ES5338.1 Carrier Board for Wheel Speed Sensor Simulation, PSI5, Direct Current Output (6 Sockets) PB5338CURR.1-A Wheel Speed Sensor Simulation, PSI5, Direct Current Output Piggyback

User's Guide

Contents

1   Introduction

This User's Guide contains the description of the ES5338.1 Carrier Board for Current Output Piggyback PB5338CURR.1-A. The ES5338.1 Carrier Board can be populated with up to six modules of the PB5338CURR.1-A Wheel Speed Sensor Simulation Piggyback. This combination allows simulating up to six sensors.

The ES5338.1 Carrier Board simulates the signals of active digital wheel speed sensors that offer a speed measurement (distance measurement) of close to v = 0 km/h. This also covers the partially stricter v_{min} requirements for the simulation, e.g. of navigation systems, anti-rollback devices, parking assist systems, etc.

Two additional functions are the simulation of sensor signals following the PSI5 sensor protocol and a Direct Current Output.

> ⚠️ **CAUTION!**
>
> *Some components of the ES5338.1 Carrier Board can be damaged or destroyed by electrostatic discharges. Leave the plug-in card in its transport packaging until it is installed.*
> *The ES5338.1 Carrier Board and the PB5338CURR.1-A Piggyback should only be removed, configured and installed at a workplace that is secured against static discharges.*

This chapter contains information about the following topics:

- "Properties" on page 6
- "Basic Safety Notices" on page 8
- "Identifications on the Product" on page 13
- "CE Mark" on page 13
- "RoHS Conformity" on page 13
- "KC marking" on page 14
- "Product Return and Recycling" on page 14
- "Declarable Substances" on page 14
- "About this Manual" on page 15

1.1 Properties

This chapter describes the fundamental properties of the ES5338.1 Carrier Board.

1.1.1 Properties of the ES5338.1 Carrier Board

The ES5338.1 Carrier Board is a plug-in card for a LABCAR HiL system for use in the ES5300.1-A Housing and in the ES5300.1-B Housing. The ES5338.1 Carrier Board can be populated with up to six PB5338CURR.1-A Piggybacks.

The properties of the ES5338.1 Carrier Board are as follows:

- 4U/5HP plug-in card for a LABCAR HiL system
- Compatibility with ES5300.1-A Housing and ES5300.1-B Housing
- Slots for up to six PB5338CURR.1-A Piggybacks
- Connection to the ES5300.1-A backplane or ES5300.1-B backplane via the interfaces SPI, I2C and JTAG
- I/O connections via a VG96 plug connector for connection to an ECU
- Function generator that can control the current source of each Piggyback for simulating one of the following six signal types:

  1. DF10 wheel speed sensor signals

  2. DF11s wheel speed sensor signals

  3. DF11i wheel speed sensor signals

  4. VDA wheel speed sensor signals

  5. PSI5 sensor signals following PSI5 standards V1.3 and V2.1

  6. Direct Current Output (direct control of current source via the simulation model)

- Output of sensor signals as digital current signals on 6 channels
- Mixed configuration of channels is possible
- Updating the function generator is possible with HSP

When it is fully populated, the ES5338.1 Carrier Board may be used for simulating four wheel speed sensors and two PSI5 pressure sensors, for example.

1.1.2   Block Diagram of ES5338.1 Carrier Board

The block diagram in Fig. 1-1 on page 7 shows the essential functional units of the ES5338.1 Carrier Board.
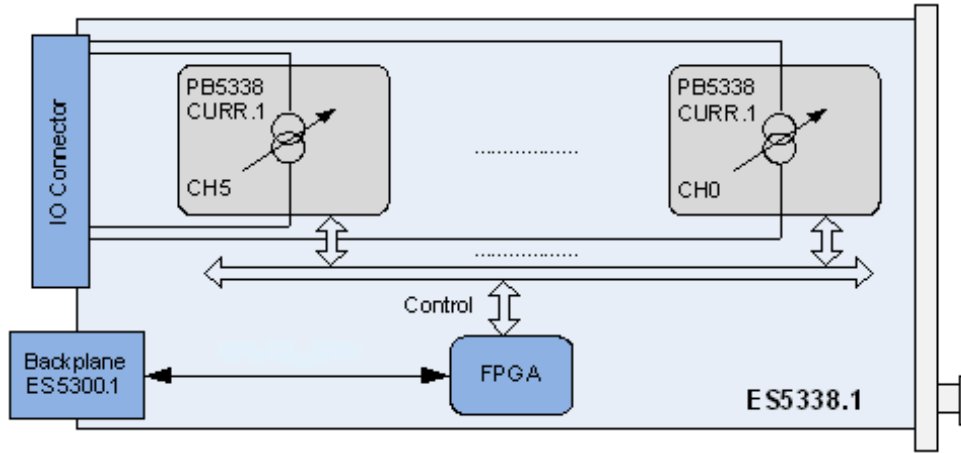
Fig. 1-1   Block diagram of ES5338.1 Carrier Board

1.2   Basic Safety Notices

Observe the following safety notices to avoid health issues or damage to the device.

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 carefully.

CAUTION!

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

WARNING!

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

DANGER!

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

1.2.2   General Safety Information

Please observe the Product Safety Notices ("ETAS Safety Notice") and the following safety notices to avoid health issues or damage to the device.

Note

The User's Guide must be read prior to the startup of the product!

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 put life at risk or cause damage to health or property.

The system integrator is responsible for the safety of systems that use the product!

General Safety at Work

Follow the existing regulations for work safety and accident prevention. All applicable regulations and laws regarding operation must be strictly adhered to when using this product.

1.2.4   Intended Use

The ES5338.1 Carrier Board is a plug-in card for the ES5300.1-A Housing and the ES5300.1-B Housing. The ES5338.1 Carrier Board can accommodate up to six PB5338CURR.1-A Piggybacks.

The ES5338.1 Carrier Board consists of the following:

- Six slots that accept current output modules
- Up to six current output modules of similar design
- SPI, I²C interfaces for the ES5300.1-A Housing or ES5300.1-B Housing
- Output interface (current outputs) to the ECU
- Voltage supply of the plug-in modules (current output modules)

The ES5338.1 Carrier Board may be installed and operated only in the ES5300.1-A Housing or in the ES5300.1-B Housing and must not be operated as a stand-alone-unit.

The intended use of the ES5338.1 Carrier Board in an ES5300.1-A Housing or in an ES5300.1-B Housing is as follows:

- Use as a component in industrial lab facilities or at industrial workplaces
- Use as a hardware interface for ECUs in a hardware-in-the-loop test system
- Use in conjunction with ETAS software that supports the ES5300.1-A Housing and the ES5300.1-B Housing
- Use as an interface in conjunction with software programs that operate the standardized, documented and open APIs of ETAS software products

The ES5338.1 Carrier Board is **not** intended for the following:

- Use within a vehicle on the road
- Use as part of a life support system
- Use as part of a medical application
- In applications where misuse can lead to injuries or damages
- Use in environments in which conditions prevail that fall outside the specified ranges (see "Ambient Conditions" on page 37)
- Use with signal conditioning that falls outside the specified ranges (see voltages, currents and power consumption in the chapter "Technical Data and Standards" on page 37)

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 must only be operated in a technically flawless state, in accordance with its intended purpose and in a safety-conscious and hazard-aware manner under consideration of the documentation regarding the product. If the product is not used in accordance with its intended purpose, its product safety may be impaired.

Requirements for Operation

The following requirements are necessary for safe operation:

- Use the product only according to the specifications in the corresponding User's Guide. If the product is used in any other way, product safety is no longer ensured.
- Do not use the product in a wet or damp environment.
- Do not use the product in potentially explosive atmospheres.

Electrical Safety and Power Supply

Observe the regulations applicable at the operating location concerning electrical safety as well as the laws and regulations concerning work safety!

> **WARNING!**
>
> *Fire Hazard!*
> *Use only fuses that comply with the specification in Tab. 2-1*
> *on page 22!*
> *Never bridge defective fuses!*
> *Failure to observe the fuse specification can lead to excess currents, short circuits and fires.*

Power Supply

The product is powered by the ES5300.1-A Housing or the ES5300.1-B Housing via the PCIe backplane connector.

The electrical connection is made via the backplane connector CO200.

Insulation requirements for lab power supplies to circuits connected to the HiL-System:

- The power supply to live circuitry must be safely isolated from the supply voltage. For example, use a car battery or a suitable lab power supply.
- Only use lab power supplies with dual protection for the supply network (with double/reinforced insulation (DI/RI)). Lab power supplies that comply with IEC/EN 60950 or IEC/EN 61010 meet this requirement.
- The lab power supply must be approved for use at a height of 2000 m and in ambient temperatures of up to 40 °C.

De-energizing the Add-on Card

Switch off the ES5300.1-A Housing or the ES5300.1-B Housing and external power supplies, and unplug the power plug and other connectors attached to the add-on card. Wait at least three minutes before removing the add-on card.

Approved Cables

The signal lines must not exceed a maximum length of 3 m.

⚠️ **WARNING!**

Fire hazard!
Use only approved cables for creating cable assemblies (e.g. for connecting the ECU and external loads). The cables used must, in particular, be suitable for the currents, voltages and temperatures which occur and must be flame-retardant in accordance with one of the following standards IEC60332-1-2, IEC60332-2-2, UL2556/ UL1581VW-1!

Requirements for the installation location

⚠️ **WARNING!**

This is class A equipment. This equipment can cause radio interference in residential areas. Should that be the case, the operator may be requested to institute reasonable measures.

Requirements for ventilation

⚠️ **CAUTION!**

The air circulation inside the ES5300.1-A Housing or the ES5300.1-B Housing can be ensured only if all free slots are covered with front plates. Otherwise, it may lead to overtemperatures and trip the overtemperature protection of the ES5300.1-A or ES5300.1-B. For this reason, install front plates in all free slots!

Transport and Installation

To avoid damages to the hardware from electrostatic discharge, please observe the following precautionary measures:

⚠️ **CAUTION!**

Some components of the ES5338.1 Carrier Board can be damaged or destroyed by electrostatic discharges. Leave the plug-in card and the Piggybacks in the transport packaging until their installation.
The ES5338.1 Carrier Board and the PB5338CURR.1-A Piggyback should only be removed, configured and installed at a workplace that is secured against static discharges.

⚠️ **CAUTION!**

The ES5338.1 Carrier Board is designed exclusively for the ETAS PB5338CURR.1-A Piggyback.
The installation of non-supported boards can lead to damages of the ES5338.1 Carrier Board, the ES5300.1-A Housing or ES5300.1-B Housing and/or the non-supported board.

> **CAUTION!**
>
> *In order to prevent damage to the add-on card and the LABCAR Housing, and thereby also avoid damage to property or health, observe the installation instructions and information contained in the relevant User's Guides.*

> **CAUTION!**
>
> *If cards (e.g. for startup or calibration) are unlocked but not completely removed from the housing, they must be pulled out far enough that the distance between the respective card and the backplane of the housing is at least 1 cm! Otherwise, contacts may be established between the cards and lead to their destruction.*

Connecting/Disconnecting Devices

To avoid injuries and hardware damages, please observe the following precautionary measures:

*   Do not apply any voltages to the connections of the ES5338.1 Carrier Board that do not correspond to the specifications of the respective connection.
*   Do not connect or disconnect any devices while the ES5300.1-A Housing or ES5300.1-B Housing or external devices are switched on. First, switch off the ES5300.1-A Housing or ES5300.1-B Housing by shutting down the Real-Time PC and by activating the On/Off switch at the rear, then unplug the power plug.
*   When plugging in connectors, ensure that they are inserted straight and no pins are bent.

Maintenance

The product does not require maintenance.

Repairs

If an ETAS hardware product needs to be repaired, return the product to ETAS.

Cleaning

The product is not expected to require cleaning.

1.3   Identifications on the Product

The Following Symbols are used for Product Labeling:

Symbol	Description
⚠️	The User's Guide must be read prior to the startup of the product
CE	Marking for CE conformity, see "CE Mark" on page 13
♲e	Marking for China RoHS, see chapter, see "RoHS Conformity" on page 13
🗑️	Marking for conformity with WEEE directive, see "Product Return and Recycling" on page 14
KC	Marking for KCC Conformity, see "KC marking" on page 14

Observe the information in the chapter "Technical Data and Standards" on page 37.

1.3.1   CE Mark

With the CE mark 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.

1.3.2   RoHS Conformity

European Union

The EU Directive 2011/65/EU limits the use of certain dangerous materials for electric and electronic devices (RoHS conformity).

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

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.

1.3.3 KC marking

With the KC mark attached to the product and its packaging, ETAS confirms that the product has been registered in accordance with the product-specific KCC guidelines of the Republic of Korea.

1.4 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. 1-2   WEEE symbol

The WEEE symbol 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 "ETAS Contact Addresses" on page 41).

1.5 Declarable Substances

European Union

Some products from ETAS GmbH (e.g. modules, boards, cables) use components with substances that are subject to declaration in accordance with the REACH-regulation (EU) no.1907/2006.

Detailed information is located in the ETAS download center in the customer information "REACH Declaration" (www.etas.com/Reach). This information is continuously being updated.

1.6   About this Manual

This manual consists of the following chapters:

- "Introduction" on page 5
  This chapter

- "Design, Installation and Fuses" on page 17
  This chapter contains information about the setup and installation of the ES5338.1 Carrier Board and the PB5338CURR.1-A Piggyback. It also contains information about the fuses.

- "Simulated Sensor Signals" on page 27
  This chapter describes the sensor signals that can be generated with the ES5338.1 Carrier Board.

- "Connections and Plug Connections" on page 33
  This section provides a description of the different connections of the ES5338.1 Carrier Board.

- "Technical Data and Standards" on page 37
  This chapter contains the technical data of the ES5338.1 Carrier Board for Current Output Piggyback PB5338CURR.1-A. It also contains standards met.

1.6.1   Working with this Manual

Presentation 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:

Target definition

Any advance information...

1. Step 1

   Any explanation for step 1...

2. Step 2

   Any explanation for step 2...

Any concluding comments...

Specific example:

Creating a new file

Before creating a new file, no other file may be open.

1. Select **File → New**.

   The "Create File" dialog box appears.

2. Enter the name of the new file in the "File name" field.

   The file name may not have more than 8 characters.

3. Click on **OK**.

The new file is being created and saved under the name you specified. You can now work with the file.

Typographical Conventions

The following typographical conventions are used:

Select **File → Open**.	Menu commands are displayed in bold/blue.
Click on **OK**.	Buttons are displayed in bold/blue.
Press <ENTER>.	Key commands are printed in small capitals enclosed in angle brackets.
The "Open file" dialog window appears.	Names of program windows, dialog windows, fields and similar are given in quotation marks.
Select the `setup.exe` file.	Text in selection lists, program code, as well as path and file names are displayed in `Courier` font.
A conversion between the logical and arithmetic data types is *not* possible.	Content-based highlights and newly introduced terms are placed in *italics*.

Important notes for the user are presented as follows:

Note

Important note for the user.

2   Design, Installation and Fuses

This chapter contains information about the setup and installation of the ES5338.1 Carrier Board and the PB5338CURR.1-A Piggyback. It also contains information about the fuses.

- "Design of the ES5338.1 Carrier Board" on page 18
- "Fuses" on page 21
- "Assembly of Piggyback" on page 23
- "Installation in the ES5300.1-A Housing and the ES5300.1-B Housing" on page 25

> ⚠ **CAUTION!**
>
> *Some components of the ES5338.1 Carrier Board can be damaged or destroyed by electrostatic discharges.*
> *Leave the plug-in card in its transport packaging until its installation. The ES5338.1 Carrier Board and the PB5338CURR.1-A Piggyback should only be removed, configured and installed at a workplace that is secured against static discharges.*

2.1   Scope of Supply

You can find the scope of supply in chapter "Ordering Data" on page 39.

2.2   Design of the ES5338.1 Carrier Board

The front plate and plug side of the ES5338.1 Carrier Board are shown in Fig. 2-1..
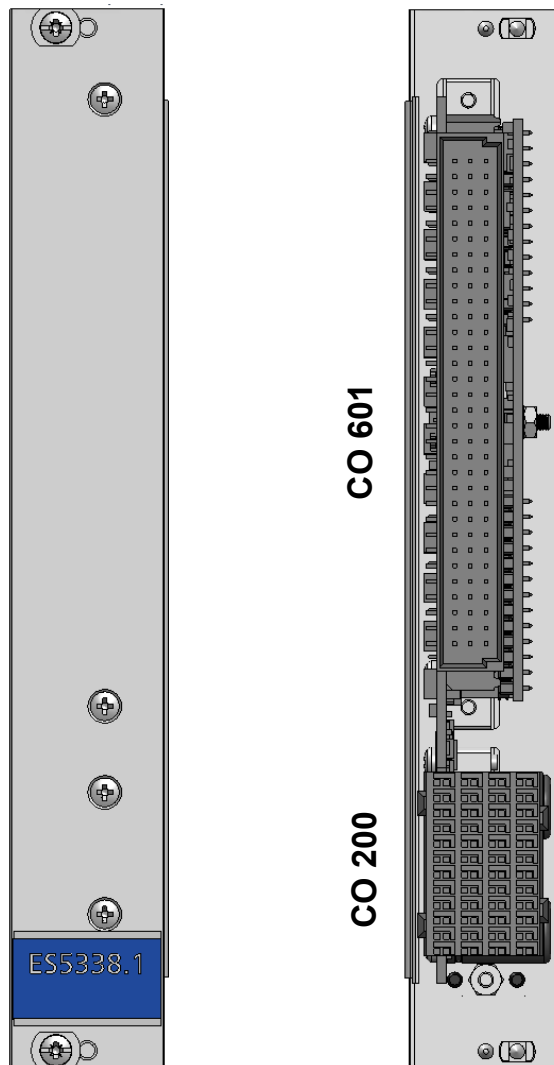
Fig. 2-1   Front plate and plug side of the ES5338.1 Carrier Board

The backplane connector "CO200" forms the communication interface to the ES5300.1-A Housing and to the ES5300.1-B Housing. The "CO200" also handles the voltage supply for the ES5338.1 Carrier Board.

The pin assignment is located in "Backplane Connector CO200" on page 33.

The "CO601" plug connector is the input and output interface for connecting an ECU to an HiL system.

The pin assignment is located in "VG 96 Plug CO601" on page 35.

The ES5338.1 Carrier Board is delivered without PB5338CURR.1-A Piggyback. The ES5338.1 Carrier Board is shown in Figure 1-2 in its delivery state.
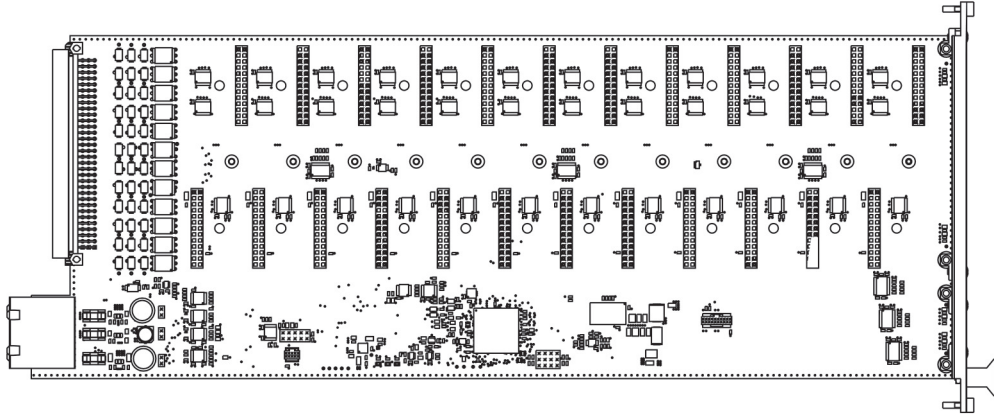
Fig. 2-2   Longitudinal view of ES5338.1 Carrier Board without piggybacks

Figure 1-3 shows the PB5338CURR.1-A Piggyback.
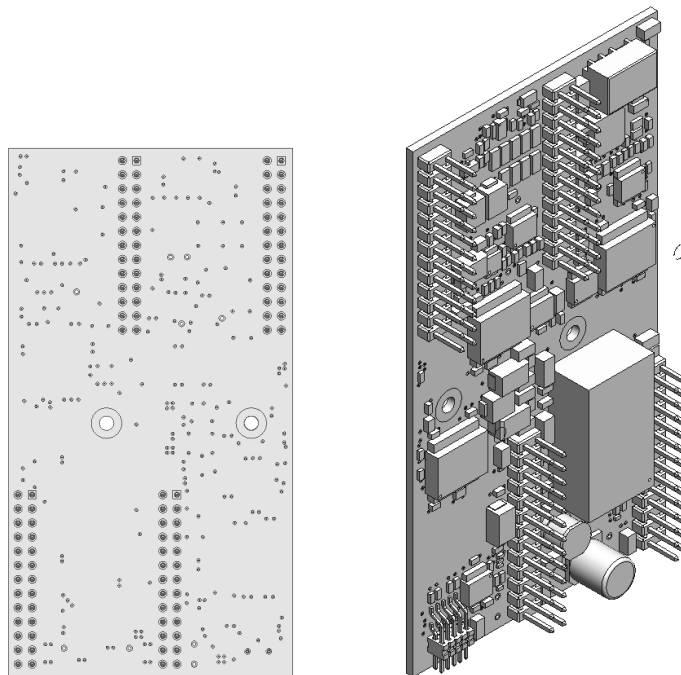
Fig. 2-3   View of a PB5338CURR.1-A Piggyback

Figure 1-4 represents the ES5338.1 Carrier Board populated with six PB5338CURR.1-A Piggybacks.
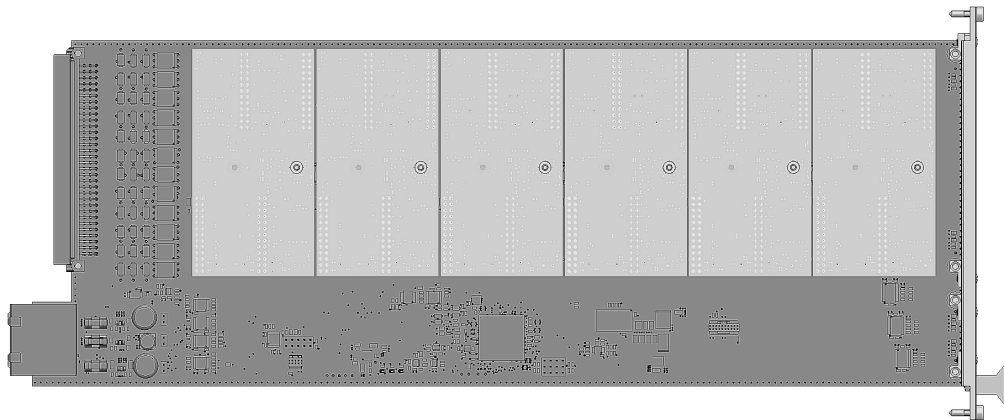
Fig. 2-4   Longitudinal view of the ES5338.1 Carrier Board populated with six PB5338CURR.1-A Piggybacks

> **CAUTION!**
>
> *The ES5338.1 Carrier Board is designed exclusively for the ETAS PB5338CURR.1-A Piggyback.*
> *The installation of non-supported boards can lead to damages of the ES5338.1 Carrier Board, the ES5300.1-A Housing or ES5300.1-B Housing and/or the non-supported board.*

2.3   Fuses

The voltages of the backplane of the ES5300.1-A Housing or the ES5300.1-B Housing are protected with fuses on the ES5338.1 Carrier Board.
In case of a fuse defect, we recommend sending the board to ETAS for further testing. For this purpose, the device should be sent to ETAS (see "ETAS Contact Addresses" on page 41).

If a fuse trips multiple times, the device must be sent to ETAS.

> **WARNING!**
>
> *Fire Hazard!*
> *Use only fuses that comply with the specification in Tab. 2-1 on page 22!*
> *Never bridge defective fuses!*
> *Failure to observe the fuse specification can lead to excess currents, short circuits and fires.*

> **CAUTION!**
> *Replace fuses only with uninstalled ES5338.1 Carrier Board!*

Fig. 2-5 on page 22 shows the position of the fuses on the ES5338.1 Carrier Board.
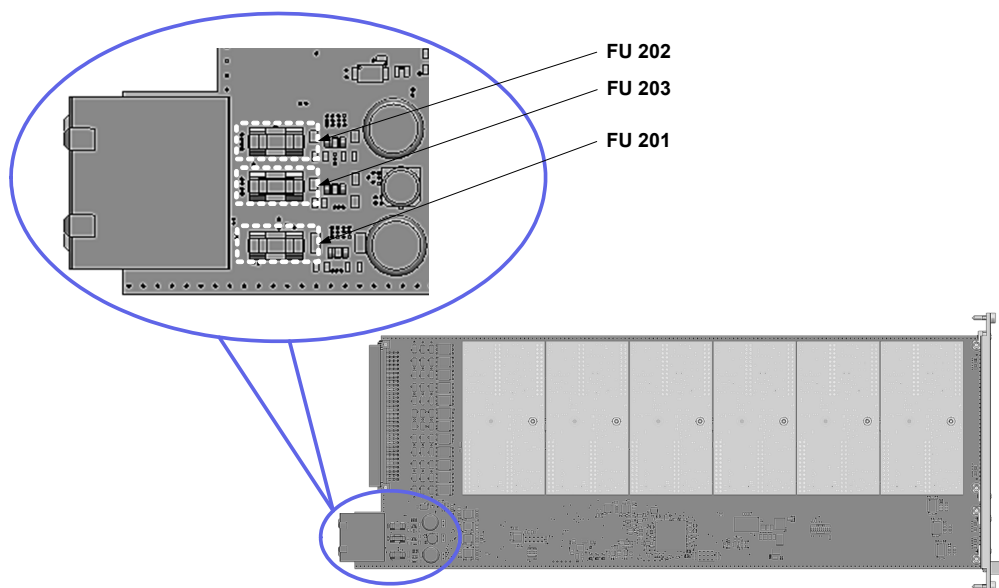
Fig. 2-5   Position of fuses on the ES5338.1 Carrier Board

2.3.1   Specification of Fuses:

The specification of the fuses is as follows:

Fuse	Type	Specification	Protection of (Voltage)
FU202	NANO2® Slo-Blo® Fuse 452/454 Series	T 1 A	VCC5 (+5 V)
FU203	NANO2® Slo-Blo® Fuse 452/454 Series	T 2 A	VCC3_3 (+3.3 V)
FU201	NANO2® Slo-Blo® Fuse 452/454 Series	T 3 A	VCC12 (+12 V)

Tab. 2-1   Specification of fuses

2.4   Assembly of Piggyback

This chapter describes how the PB5338CURR.1-A Wheel Speed Sensor Simulation Piggyback are installed on an ES5338.1 Carrier Board.

> ⚠️ **CAUTION!**
>
> *Some components of the ES5338.1 Carrier Board can be damaged or destroyed by electrostatic discharges. Leave the plug-in card in its transport packaging until its installation.*
> *The ES5338.1 Carrier Board and the PB5338CURR.1-A Piggyback should only be removed, configured and installed at a workplace that is secured against static discharges.*

> ⚠️ **CAUTION!**
>
> *The ES5338.1 Carrier Board is designed exclusively for the ETAS PB5338CURR.1-A Piggyback.*
> *The installation of non-supported boards can lead to damages of the ES5338.1 Carrier Board, the ES5300.1-A Housing or ES5300.1-B Housing and/or the non-supported board.*

> ⚠️ **CAUTION!**
>
> *Ensure that the components are subject to the least possible mechanical stress. Tighten the nuts only slightly (approx. 0.3 Nm). Note that the guide bolt does not contact any electronic components or create any mechanical stress during the installation of the PB5338CURR.1-A (indicated by a red flash in Fig. 2-7).*
> *Excessive mechanical stress of the components can lead to malfunctions of the ES5338.1 Carrier Board and the PB5338CURR.1-A Piggyback, which can cause property damages and personal injuries.*

Assembly of the PB5338CURR.1-A Piggyback on the ES5338.1 Carrier Board

The assembly of a PB5338CURR.1-A Piggyback on the ES5338.1 Carrier Board is described below.
Proceed analogously with the assembly of additional PB5338CURR.1-A Piggy-backs

1. Ensure that ESD-compliant conditions exist at your workplace.

2. Align the PB5338CURR.1-A Piggyback to the respective guide bolt (red dashed rectangles in Fig. 2-7) of each slot of the ES5338.1 Carrier Board.

Note

The alignment must also be done to the connectors! For each Piggyback, 4 connectors must be connected (see Fig. 2-6).
Note that the guide bolt does not contact any electronic components or create any mechanical stress during the installation of the PB5338CURR.1-A Piggyback (indicated by the red arrow in Fig. 2-7).

3. For each Piggyback, 4 connectors must be connected (marked in Fig. 2-6).

4. When the alignment to the guide bolts and connectors is correct, secure the PB5338CURR.1-A Piggyback with slight pressure.
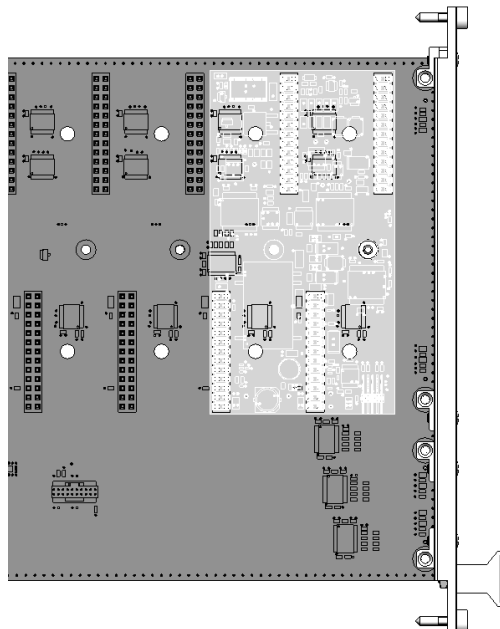
Fig. 2-6   Installed PB5338CURR.1-A Piggyback
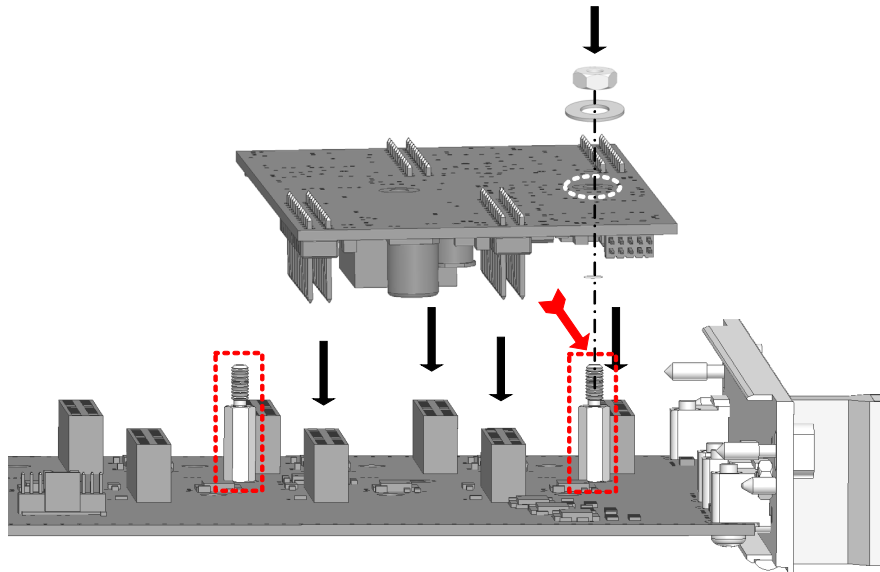
Fig. 2-7   Side view of assembly of a PB5338CURR.1-A Piggyback

5. Secure the PB5338CURR.1-A Piggyback with the included M2.5 hexagon nut and washer. The washer must be located between PB5338CURR.1-A Piggyback and hexagon nut. Slightly tighten the hexagon nut.

2.5   Installation in the ES5300.1-A Housing and the ES5300.1-B Housing

This chapter describes how the ES5338.1 Carrier Board is installed in the ES5300.1-A Housing or in the ES5300.1-B Housing.

⚠️ **CAUTION!**

Do not install any boards while the ES5300.1-A Housing or ES5300.1-B Housing is switched on!

⚠️ **CAUTION!**

Some components of the ES5338.1 Carrier Board can be damaged or destroyed by electrostatic discharges. Leave the plug-in card in its transport packaging until its installation.
The ES5338.1 Carrier Board and the PB5338CURR.1-A Piggyback should only be removed, configured and installed at a workplace that is secured against static discharges.

> **CAUTION!**
>
> *If correctly installed, the ES5338.1 Carrier Board occupies only one slot of the ES5300.1-A Housing or the ES5300.1-B Housing.*
> *If neighboring boards or cover slots collide with the ES5338.1 Carrier Board, then the combination of PB5338CURR.1-A and ES5338.1 Carrier Board is not correctly installed.*
> *Observe "Assembly of the PB5338CURR.1-A Piggyback on the ES5338.1 Carrier Board" on page 24.*

> **CAUTION!**
>
> *The air circulation inside the ES5300.1-A Housing or the ES5300.1-B Housing can be ensured only if all free slots are covered with front plates. Otherwise, it may lead to overtemperatures and trip the over-temperature protection of the ES5300.1-A Housing or ES5300.1-B Housing. For this reason, install front plates in all free slots!*

Installation of the ES5338.1 Carrier Board in the ES5300.1-A Housing or ES5300.1-B Housing

1. Ensure that ESD-compliant conditions exist at your workplace.
2. Shut down the real-time PC and switch off the power supply of the ES5300.1-A or ES5300.1-B using the switch at the rear of the housing.
3. Wait a few minutes for the components (capacitors, etc.) to be discharged.
4. Insert the ES5338.1 Carrier Board (handle at the front plate must point down!) into the upper and lower rail of the slot and push it in a little bit.
5. Carefully push in the carrier board until the backplane connector of the ES5338.1 Carrier Board is completely inserted in the socket of the backplane.

> **Note**
>
> *Watch for cables in the insertion area while pushing in the board – pull the lines to the front door area if necessary.*

6. Secure the carrier card by fastening the front plate with screws.
7. Install front plates at all open slots before starting up the ES5338.1 Carrier Board.

3 Simulated Sensor Signals

This chapter describes the sensor signals that can be generated with the ES5338.1 Carrier Board.

The ES5338.1 Carrier Board can simulate one sensor of the following types for each populated PB5338CURR.1-A Piggyback:

With Direct Current Output, the current source is directly controlled by the simulation model.

3.1 Creating Real Sensor Signals in the Vehicle

The wheel speed sensor types DF10, DF11s, DF11i and VDA listed above are active digital sensors. The real wheel speed sensors generate the signals using the magneto-resistive effect or the Hall effect. When passing an pick-up wheel (ferromagnetic gear wheel or punching sheet or wheel with attached multipoles), the resistance or the Hall voltage of the sensor element changes. This change is based on the change of magnetic field strength at the sensor element. An analysis electronics outputs digital rectangular current pulses whose frequency is proportional to the wheel speed.
The magnetic field strength at the sensor element can also be used to detect tooth voids and assembly errors. The phase of the induced signal provides information about the direction of rotation.
This makes the output of additional information in form of PWM signals or additional data bits possible, depending on the sensor type.

The use of this measuring principle allows determining the speed (distance measurement) of close to v = 0 km/h. This also covers the partially stricter v_{min} requirements for the simulation, e.g. of navigation systems, anti-rollback devices, parking assist systems, etc.

An other series of sensors, e.g. pressure sensors, generate signals based on the PSI5 standard.

3.2 Generation of Sensor Signals with the ES5338.1 Carrier Board

The ES5338.1 Carrier Board simulates the signals of the aforementioned wheel speed sensors. The simulated wheel speed sensor signals are generated with the help of data from a vehicle model that runs on the RTPC. The configuration of the piggybacks of the ES5338.1 Carrier Board as sensor for the vehicle simulation model is done via RTIO using LABCAR-OPERATOR (see LABCAR-RTC User's Guide). With the PCIe Backplane Connector CO200 of the ES5300.1-A Housing or ES5300.1-B Housings, the relevant vehicle model data are made available to the ES5338.1 Carrier Board function generator. The ES5338.1 Carrier Board then generates the corresponding wheel speed sensor signals with the vehicle simulation model data and RTIO settings.

Signals following the PSI5 standard can also be generated by the ES5338.1 Carrier Board.

With Direct Current Output, the current source is directly controlled by the vehicle simulation model.

The simulated sensor signals Curr_0_n, Curr_0_p ... Curr_5_n, Curr_5_p are output as digital output signals at the "CO601" plug (see "Pin assignment of signal channels on CO601" on page 35).

3.3   Signal Shapes

This chapter describes the wheel speed sensor signals generated by the ES5338.1 Carrier Board.
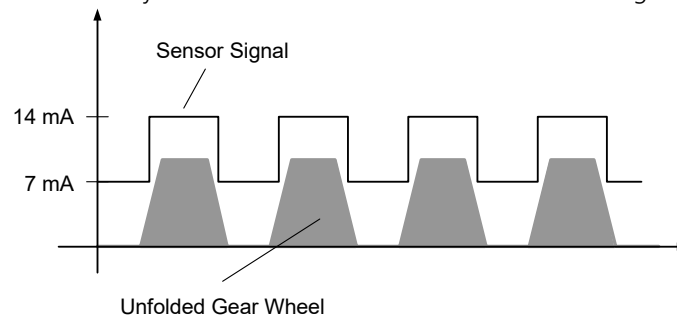
3.3.1   DF10 and DF11s

The sensor signals of type DF10 and DF11s are digital rectangular current pulses whose frequency is proportional to the wheel speed from the vehicle model.

The simulated DF10 and DF11s sensor signals contain information about the following parameters:

- Wheel speed
- Tooth voids

A tooth void pattern can be defined by the user (see LABCAR-RTC Users Guide).

An example of the DF10 or DF11s wheel speed sensor signal without tooth voids simulated by the ES5338.1 Carrier Board is shown in Fig. 3-1.

Fig. 3-1   Output signal of a simulated sensor of type "DF10" or "DF11s"

The sensor signal can be configured in LABCAR-OPERATOR. A detailed description is located in the LABCAR-RTC User's Guide.

3.3.2   DF11i

The simulated DF11i signals are PWM current pulses. They contain information about the following parameters:

- Wheel speed
- Tooth voids
- Travel direction
- Standstill detection
- Air gap reserve error detection
- Installation position error detection

The DF11i wheel speed sensor signals are digital rectangular current pulses whose frequency is proportional to the wheel speed from the vehicle model.

Additional information about travel direction, standstill, air gap reserve and installation position are in the pulse duration of the high phases of the PWM current pulses. The pulse duration consists of multiples of a time interval T_0 definable by the user in the RTIO.

During the segment change of the pick-up wheel, every high phase is preceded by a low phase of duration T_0 (pre-bit phase).

Tab. 3-1 on page 30 and Fig. 3-2 on page 31 explain the actions of the PWM current pulses of a simulated sensor of type DF11i.

A description for configuring the DF11i signals is located in the LABCAR-RTC User's Guide.

Information	Pulse duration	Description
Wheel speed	Dependent of travel direction and installation position of the sensor	Frequency of PWM signal is proportional to the wheel speed
Tooth voids	Dependent of travel direction and installation position of the sensor	Tooth void pattern can be created by the user. Output of a current value for tooth voids defined in the RTIO
Segment change at the pick-up wheel (pre-bit phase)	T_0 Adjustable in the RTIO	Low pulse followed by high phase whose length depends on travel direction and installation position
Travel direction reverse, regular installation position	$2\,T_0$	High pulse
Travel direction forward, regular installation position	$4\,T_0$	High pulse
Travel direction reverse, installation position error (field strength too low)	$8\,T_0$	High pulse
Travel direction forward, installation position error (field strength too low)	$16\,T_0$	High pulse
Air gap reserve error (very low field strength)	T_0	High pulse The air gap reserve indicates whether the change in magnetic field strength is below a value required for error-free functioning
Standstill detection or no field	$32\,T_0$	High pulse is output in case of a standstill after a time interval defined in the RTIO.

Tab. 3-1   Action of PWM current pulses of a simulated sensor of type DF11i (see also Fig. 3-2 on page 31)

.
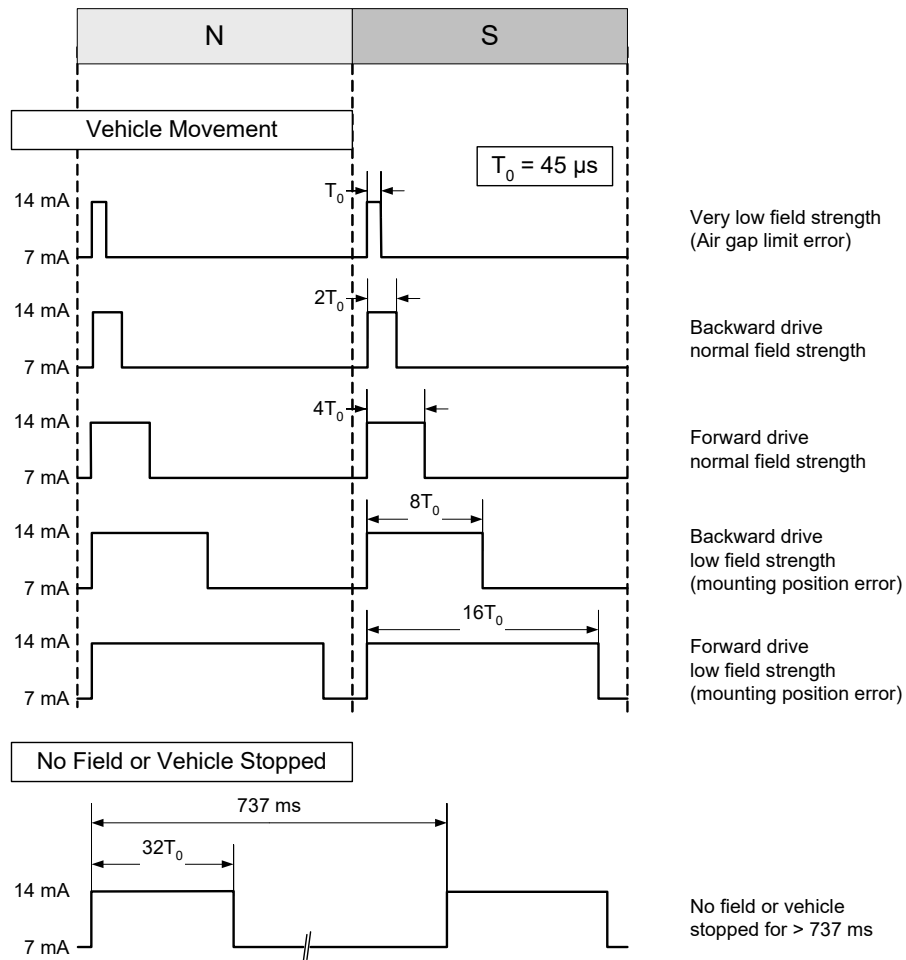
Fig. 3-2   Output signals of a sensor of type "DF11i"
               "N" and "S" represent adjacent segments of the pick-up wheel.

3.3.3   VDA

The wheel speed sensor signals of type VDA consist of one speed pulse followed by 9 data bits for each segment of the pick-up wheel. They contain information about the following parameters:

- Wheel speed
- Tooth voids
- Travel direction
- Standstill detection
- Air gap reserve error detection
- Installation position error detection

Fig. 3-3 shows an example of a wheel speed sensor signal of type VDA.
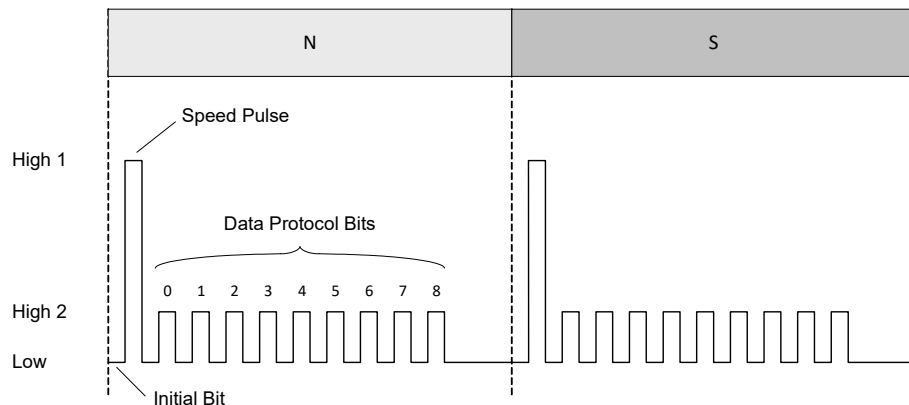
Fig. 3-3   Speed pulse and data bits
"N" and "S" represent adjacent segments of the pick-up wheel.

The speed pulse "High 1" is output at every segment change of the pick-up wheel. This pulse is preceded by an initial bit that sets the current level to "Low". The speed pulse is followed by additional nine data bits with a current level of "High 2" or"Low" (for logical 1 or 0), which contain additional information about travel direction, installation position and standstill.

A description for configuring the DF11i signals and the meaning of the data bits is located in the LABCAR-RTC User's Guide.

3.3.4   PSI5

The ES5338.1 Carrier Board can generate signals following PSI5 (Peripheral Sensor Interface 5), version V 1.3 and V 2.1. They can be used, e.g. to simulate pressure sensors.

A description for configuring the PSI5 signals is located in the LABCAR-RTC User's Guide.

3.3.5   Direct Current Output

The Direct Current Output can be used to output a sensor signal directly from the simulation model running on the RTPC.

A description for configuring the Direct Current output is located in the LABCAR-RTC User's Guide.

4   Connections and Plug Connections

This section provides a description of the different connections of the ES5338.1 Carrier Board.

- "Backplane Connector CO200" on page 33
- "VG 96 Plug CO601" on page 35

⚠️ **WARNING!**

Fire hazard!
Use only approved cables for creating cable assemblies (e.g. for con-necting the ECU and external loads). The cables used must be suitable particularly for occurring currents, voltages and temperatures and must be flame-retardant in accordance with one of the following standards IEC 60332-1-2, IEC 60332-2-2, UL 2556/UL1581VW-1!

4.1   Backplane Connector CO200

The backplane connector "CO200" forms the communication interface to the ES5300.1-A Housing and to the ES5300.1-B Housing. The "CO200" also han-dles the voltage supply for the ES5338.1 Carrier Board.

Type: ERNI ERMet ZD 4-pair angled female multipoint connector (4-12) (order no. 973099)

Counterplug (in ES5300): ERNI ERMet ZD 4-pair straight male multipoint con-nector (4-12) (order no. 973096)
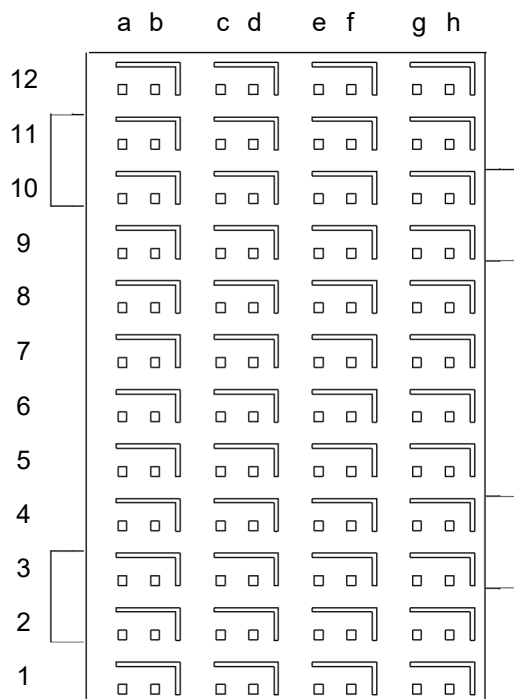
Fig. 4-1   Connector to backplane (top view)

The assignment of the pins is as follows (the maximum possible pin assignment for the ES5300.1-A Housing and the ES5300.1-B Housing is given):

	h	g	f	e	d	c	e	a
12	GBLI_TX_n_0	GBLI_TX_p_0	GBLI_RX_n_0	GBLI_RX_p_0	M_LVDS_n_7	M_LVDS_p_7	BN_5	BN_4
12-shield	GND		GND		GND		GND	
11	GBLI_TX_n_1	GBLI_TX_p_1	GBLI_RX_n_1	GBLI_RX_p_1	M_LVDS_n_6	M_LVDS_p_6	SPI_CS_B_n	SPI_CS_A_n
11-shield	GND		GND		GND		GND	
10	GBLI_TX_n_2	GBLI_TX_p_2	GBLI_RX_n_2	GBLI_RX_p_2	M_LVDS_n_5	M_LVDS_p_5	SPI_MOSI	SPI_CLK
10-shield	GND		GND		GND		GND	
9	GBLI_TX_n_3	GBLI_TX_p_3	GBLI_RX_n_3	GBLI_RX_p_3	M_LVDS_n_4	M_LVDS_p_4	PCIE_WAKEn	SPI_MISO
9-shield	GND		GND		GND		GND	
8	GBLI_PRESENT_n	GEO_ADDR_4	PCIE_REFCLK_n	PCIE_REFCLK_p	M_LVDS_n_3	M_LVDS_p_3	n.c.	n.c.
8-shield	GND		GND		GND		GND	
7	PCIE_RX_n_0	PCIE_RX_p_0	PCIE_TX_n_0	PCIE_TX_p_0	M_LVDS_n_2	M_LVDS_p_2	n.c.	n.c.
7-shield	GND		GND		GND		GND	
6	Ass. internally	Ass. internally	Ass. internally	Ass. internally	M_LVDS_n_1	M_LVDS_p_1	PCIE_JTAG_TCK	PCIE_JTAG_TDI
6-shield	GND		GND		GND		GND	
5	Ass. internally	Ass. internally	Ass. internally	Ass. internally	M_LVDS_n_0	M_LVDS_p_0	PCIE_JTAG_TDO	PCIE_JTAG_TMS
5-shield	GND		GND		GND		GND	
4	Ass. internally	Ass. internally	IAss. internally	Ass. internally	GEO_ADDR_1	GEO_ADDR_0	BN_3	BN_2
4-shield	GND		GND		GND		GND	
3	VCC24	VCC24	GEO_ADDR_3	GEO_ADDR_2	PCIE_SMBDAT	PCIE_SMBCLK	BN_1	BN_0
3-shield	VCC3_3		VCC3_3		VCC3_3		VCC3_3	
2	VSS12	VSS12	VCC3_3	VCC5	PCIE_PERSTn	PCIE_PRSNT1n	PCIE_PRSNT2n_X1	PCIE_PRSNT2n_X4
2-shield	VCC12		VCC12		VCC12		VCC12	
1	VCC3_3	VCC3_3	VCC5	VCC5	VCC12	VCC12	VCC12	VCC12
1-shield	VCC12		VCC12		VCC12		VCC12	

4.2   VG 96 Plug CO601

The CO601 plug connector forms the I/O interface for the connection of the
ES5338.1 Carrier Boards to an ECU.

> **Note**
>
> *With respect to the permissible voltages and currents, observe the specifica-*
> *tions in "Current Outputs" on page 37.*

A	Signal	B	Signal	C	Signal
24-32	n.c.	24-32	n.c.	24-32	n.c.
23	Curr 5 n	23	Reference 5	23	Curr 5 p
22	n.c.	22	n.c.	22	n.c.
21	n.c.	21	n.c.	21	n.c.
20	n.c.	20	n.c.	20	n.c.
19	Curr 4 n	19	Reference 4	19	Curr 4 p
18	n.c.	18	n.c.	18	n.c.
17	n.c.	17	n.c.	17	n.c.
16	n.c.	16	n.c.	16	n.c.
15	Curr 3n	15	Reference 3	15	Curr 3p
14	n.c.	14	n.c.	14	n.c.
13	n.c.	13	n.c.	13	n.c.
12	n.c.	12	n.c.	12	n.c.
11	Curr 2 n	11	Reference 2	11	Curr 2 p
10	n.c.	10	n.c.	10	n.c.
9	n.c.	9	n.c.	9	n.c.
8	n.c.	8	n.c.	8	n.c.
7	Curr 1 n	7	Reference 1	7	Curr 1 p
6	n.c.	6	n.c.	6	n.c.
5	n.c.	5	n.c.	5	n.c.
4	n.c.	4	n.c.	4	n.c.
3	Curr 0 n	3	Reference 0	3	Curr 0 p
2	n.c.	2	n.c.	2	n.c.
1	n.c.	1	n.c.	1	n.c.

Tab. 4-1   Pin assignment of signal channels on CO601

Type: DIN 41612, Type C

Counterplug: DIN41612 plug connector without crimp contacts (order no.
Harting 09030963214); crimp contacts (order no. Harting 09020008484)

Connecting an ES5338 Sensor Channel to an ECU

The simulated sensor channel x is located between pin Ax and pin Cx.
The connection of the reference pin Bx is optional.

A possibility for connecting a sensor channel to an ECU is shown in Fig. 4-2.

- The sensor supply voltage is connected to pin Cx.

- The measurement of the sensor signal is done at pin Ax via a pull-down resistor.

- For suppressing interfering signals, the reference pin Bx can be optionally connected to the Sensor GND potential of the ECU.
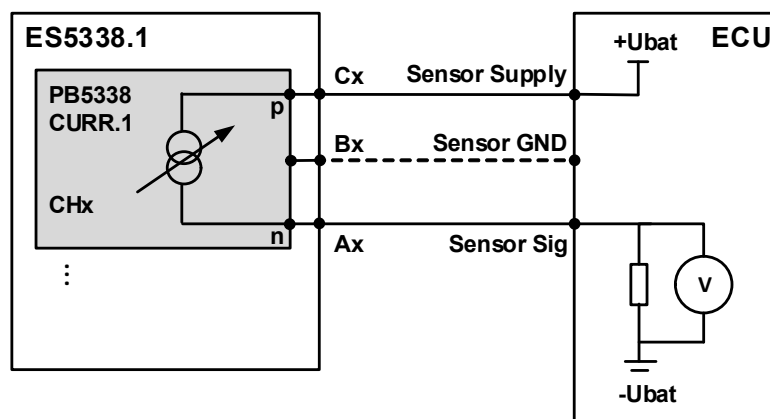
Fig. 4-2   Equivalent circuit for the connection of a sensor channel to an ECU

Note

The function of the reference pin is given only if noise immunity is observed during the design of the grounding/cabling concept. (This means, for example, signal flow with low impedance, defined reference potentials, low transition resistances, shielded design, no crosstalk).

5 Technical Data and Standards

This chapter contains the technical data of the ES5338.1 Carrier Board for Current Output Piggyback PB5338CURR.1-A.
It also contains standards met.

5.1 Technical Data

Current Outputs

Output current	0 to 120 mA
Accuracy	±0.5 mA at 40 mA ±1.5 mA at 120 mA
Output frequency	max. 500 kHz
Electric strength	±60 V DC
Galvanic isolation	yes

Electrical data ES5300.1-A, ES5300.1-B PCIe backplane

Max. permissible power consumption	16 W at 12 V DC 1 W at 5 V DC 1 W at 3.3 V DC

Functions

Wheel speed sensor simulation for types	DF10 DF11i DF11s VDA
PSI5 sensor protocol, following	V1.3, V2.1
Direct current output	any value between 0 mA...120 mA

Storage Conditions

Temperature	-20 °C to 85 °C (-4 °F to 185 °F)
Relative humidity	0 to 95% (non-condensing)

Ambient Conditions

Environment	Use only inside enclosed and dry rooms
Max. contamination level	2
Temperature during operation	5 °C to 40 °C (41 °F to 104 °F)
Relative humidity	0 to 95% (non-condensing)
Operating altitude	-200 m to 2000 m above sea level

Physical Dimensions of ES5338.1 Carrier Board

Height	4 U
Width	5 HP
Weight	0,5 kg

Physical dimensions of PB5338CURR.1-A Piggyback

Length	95 mm
Width	51 mm
Depth	17 mm

5.2   Standards met

The ES5338.1 Carrier Board meets the following standards:

Standard	Test
IEC 61326-1	Electrical equipment for measurement, control and laboratory use – EMC requirements (industrial setting)
IEC 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements

The board is only intended for use in industrial settings in accordance with EN 61326-1. Avoid potential radio interference when using the module outside of the industrial settings with additional shielding measures!

⚠ **WARNING!**

This is class A equipment. This equipment can cause radio interference in residential areas. Should that be the case, the operator may be requested to institute reasonable measures.

Note

The signal lines may not exceed a maximum length of 3 m!

6   Ordering Data

Order name	Short name	Order number
ES5338.1 Carrier Board Carrier Board for Wheel Speed Sensor Simulation. PSI5, Direct Current Output (6 Sockets)	ES5338.1 Carrier Board	F-00K-110-051
PB5338CURR.1-A Wheel Speed Sensor Simulation, PSI5, Direct Current Output Piggyback	PB5338CURR.1-A	F-00K-110-052

Scope of Supply	Quantity
ES5338.1 Carrier Board	1

7   ETAS Contact Addresses

ETAS HQ

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Borsigstraße 24	Phone:	+49 711 3423-0
70469 Stuttgart	Fax:	+49 711 3423-2106
Germany	WWW:	www.etas.com

ETAS Subsidiaries and Technical Support

For details of your local sales office as well as your local technical support team and product hotlines, take a look at the ETAS website:

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

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