



CBS100.1-2 / CBS104.1-2 / CBS105.1-2

Smart Lambda Sensor Cable

User's Guide

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1 General

This chapter contains information about the following topics:

- "About this Manual" on page 5
- "Basic Safety Notices" on page 6
- "Identifications on the Product" on page 9
- "RoHS Conformity" on page 10
- "CE Marking" on page 10
- "Product Return and Recycling" on page 10

1.1 About this Manual

Representation of information

All activities to be performed by the user are presented in a "Use Case" format. That is, the goal to be accomplished is briefly defined in the heading, and the respective steps required for reaching this goal are then presented in a list. The presentation looks as follows:

Goal definition:

Any preliminary information...

1. Step 1

Any explanations for step 1...

2. Step 2

Any explanations for step 2...

3. Step 3

Any explanations for step 3...

Any concluding comments...

Typographical conventions

The following typographical conventions are used:

Click on OK .	Button labels are printed in bold characters.
Press <ENTER>.	Keyboard commands are presented in angled brackets starting with capital letter.
The "File Open" dialog appears.	Names of program windows, dialog windows, fields and similar are given in quotation marks.
Bold	Labels of the device
<i>Italic</i>	Particularly important text passages

Important notes for the user are presented as follows:



Important note for the user.

1.2 Basic Safety Notices

1.2.1 Identification of Safety Notices

The safety notices contained in this manual are identified with the danger symbol shown below:



The safety notices shown below are used for this purpose. They provide notes to extremely important information. Please read this information very carefully.



DANGER

indicates an immediate danger with a high risk of death or serious injury, if not avoided.



WARNING

indicates a possible danger with moderate risk of death or (serious) injury, if not avoided.



CAUTION

identifies a hazard with low risk that could result in minor or medium physical injuries or property damages if not avoided.

1.2.2 General Safety Information

Please observe the Product safety notices for the product ("Safety Advice Smart Lambda Sensor Cable CBS10x.x") and the following safety notices to avoid any effects on your health or damages to the device.



TIP

Carefully read the documentation that belongs to the product prior to the startup.

ETAS GmbH does not assume any liability for damages resulting from improper handling, unintended use or non-observance of the safety precautions.

1.2.3 Requirements for Users and Duties for Operators

The product may be assembled, operated and maintained only if you have the necessary qualification and experience for this product. Improper use or use by a user without sufficient qualification can lead to damages or injuries to one's health or damages to property.

General safety at work

The existing regulations for safety at work and accident prevention must be followed.

1.2.4 Intended Use

Application areas of the product

The CBS10x.1-2 Smart Lambda Sensor Cable is exclusively approved for installation and use in stationary assemblies and devices in industrial and commercial areas.

The product is **not** approved for the following application areas:

- Non-stationary and mobile use,
- Use in the automotive industry and
- Automotive applications.

Use in systems with safety-relevant functions

The CBS10x.1-2 Smart Lambda Sensor Cable may not be installed as a component in a safety circuit or used for safety-relevant functions within safety circuits. In systems with safety-relevant functions, the lambda sensor cable may be used exclusively in conjunction with higher-order safety systems.

Requirements for operation

- Observe the notes for the ambient conditions (see chapter 4.1.2 on page 25).
- Ensure that the connection and adjustment values are observed (see chapter 4.3.1 on page 28).



CAUTION

Damage or destruction of the Smart Lambda Sensor Cable is possible.

The Smart Lambda Sensor Cable is approved only for the assembly and operation on components or at locations that ensure that the technical data of the cable (see chapter 4 on page 25) are being maintained during operation.

Fastening with cable ties



CAUTION

Damage to the housing is possible!

Cable ties for fastening the Smart Lambda Sensor Cable may be attached only to the infeed lines of the cable. Fastening on the electronic module (housing) of the cable is not allowed.

Opening the electronic module



CAUTION

Loss of the function is possible!

Do not open the electronic module (housing) of the Smart Lambda Sensor Cable! A safe function in the re-closed state cannot be guaranteed.

Lambda sensor

NOTICE

Each lambda sensor is individually trimmed via a resistor in the plug of the lambda sensor. For this reason, the plug of the lambda sensor may not be removed.

The lambda sensor connected to the product requires a power supply for the sensor heater.



CAUTION

If the sensor heater is missing, it could lead to premature deterioration or damage of the lambda sensor.

The lambda sensor must be supplied with current at all times as soon as it is exposed to the exhaust gases of a combustion process.

If the CBS10x.1-2 cable is connected with a voltage supply, the required regulated sensor heater voltage is provided at the sensor connection.

Safety notices for specific components



CAUTION

Risk of burns!

The LSU4.9 lambda sensor connected to the lambda sensor cable will become very hot during operation.

Requirements for the technical state of the product

The product is designed in accordance with state-of-the-art technology and recognized safety rules. The product may be operated only in a technically flawless condition and according to the intended purpose and with regard to safety and dangers as stated in the respective product documentation. If the product is not used according to its intended purpose, the protection of the product may be impaired.

Maintenance and cleaning


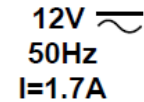



The product is maintenance-free. For cleaning, use a clean and dry cloth.

Use of Open Source Software

The product uses Open Source Software (OSS). This software is installed in the product at the time of delivery and needs not to be installed or updated by the user. Reference shall be made to the use of the software in order to fulfill OSS licensing terms. Additional information is available in the document "OSS Attributions List" at the ETAS website www.etas.com.

1.3 Identifications on the Product

The following symbols are used for identifying the product:

Symbol	Description
	The User's Guide must be read prior to the startup of the product!
	Operating voltage (rated voltage), current consumption (max.), see chapter 4.3.1 on page 28
	Marking for CE conformity, see chapter 1.5 on page 10
	Marking for RoHS, see chapter 1.4.1 on page 10
	Marking for China RoHS, see chapter 1.4.2 on page 10

Please observe the information in the chapter "Technical Data" on page 25.

1.4 **RoHS Conformity**

1.4.1 **European Union**

The EU Directive 2011/65/EU restricts the use of certain hazardous substances (RoHS conformity) for electrical and electronic devices.

ETAS confirms that the product meets this directive applicable in the European Union.

1.4.2 **China**

With the China RoHS identification attached to the product or its packaging, ETAS confirms that the product meets the guidelines of the "China RoHS" (Management Methods for Controlling Pollution Caused by Electronic Information Products Regulation) applicable in the People's Republic of China.

1.5 **CE Marking**

With the CE marking attached to the product or its packaging, ETAS confirms that the product corresponds to the product-specific, applicable European Directives. The CE Declaration of Conformity for the product is available upon request.

1.6 **Product Return and Recycling**

The European Union (EU) released the Directive for Waste Electrical and Electronic Equipment - WEEE to ensure the setup of systems for collecting, treating and recycling electronic waste in all countries of the EU.

This ensures that the devices are recycled in a resource-friendly way that does not represent any risk to personal health and the environment.



Fig. 1-1 WEEE Symbol

The WEEE symbol (see Fig. 1-1 on page 10) on the product or its packaging identifies that the product may not be disposed of together with the remaining trash.

The user is obligated to separately collect old devices and provide them to the WEEE return system for recycling.

The WEEE Directive applies to all ETAS devices, but not to external cables or batteries.

Additional information about the recycling program of ETAS GmbH is available from the ETAS sales and service locations (see chapter 6 on page 37).

2 Hardware Description

2.1 Overview

2.1.1 Products and Application Areas

The Smart Lambda Sensor Cables CBS100.1-2, CBS104.1-2 and CBS105.1-2 convert the signal of a Bosch LSU4.9 broadband lambda sensor into an analog output signal. The three Smart Lambda Sensor Cables of this product family were developed for different applications.

The electronics for measuring the oxygen content or the lambda value and for controlling the sensor heater is integrated in the cable so that the LSU4.9 lambda sensor together with the Smart Lambda Sensor Cable and a power supply is ready for immediate use.



Fig. 2-1 CBS10x.1-2 Smart Lambda Sensor Cable

i TIP

Unless otherwise indicated, the descriptions, properties and technical data in this manual apply to all variants of the Smart Lambda Sensor Cable (CBS100.1-2, CBS104.1-2 and CBS105.1-2). In these generally applicable text segments, the common short name "CBS10x.1-2" is being used.

i TIP

The CBS10x.1-2 Smart Lambda Sensor Cables feature an identical mechanical design, except for the number of connecting lines.

The CBS10x.1-2 Smart Lambda Sensor Cable is fitted with an RB150 plug for connecting the LSU4.9 sensor. The signal, diagnostic and configuration lines at the other end of the cable are fitted with ferrules and can easily be configured with specific plugs of the customer.

CBS100.1-2 and CBS105.1-2

If the Smart Lambda Sensor Cables CBS100.1-2 and CBS105.1-2 are supplied with DC voltage, it can be configured whether the output signal is a function either of the oxygen content or the lambda value of the gas or the pump current of the sensor.

CBS104.1-2

Together with an LSU4.9 lambda sensor, the CBS104.1-2 Smart Lambda Sensor Cable emulates an LSM11 discrete-level sensor. With connected LSU4.9 lambda sensor, the signal of an LSM11 discrete-level sensor in the range of -20 mV to +80 mV is exactly replicated by the analog signal at the cable output. In the process, the emulation of the LSM11 discrete-level sensor with the LSU4.9 broadband sensor supplies significantly more reliable measuring results on the lean scale than the original LSM11 discrete-level sensor. LSM11 discrete-level sensors in use can simply be replaced electrically and mechanically with an LSU4.9 broadband sensor and a CBS104.1-2 cable.

2.1.2 Properties

Properties of the CBS10x.1-2 Smart Lambda Sensor Cables:

- Integrated control of the heater of the lambda sensor
- Galvanic isolation of analog output from the supply voltage
- Selectable measure variable (CBS100.1-2 and CBS105.1-2; only with supply of DC voltage)

Output signal and measure variables

Output signal/ measure variable	CBS100.1-2	CBS104.1-2	CBS105.1-2
Output signal	Voltage	Voltage	Current
Oxygen content	X	X LSM11 emulation	X
Lambda	X	-	X
Pump current	X	-	X

The complete technical data of the CBS10x.1-2 Smart Lambda Sensor Cables are located in the chapter "Technical Data" on page 25.

2.2 Design of the Smart Lambda Sensor Cable

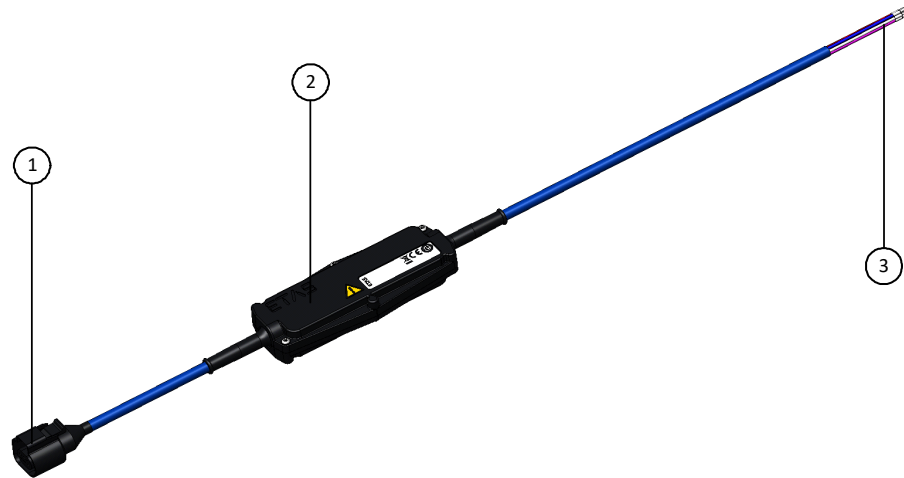


Fig. 2-2 Design of the Smart Lambda Sensor Cable

Part in Fig. 2-2	Comment
1	RB150 coupling (code 1) for the Bosch LSU4.9 lambda sensor
2	Electronic module with measurement electronics and heater control for the lambda sensor
3	Open cable end with ferrules

The terminal assignment of the Smart Lambda Sensor Cable is located in chapter 4.2.2 on page 26.

2.2.1 "LAMBDA" Connection with RB150 Coupling (Code 1)

The Bosch LSU4.9 lambda sensor (code 1) is connected to the RB150 coupling of the CBS10x.1-2 Smart Lambda Sensor Cable (part 1 in Fig. 2-2 on page 13).

NOTICE

Each lambda sensor is individually trimmed via a resistor in the plug of the lambda sensor. For this reason, the plug of the lambda sensor may not be removed.

2.2.2 Electronic Module

The following function groups are contained in the electronic module of the Smart Lambda Sensor Cable:

- Heater control for the lambda sensor
- Measurement electronics/ signal conditioning
- Diagnostic circuit
- Electrical isolation

Diagnostic circuit

A diagnostic circuit of the CBS10x.1-2 Smart Lambda Sensor Cable continuously checks the stability of the internal control circuits, the correct function of the connected sensor and the cable connections to the sensor. An error case is signaled at the "ERROR" connection.

Electrical isolation

The analog output (AOUT, AOUT_GND) is electrically isolated from the supply voltage (AC1, AC2) for all cable variants.

The connections "CONFIG" (configuration input) and "ERROR" (error output) of the Smart Lambda Sensor Cables are electrically isolated from the "AOUT" connection (analog output): the configuration input and error output are not on the potential of the output signal, but on the potential of the supply voltage.

2.2.3 Inputs and Outputs (Open Cable End)

The signal, diagnostic and configuration lines at the open end of the CBS10x.1-2 Smart Lambda Sensor Cable (part 3 in Fig. 2-2 on page 13) are connected to the power supply and the inputs and outputs of the application circuit. Depending on the cable type, the following signals are available at the lines fitted with ferrules:

Connection	CBS100.1-2	CBS104.1-2	CBS105.1-2
Analog output	X	X	X
Configuration input	X	-	X
Error output	X	-	X

The mapping of the signals to the connections is located in chapter 4.2.4 on page 27.

2.2.4 Connections "AOUT" and "AOUT_GND"

CBS100.1-2 and CBS104.1-2

The "AOUT" connection of the Smart Lambda Sensor Cables CBS100.1-2 and CBS104.1-2 is a voltage output.

CBS105.1-2

The "AOUT" connection of the CBS105.1-2 Smart Lambda Sensor Cable is a passive current output (4 to 20 mA).

For the function of the CBS105.1-2 Smart Lambda Sensor Cable, it is absolutely necessary to connect the "AOUT" connection to an active input of an analysis circuit so that the current interface is supplied with voltage.

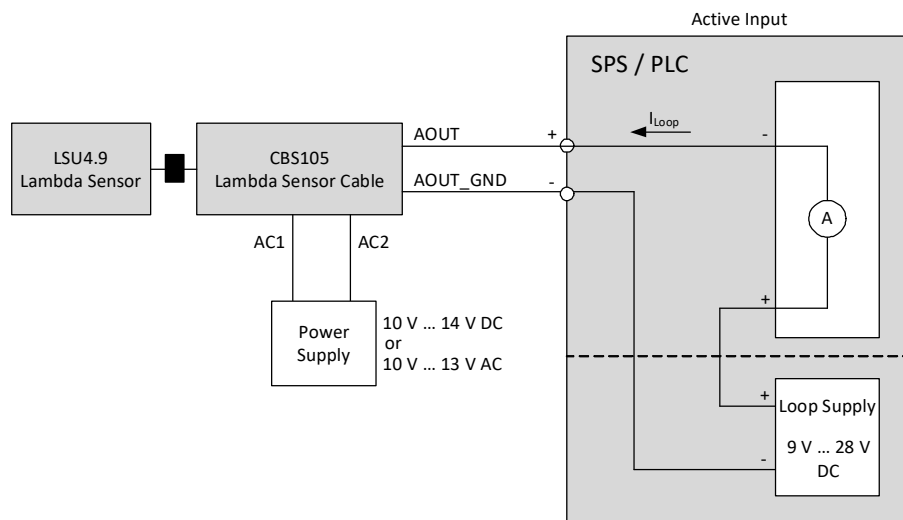


Fig. 2-3 Connecting the CBS105.1-2 Smart Lambda Sensor Cable

The CBS105.1-2 Smart Lambda Sensor Cable must be connected as passive 2-wire measuring transformer with additional voltage supply for the current interface (see Fig. 2-3 on page 15). An additional external power supply or a voltage supplied by the PLC can be used for the voltage supply of the current interface (loop supply) of the Smart Lambda Sensor Cable.

i TIP

Operating the current interface ("AOUT" output) of the CBS105.1-2 Smart Lambda Sensor Cable requires an additional voltage supply. The current interface is not supplied via the voltage supply of the Smart Lambda Sensor Cable (connections "AC1" and "AC2"!).

2.2.4.1 Output signals and measure variables

Supply with DC voltage

If the Smart Lambda Sensor Cables CBS100.1-2 and CBS105.1-2 are supplied with DC voltage, the wiring of the "CONFIG" connection allows selecting to which measure variable the signal issued at the "AOUT" connection is assigned (see chapter 4.3.4 on page 29).

Output signal/ measure variable	CBS100.1-2	CBS104.1-2	CBS105.1-2
Output signal	Voltage	Voltage	Current
Oxygen content	X	X LSM11 emula- tion	X
Lambda	X	-	X
Pump current	X	-	X

Supply with AC voltage

If the Smart Lambda Sensor Cables CBS100.1-2 or CBS105.1-2 are supplied with AC voltage, the oxygen content is issued as measure variable at the "AOUT" connection. The measure variables lambda and pump current cannot be selected in the operating mode.

Output signal/ measure variable	CBS100.1-2	CBS104.1-2	CBS105.1-2
Output signal	Voltage	Voltage	Current
Oxygen content	X	X LSM11 emula- tion	X
Lambda	-	-	-
Pump current	-	-	-

i TIP

A voltage corresponding to the behavior of an LSM11 discrete-level sensor is always output at the "AOUT" connection of the CBS104.1-2 Smart Lambda Sensor Cable.

2.2.5 "CONFIG" Connection (Configuration Input)

If the Smart Lambda Sensor Cables CBS100.1-2 and CBS105.1-2 are supplied with DC voltage, wiring the "CONFIG" connection allows selecting whether the output signal is a function either of the oxygen content or of the lambda value of the gas or the pump current of the sensor (see chapter 4.3.4 on page 29).

i TIP

When supplying the CBS10x.1-2 Smart Lambda Sensor Cables with AC voltage, the connections "CONFIG" and "ERROR" are without function.

i TIP

The "CONFIG" connection of the CBS104.1-2 Smart Lambda Sensor Cable is without function.

2.2.6 "ERROR" Connection (Error Output)

The CBS10x.1-2 Smart Lambda Sensor Cables signal an error case at the "ERROR" connection with a voltage of approx. 4 V to ground. As soon as the error condition no longer exists, it is switched back to normal operation.

i TIP

When supplying the CBS10x.1-2 Smart Lambda Sensor Cables with AC voltage, the connections "CONFIG" and "ERROR" are without function.

 **TIP**

Contrary to the industry standard (current interface 4 to 20 mA), the CBS105.1-2 Smart Lambda Sensor Cable does not supply an increased current signal at the "AOUT" output in case of an error. An error case is signaled at the "ERROR" connection.

To signal an error state in the application circuit, an optocoupler, an LED or a programmable logic controller (PLC) can be connected directly to the "ERROR" error output.

Signaled error states

- As long as the sensor temperature is still below approx. 750 °C (rated: 780 °C) during the warm-up phase.
- If the AC1/AC2 supply voltage falls outside the allowed range.
- If the sensor is being cooled off too much or heated up further due to external exhaust gas temperatures or the exhaust gas volume flow:
 $T_{\text{sensor}} < 750 \text{ °C}$ or $T_{\text{sensor}} > 800 \text{ °C}$
- If a short circuit of the sensor signals to the positive or negative supply voltage occurs in the sensor or in the cable harness to the sensor or if a line interruption occurs in the cable harness to the sensor.

2.2.7 Connections "AC1" and "AC2" (Voltage Supply)

The Smart Lambda Sensor Cables of the CBS10x.1-2 product family can be supplied with a DC or AC voltage.

The electronics for the sensor heater is integrated in the cable so that the LSU4.9 lambda sensor together with the Smart Lambda Sensor Cable is supplied by a common power supply.

 **TIP**

Operating the current interface ("AOUT" output) of the CBS105.1-2 Smart Lambda Sensor Cable requires an additional voltage supply. The current interface is not supplied via the voltage supply of the Smart Lambda Sensor Cable (connections "AC1" and "AC2")!

Switching on the power supply

The supply voltage of the CBS10x.1-2 Smart Lambda Sensor Cables must be supplied via a switching process.

The power supply of the CBS105.1-2 Smart Lambda Sensor Cable and the external power supply for feeding the current interface can be switched on in a random order.

3 Commissioning

This chapter contains information about the following topics:

- "General Recommendations for Installation and Operation" on page 18
- "Startup Sequence" on page 19
- "Assembly of the Lambda Sensor" on page 19
- "Cabling" on page 22

3.1 General Recommendations for Installation and Operation

3.1.1 Lambda Sensor Cable

Assembly location



CAUTION

Damage or destruction of the Smart Lambda Sensor Cable is possible.

The Smart Lambda Sensor Cable is approved only for the assembly and operation on components or at locations that ensure that the technical data of the cable (see chapter 4 on page 25) are being maintained during operation.

Fastening with cable ties



CAUTION

Damage to the housing is possible!

Cable ties for fastening the Smart Lambda Sensor Cable may be attached only to the infed lines of the cable. Fastening on the electronic module (housing) of the cable is not allowed.

Opening the electronic module



CAUTION

Loss of the function is possible!

Do not open the electronic module (housing) of the lambda sensor cable! A safe function in the re-closed state cannot be guaranteed.

3.1.2 Lambda Sensor

With improper handling, the lambda sensor can deteriorate prematurely or be damaged.

Deteriorated or defective lambda sensors

Deteriorated or defective lambda sensors must be replaced with a new unit. De-energize the Smart Lambda Sensor Cable before replacing the lambda sensor.



CAUTION

If the sensor heater is missing, it could lead to premature deterioration or damage of the lambda sensor.

The lambda sensor must be supplied with current at all times as soon as it is exposed to the exhaust gases of a combustion process.

If the CBS10x.1-2 cable is connected with a voltage supply, the required controlled sensor heater voltage is provided at the sensor connection.

NOTICE

Each lambda sensor is individually trimmed via a resistor in the plug of the lambda sensor. For this reason, the plug of the lambda sensor may not be removed.

3.2 Startup Sequence

Sequence for the startup of the Smart Lambda Sensor Cable:

- A Install LSU4.9 lambda sensor in the exhaust-gas routing (see chapter 3.3 on page 19)
- B The connections of the CBS10x.1-2 Smart Lambda Sensor Cable can be cabled in any order (see chapter 3.4 on page 22).



TIP

Observe the general recommendations for installing and operating the Smart Lambda Sensor Cable and the lambda sensor in chapter 3.1 on page 18!

3.3 Assembly of the Lambda Sensor

3.3.1 Technical Information



TIP

Additional information about the Bosch lambda sensors are located in the document "*Bosch: Technical Customer Information for LSU4.9*" (Y 258 K01 008-000).

3.3.2 Notes about Installing the Lambda Sensor

The following general guidelines should be taken into consideration when installing the LSU lambda sensor:

- Select the installation location in exhaust-gas lines so that a representative exhaust gas composition is ensured while maintaining the specified temperature limits.

The following maximum values apply to the LSU4.9 lambda sensor:

- Maximum gas temperature: 930 °C
- Maximum hexagon temperature: 570 °C

Depending on the operating voltage, cold exhaust gas in conjunction with high rate of flow can cause the operating temperature of the sensor cell to fluctuate. This can lead to measurement errors.

Hot exhaust gas with temperatures above the regulated ceramic temperature can cause the operating temperature of the sensor cell to increase. This can also lead to measurement errors.

- The active sensor ceramics is quickly heated up by the internal heater. The installation location must be selected so that as little condensate as possible can enter from the exhaust gas system in order to avoid ceramic breaks.

Select the installation location and installation position of the sensor so that the sensor is possibly installed in downward sloping exhaust-gas pipes and exhaust-gas systems in order to avoid a concentration of condensate in front of the sensor installation location (no indentations, projections, tearing edges).

- The installation angle position should be sloped at least 10° to the horizontal (sensor tip pointing downward).

This prevents condensate from collecting between sensor housing and sensor ceramics during operation in cold environments.

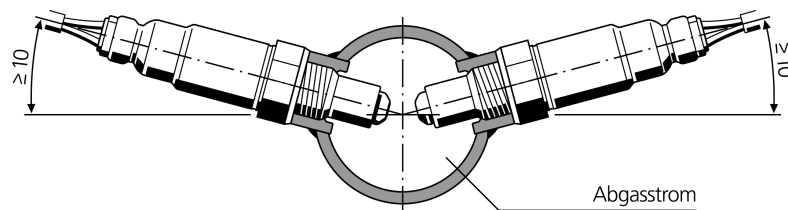


Fig. 3-1 Installation Angle Position

- Assembly with special grease on fixing thread (e.g. Bosch lambda sensor assembly paste, item number 1 987 123 020).
- Tightening torque: 50 Nm to 60 Nm, material properties and thread strength must be dimensioned accordingly.
- Avoid impermissible heating of the cable gland close to the sensor.
- The use of cleaning or lubricating fluids as well as evaporating solids at the sensor plug connection is not allowed.

3.3.3 Assembly of the Bosch Lambda Sensor

Assembling the LSU4.9 lambda sensor

i TIP

During the assembly of the lambda sensor, observe the installation guidelines in chapter 3.3 on page 19.

1. Select a position for the lambda sensor that is not too close to the combustion chamber to avoid a possible overheating of the sensor and heat damages to the sensor.
2. Prior to the installation of the sensor, a threaded nipple is welded into the exhaust-gas pipe.

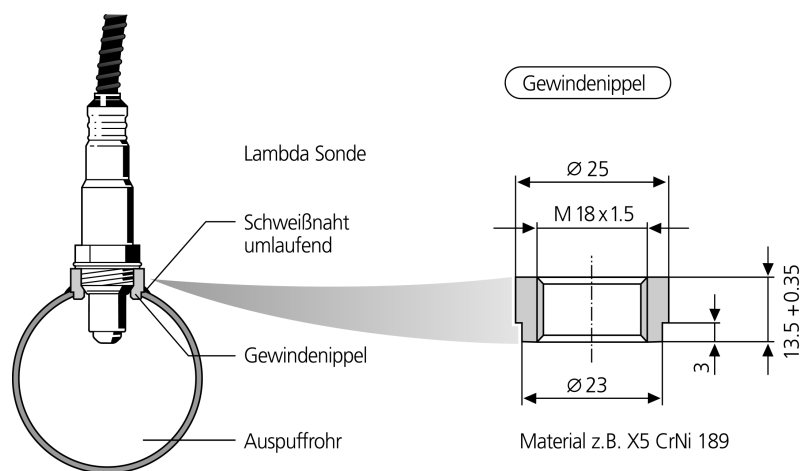


Fig. 3-2 Installation of the Lambda Sensor

3. When installing the LSU lambda sensor, ensure that a high heat-resistant lubricant is used (cp. Page 20). Distribute it all around the threaded nipple of the LSU lambda sensor. This prevents problems during a later removal of the sensor.
4. The tip of the LSU lambda sensor should reach into the exhaust-gas pipe by at least 50% since this a well-mixed exhaust gas will be present at that point.

3.4 Cabling

The connections of the CBS10x.1-2 Smart Lambda Sensor Cable can be cabled in any order.

TIP

The "CONFIG" connection of the CBS104.1-2 Smart Lambda Sensor Cable is without function.

TIP

When supplying the CBS10x.1-2 Smart Lambda Sensor Cables with AC voltage, the connections "CONFIG" and "ERROR" are without function.

TIP

It is recommended to electrically insulate and mechanically secure any unused connections of the Smart Lambda Sensor Cable.

3.4.1 "LAMBDA" Connection (Lambda Sensor)

The Bosch LSU4.9 lambda sensor (code 1) is connected to the RB150 coupling (part 2 in Fig. 2-2 on page 13) of the Smart Lambda Sensor Cable.

Connecting the Smart Lambda Sensor Cable with the lambda sensor

1. Connect the RB150 coupling (code 1) of the Smart Lambda Sensor Cable with the LSU4.9 lambda sensor.

TIP

The CBS10x.1-2 cable is intended only for use with the Bosch LSU4.9 lambda sensor.

3.4.2 "AOUT" Connection (Analog Output)

The measure variable of the Smart Lambda Sensor Cable is provided at the "AOUT" connection as analog output signal (see chapter 2.2.4 on page 14).

Cabling the analog output with your analog measurement device

1. Connect the connections "AOUT" (white) and "AOUT_GND" (blue) of the open cable end with a measurement device, e.g. the analog input of the (process) controller.

TIP

The analog output is electrically isolated from the supply voltage.

Observe the color coding of the cable ends.

Requirements on the voltage supply of the Smart Lambda Sensor Cable are located in the chapter 4.3.1 on page 28.

3.4.3 "CONFIG" Connection (Configuration Input)

The measure variable output at the "AOUT" output can be selected by wiring the "CONFIG" connection. Please observe the information in chapter 2.2.4 on page 14 and in chapter 2.2.5 on page 16.

Cabling the configuration input for the output of the "O2" measure variable

The "CONFIG" connection (green) of the open cable end remains open, i.e. it is not placed on a potential (operating voltage, ground).

1. Secure the connection to avoid any contact with an operating voltage potential.

The "O2" measure variable is output at the "AOUT" connection of the Smart Lambda Sensor Cable.

Cabling the configuration input for outputting the "Lambda" measure variable

1. Connect the "CONFIG" connection (green) of the open cable end with the positive terminal of the power supply.

Observe the color coding of the cable end.

The "Lambda" measure variable is output at the "AOUT" connection of the Smart Lambda Sensor Cable.

Cabling the configuration input for outputting the "Pump current" measure variable

1. Connect the "CONFIG" connection (green) of the open cable end with the negative terminal of the power supply.

Observe the color coding of the cable end.

The "Pump current" measure variable is output at the "AOUT" connection of the Smart Lambda Sensor Cable.

3.4.4 "ERROR" Connection (Error Output)

Cabling the error output

1. Connect the "ERROR" connection (pink) of the open cable end
 - directly with an LED

or

- directly with an optocoupler

or

- with your programmable logic controller (PLC).

Observe the color coding of the cable end.

3.4.5 Connections "AC1" and "AC2" (Voltage Supply)



The measurement electronics in the CBS10x.1-2 Smart Lambda Sensor Cable and the heater of the lambda sensor are connected with the power supply at a common connection (AC1).

Requirements on the voltage supply of the Smart Lambda Sensor Cable are located in the chapter 4.3.1 on page 28.

The cabling of the connections "AC1" and "AC2" described the mapping for operation with DC voltage.

Cabling the Smart Lambda Sensor Cable with the voltage supply

1. Connect the "AC2" connection (black) of the open cable end with the negative terminal of the power supply.
2. Connect the "AC1" connection (red) of the open cable end with the positive terminal of the power supply.

Observe the color coding of the cable ends.

4 Technical Data

This chapter contains information about the following topics:

- "General Data" on page 25
- "Mechanical Data" on page 26
- "Electrical Data" on page 28

4.1 General Data

4.1.1 Standards

The product meets the following standards:

Standard	Test
EN 61326-1	Electrical equipment for measurement, control and laboratory use - EMC requirements
EN 61000-6-1	Immunity for residential, commercial and light-industrial environments
EN 61000-6-2	Immunity (for industrial environments)
EN 61000-6-3	Emission standard for residential, commercial and light-industrial environments
EN 61000-6-4	Emission standard (for industrial environments)
EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use

4.1.2 Ambient Conditions

Operating temperature range	-40 °C to +80 °C
	-40 °F to +176 °F
Operating altitude	max. 5000 m / 16400 ft
Degree of protection	IP44

4.2 Mechanical Data

4.2.1 Dimensions and Weight

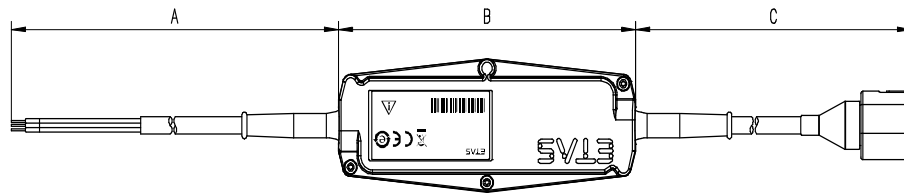


Fig. 4-1 Dimensions of the Smart Lambda Sensor Cable

Cable length (overall)	2 m / 78.75 in
Cable length A (line from electronic module including open cable end)	1.7 m / 66.93 in
Dimensions of electronic module without cable and threaded cable gland (Height x Width x Depth)	21.6 mm x 126.4 mm x 50 mm 0.85 in x 4.98 in x 1.97 in
Cable length C (line to sensor including RB150 plug)	0.3 m / 11.81 in
Weight (without sensor)	230 g

4.2.2 Connections of the Lambda Sensor Cable



Fig. 4-2 Connections of the Smart Lambda Sensor Cable

Part in Fig. 4-2	Comment
1	"LAMBDA" connection with RB150 coupling (code 1) for Bosch LSU4.9 lambda sensor
2	Open cable end with ferrules

4.2.3 "LAMBDA" Connection with RB150 Coupling (part 1 in Fig. 4-2)

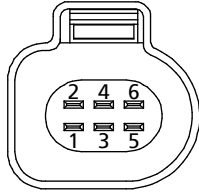


Fig. 4-3 RB150 Sensor Coupling (Code 1)

On pin	Color	Signal	Action
1	White	IP	Pump current
2	Green	IPN	Virtual ground
3	Black	H-	Heater minus
4	Red	H+	Heater plus
5	Pink	RT	Trimming resistance
6	Blue	RE+	Nernst voltage

4.2.4 Open Cable End with Ferrules (part 2 in Fig. 4-2)

The cross section of the cable measures 6 x 0.5 mm².

Color	Signal	Action
Red	AC1	Operating voltage
Black	AC2	Operating voltage, ground
Blue	AOUT_GND	Analog output, ground
White	AOUT	Analog output
Green	CONFIG	Configuration input
Pink	ERROR	Error output

TIP

It is recommended to electrically insulate and mechanically secure any unused connections of the Smart Lambda Sensor Cable.

4.3 Electrical Data

4.3.1 Voltage Supply

Operating voltage	10 V to 14 V DC and 10 V to 13 V AC, 60 Hz \pm 1 Hz
Heater supply	PWM with approx. 100 Hz
Current consumption (typ.)	1.1 A at 12 V DC
Current consumption (max.)	1.7 A at 12 V DC and start with cold sensor

i TIP

If supplied with DC voltage, the measurement electronics in the cable and the heater of the lambda sensor are connected with the power supply at a common connection (AC1 connection).

i TIP

It is recommended to use an 4 A pre-fuse.

4.3.2 Startup Behavior during Normal Startup of the Supply Voltage

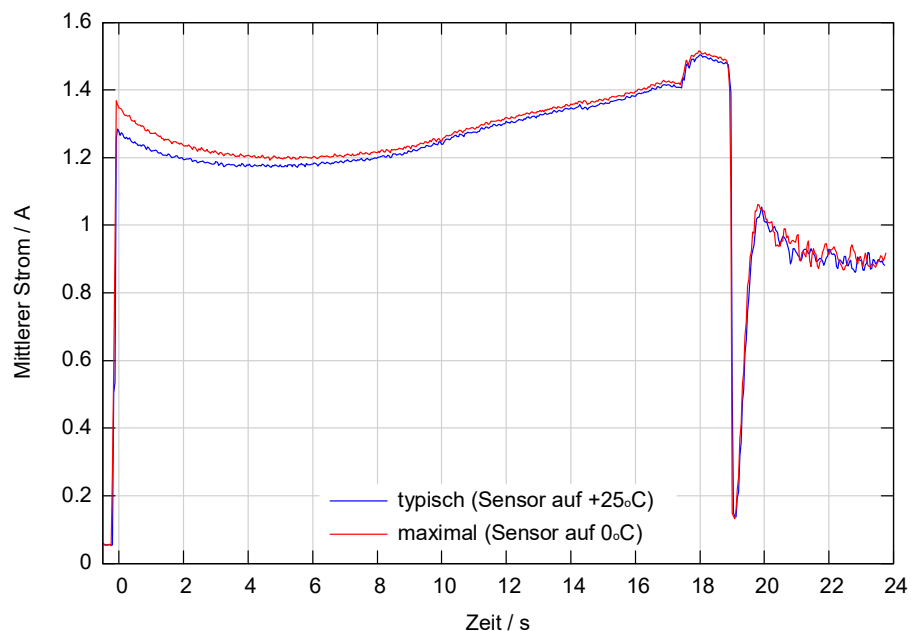


Fig. 4-4 Heat-up Characteristics of CBS10x.1-2 with LSU4.9 at 12 V DC

4.3.3 "LAMBDA" Connection with RB150 Coupling

Number of channels	1
Supported sensor type	Bosch LSU4.9 lambda sensor (code 1)
Connection	RB150 coupling (code 1)
Sensor heater	Integrated control
Typ. heat-up time	approx. 20 s at 12 V DC

TIP

Each lambda sensor is individually trimmed via a resistor in the plug of the lambda sensor. For this reason, the plug of the lambda sensor may not be removed.

4.3.4 Configuration Input ("CONFIG" Connection)

The measure variable at the "AOUT" connection can be selected by wiring the "CONFIG" input.

Measure variable at "AOUT"	"CONFIG" input
O ₂	Open
Lambda λ	Connected with V_SUPPLY ("Lambda" selection at V_CONFIG > 0.75 * V_SUPPLY)
Pump current I _p	Connected with GND ("Pump current" selection at V_CONFIG < 0.25 * V_SUPPLY)

TIP

The "CONFIG" configuration input is at the potential of the supply voltage and not at the potential of the output signal.

TIP

When supplying the Smart Lambda Sensor Cables CBS100.1-2 or CBS105.1-2 with AC voltage, the connections "CONFIG" and "ERROR" are without function.

At the "AOUT" connection, the oxygen content is output as measure variable.

TIP

The "CONFIG" connection of the CBS104.1-2 Smart Lambda Sensor Cable is without function.

4.3.5 Error Output ("ERROR" Connection)

An optocoupler, an LED or a programmable logic controller (PLC) can be connected directly to the "ERROR" error output for signaling an error state .

State	"ERROR" output
Error	approx. 4 V to ground, Short-circuit current approx. 10 mA, internal resistance approx. 400 ohm
No error	High impedance / high-resistance

TIP

The "ERROR" error output is at the potential of the supply voltage and not at the potential of the output signal.

TIP

When supplying the CBS10x.1-2 Smart Lambda Sensor Cables with AC voltage, the connections "CONFIG" and "ERROR" are without function.

4.3.6 "AOUT" Connection ("AOUT" Analog Output)

4.3.6.1 CBS100.1-2: Properties and ratings

Output voltage	0 V to 10 V
Output current	-5 mA to +5 mA
Output impedance	typ. 10 ohm
Protection	against short circuit, max. external voltage 0 V to +12 V
Electrical isolation	max. 60 V DC (output to supply voltage)

TIP

The output is high-impedance in de-energized state.

4.3.6.2 CBS104.1-2: Properties and ratings

Output voltage	-20 mV to +80 mV; LSM11 emulation
Output impedance	typ. 100 ohm
Protection	against short circuit, max. external voltage -0.3 V to +3 V
Electrical isolation	max. 60 V DC (output to supply voltage)

TIP

The output is high-impedance in de-energized state.

4.3.6.3 CBS105.1-2: Properties and ratings

Output current	4 mA to 20 mA; voltage range +9 V to +28 V
Output type	passive
Protection	against reverse polarity
Electrical isolation	max. 60 V DC (output to supply voltage)

TIP

The output is low-impedance (typically 100 ohm) in de-energized state.

TIP

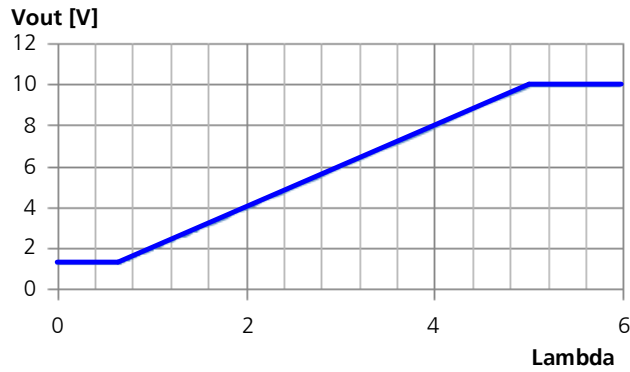
Operating the current interface ("AOUT" output) of the CBS105.1-2 Smart Lambda Sensor Cable requires an additional voltage supply. The current interface is not supplied via the voltage supply of the Smart Lambda Sensor Cable (connections "AC1" and "AC2")!

TIP

Contrary to the industry standard (current interface 4 to 20 mA), the CBS105.1-2 Smart Lambda Sensor Cable does not supply an increased current signal at the "AOUT" output in case of an error. An error case is signaled at the "ERROR" connection.

4.3.7 CBS100.1-2: Measure Ranges and Graduation

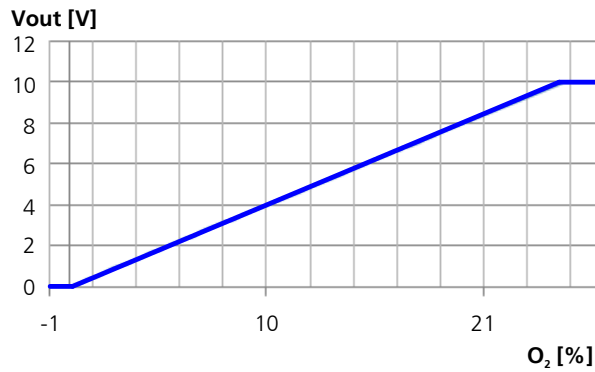
4.3.7.1 Lambda measure variable



Measure variable	Measure range	Graduation
Lambda λ	0.65 to 5.0	$V_{out} = 2.0 V * \lambda$

The values listed for measure range and graduation apply to new lambda sensors at 1013 hPa.

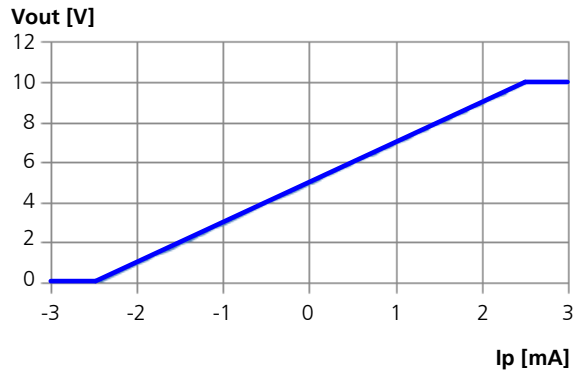
4.3.7.2 Oxygen content measure variable



Measure variable	Measure range	Graduation
O ₂	0 to 25%	$V_{out} = 0.4 V * O_2 [\%]$

The values listed for measure range and graduation apply to new lambda sensors at 1013 hPa.

4.3.7.3 Pump current measure variable

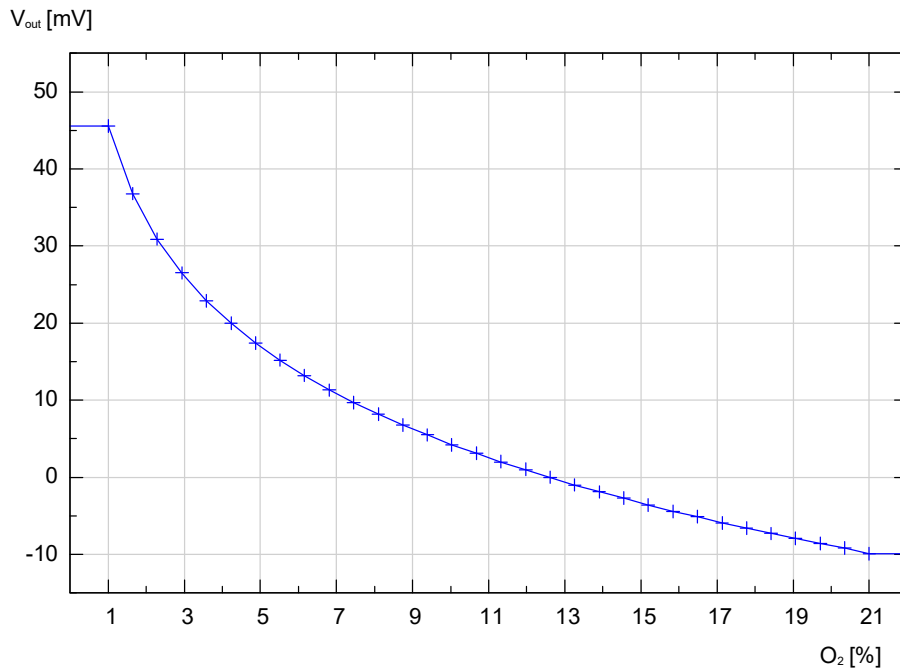


Measure variable	Measure range	Graduation
Pump current I_p	-2.5 mA to +2.5 mA	$V_{out} = 5.0 \text{ V} + 2.0 \text{ V} * I_p [\text{mA}]$

4.3.8 CBS104.1-2: Measure Range and Graduation

Together with an LSU4.9 lambda sensor, the CBS104.1-2 Smart Lambda Sensor Cable emulates an LSM11 discrete-level sensor.

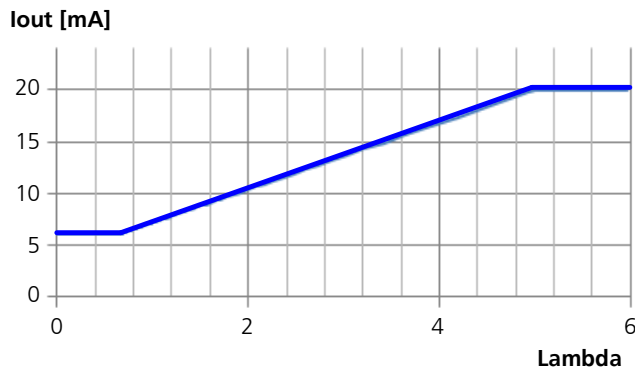
4.3.8.1 Oxygen content measure variable



The output signal is restricted to a maximum or minimum value.

4.3.9 CBS105.1-2: Measure Ranges and Graduation

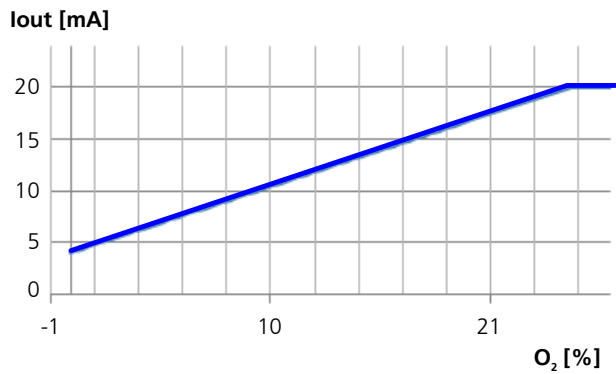
4.3.9.1 Lambda measure variable



Measure variable	Measure range	Graduation
Lambda λ	0.65 to 5.0	$I_{out} = 4 \text{ mA} + 3.2 \text{ mA} * \lambda$

The values listed for measure range and graduation apply to new lambda sensors at 1013 hPa.

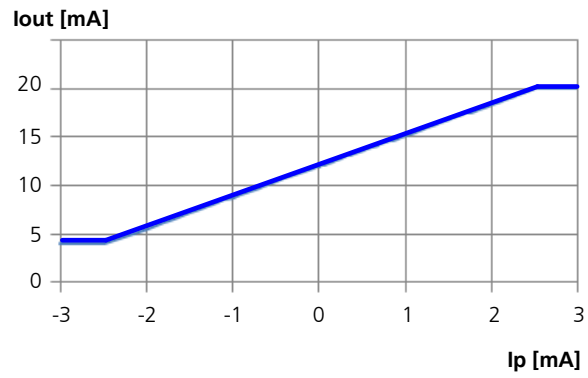
4.3.9.2 Oxygen content measure variable



Measure variable	Measure range	Graduation
O ₂	0 to 25%	$I_{out} = 4 \text{ mA} + 0.64 \text{ mA} * O_2 \text{ [%]}$

The values listed for measure range and graduation apply to new lambda sensors at 1013 hPa.

4.3.9.3 Pump current measure variable: Measure range and graduation



Measure variable	Measure range	Graduation
Pump current I_p	-2.5 mA to +2.5 mA	$I_{out} = 12 \text{ mA} + 3.2 \text{ mA} * I_p \text{ [mA]}$

5 Ordering Information

Order name	Short name	Order number
CBS10x.1-2 Smart Lambda Sensor Cable for Bosch LSU4.9, Universal, Voltage Output, RB150, open wire, 2 m	CBS100.1-2	F 00K 107 904
CBS104.1-2 Smart Lambda Sensor Cable for Bosch LSU4.9, LSM11 Emulation Output, RB150, open wire, 2 m	CBS104.1-2	F 00K 107 906
CBS105.1-2 Smart Lambda Sensor Cable for Bosch LSU4.9, Universal, Current Output, RB150, open wire, 2 m	CBS105.1-2	F 00K 107 907

6 ETAS Contact Addresses

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ETAS subsidiaries Internet: www.etas.com/en/contact.php
ETAS technical support Internet: www.etas.com/en/hotlines.php

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