1 General information

| Supply voltage (external) | |
|---|---|
| Test device 884 907 014 0 | 240 V / 50 Hz |
| Test device 884 011 158 0 | 120 V / 50 Hz |

| Supply voltage (internal) | |
|---|---|
| Power supply unit voltage V1 | +5 V (4.75 ... 5.25 V adjustable) |
| Power supply unit voltage V2 | +12 V (12 ... 15.5 V adjustable) |
| Power supply unit voltage V3 | +15 V (12 ... 15.5 V adjustable) |

| Safety device |
|---|
| Protection of the supply voltage (external) |
| Mains connection socket with micro-fuse 1.25 A medium time-lag |

| Temperature range | |
|---|---|
| Operating temperature | 20° C to +35° C |
| Storage temperature | -40° C to +70° C |

| Housing |
|---|
| Table top housing for plug-in cards in Euro format |
| Protection type IP20 as per IEC60529 |

## 5.2 Measuring accuracy

The measuring accuracy was determined according to the guide "Fähigkeitsnachweis von Messsystemen" ("Capability document for measuring systems") [of 22. December 1999] by the German Association of the Automotive Industry (VDA).

| | WFCA | WOCA | WISA [2] |
|---|---|---|---|
| Resolution | 1.0 µs | 0.1 µs | 0.1 µs |

| | WFCA | WOCA | WISA [2] |
|---|---|---|---|
| Accuracy at 20° C | ± 7.6 µs ± 1.36% | ± 0.8 µs ± 0.15% | ± 1.1 µs ± 0.11% |
| Influence of temperature on the accuracy in the range: 10° C - 30° C | ± 0.04 µs / K[1] ± 70 ppm / K[1] | ± 0.02 µs / K[1] ± 35 ppm / K[1] | ± 0.02 µs / K[1] ± 20 ppm / K[1] |

[1] The influence of the compensation depends on the connected sensor and its parameters and must be added to the device accuracy.

[2] Same inductance results in a higher (calculated) value of microseconds for WISA.

## 5.3 Calibration

The test device must be calibrated every 2 years. Only the calibration laboratory can perform a calibration.

Address:

WABCO Development GmbH
Kalibrierlabor PD-ME
Am Lindener Hafen 21
D-30432 Hanover

## 5.4 Base plate assignment

| Sensor plug | |
|---|---|
| Pin assignment of the 3-pin socket | |
| Pin 1 | GND |
| Pin 2 | NC |
| Pin 3 | Signal |

| Analogue output | |
|---|---|
| Pin assignment of the 5-pin socket | |
| Pin 1 | Signal |
| Pin 2 | NC |
| Pin 3 | GND |
| Pin 4 | NC |
| Pin 5 | NC |

**RS232**

Standard connection cable 9-pin SUB-D. (Socket/plug)

The lines are connected 1:1.

Transfer rate / data bits/ stop bits / parity /
log: 19200 / 8 / 1 / - / - /

| Abbreviation | Name | Pin No. 25-pin | Pin No. 9-pin | Input/output (from the PC perspective) |
|---|---|---|---|---|
|  | Common Ground | Pin 1 | - | - |
| TxD | Transmit Data | Pin 2 | Pin 3 | Out |
| RxD | Receive Data | Pin 3 | Pin 2 | In |
| RTS | Request To Send | Pin 4 | Pin 7 | Out |
| CTS | Clear To Send | Pin 5 | Pin 8 | In |
| DSR | Dataset Ready | Pin 6 | Pin 6 | In |
| GND | Ground | Pin 7 | Pin 5 | - |
| DCD | Data Carrier Detected | Pin 8 | Pin 1 | In |
| DTR | Data Terminal Ready | Pin 20 | Pin 4 | Out |
| RI | Ring Indicator | Pin 22 | Pin 9 | In |

WABCO Vehicle Control Systems, is one of the world's leading providers of electronic braking, stability, suspension and transmission control systems for heavy duty commercial vehicles. WABCO products are also increasingly used in luxury cars and sport utility vehicles (SUVs). Customers include the world's leading commercial truck, trailer, bus and passenger car manufacturers. Founded in the U.S. in 1869 as Westinghouse Air Brake Company,

WABCO was acquired by American Standard in 1968 and spun off in 2007. Headquartered in Brussels, Belgium, the business today employs more than 7,000 people in 34 offices and production facilities worldwide. In 2006, total sales were $2 billion. WABCO is a publicly traded company and is listed on the New York Stock Exchange with the stock symbol WBC.

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