

ES5321.1 PWM I/O Board (48/32-CH)

User's Guide



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Contents

| | | |
|-------|---|----|
| 1 | Introduction | 5 |
| 1.1 | Properties | 5 |
| 1.1.1 | Digital Inputs of ES5321.1 | 6 |
| 1.1.2 | Digital Outputs of ES5321.1 | 7 |
| 1.2 | Basic Safety Notices | 9 |
| 1.2.1 | Identification of Safety Notices | 9 |
| 1.2.2 | General Safety Information | 9 |
| 1.2.3 | Requirements for Users and Duties for Operators. | 9 |
| 1.2.4 | Intended Use. | 10 |
| 1.3 | Identifications on the Product | 14 |
| 1.3.1 | CE Mark | 14 |
| 1.3.2 | RoHS Conformity. | 14 |
| 1.3.3 | KC Marking. | 15 |
| 1.4 | Product Return and Recycling | 15 |
| 1.5 | Declarable Substances | 15 |
| 1.6 | About this Manual | 16 |
| 1.6.1 | Working with this Manual. | 16 |
| 2 | Construction, Installation and Fuses | 19 |
| 2.1 | Scope of Supply | 19 |
| 2.2 | ES5321.1 PWM I/O Board (48/32-CH) | 19 |
| 2.3 | Backplane Connector "CO200" and "CO9000" | 19 |
| 2.4 | Fuses | 20 |
| 2.5 | Installation in the ES5300.1-A and the ES5300.1-B Housing | 21 |
| 2.6 | Connecting Cable | 22 |
| 2.7 | LEDs on the ES5321.1 Backside | 23 |
| 3 | In- and Output-Signals | 25 |
| 3.1 | Supported Measuring Methods for Input Channels | 25 |

| | | |
|-------|---|----|
| 3.1.1 | Configuration with ES5436.1 to Measure ECU Digital Output Signals | |
| | | 26 |
| 3.2 | Output Modes for the Output Signals | 28 |
| 3.3 | Multi-Pulse Signals | 28 |
| 3.4 | SENT Signals | 28 |
| 4 | Connections and Connectors | 29 |
| 4.1 | Backplane Connector "CO200" | 29 |
| 4.2 | I/O Connector "CO9000" | 31 |
| 5 | Technical Data and Norms | 35 |
| 5.1 | Technical Data | 35 |
| 5.2 | Fulfilled Norms and Standards | 37 |
| 6 | Ordering Information | 38 |
| 7 | ETAS Contact Addresses | 39 |
| | Index | 41 |

1 Introduction

This manual contains the description of the ES5321.1 PWM I/O Board (48/32-CH).

**CAUTION!**

*Some components of the ES5321.1 can be damaged or destroyed by electrostatic discharges. Leave the add-on card in its transport packaging until it is installed.
Only remove, configure and install the ES5321.1 at a workplace that is protected against electrostatic discharges.*

**CAUTION!**

If cards (e.g. for startup or calibration) are unlocked but not completely removed from the housing, then they have to be pulled out so far that the distance between the respective card and the backplane of the housing is at least 1 cm! Otherwise, it may lead to contacts between the cards and the backplane which could lead to damages.

This chapter contains information about the following topics:

- "Properties" on page 5
- "Basic Safety Notices" on page 9
- "Identifications on the Product" on page 14
 - "CE Mark" on page 14
 - "RoHS Conformity" on page 14
 - "KC Marking" on page 15
- "Product Return and Recycling" on page 15
- "Declarable Substances" on page 15
- "About this Manual" on page 16

1.1 Properties

The ES5321.1 PWM I/O board features 48 input channels and 32 output channels, which can all be configured as PWM or digital I/O channels. In particular, the following signals can be generated or measured:

- Measuring signals with frequencies up to 100 kHz (on up to 48 channels)
- Generating signals with frequencies up to 100 kHz (on up to 32 channels)
- Generating multi-pulse signals with up to eight different period lengths and duty cycles (on up to four channels).
- Generating signals based on the SENT specification (on up to 16 channels)
- Measuring signals based on the SENT specification (on up to 4 channels)

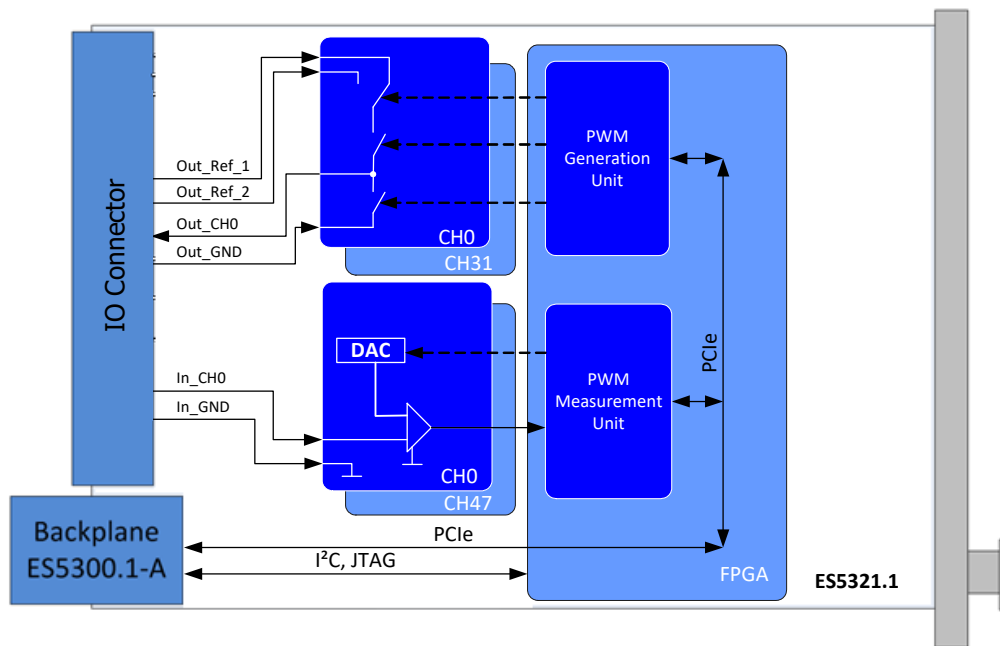


Fig. 1-1 Block diagram of ES5321.1

1.1.1 Digital Inputs of ES5321.1

The following measuring methods exist for the 48 measuring inputs:

- Pulse-width measurement (High Time [μs], Low Time [μs])
- Additive pulse-width measurement (Additive High Time [μs], Additive Low Time [μs])
- Frequency measurement
- Duty cycle measurement (Duty Cycle L/(L+H), Duty Cycle H/(L+H))
- Level measurement (Active High, Active Low)
- Measurement of SENT signals

Fig. 1-2 shows the block diagram of an input channel.

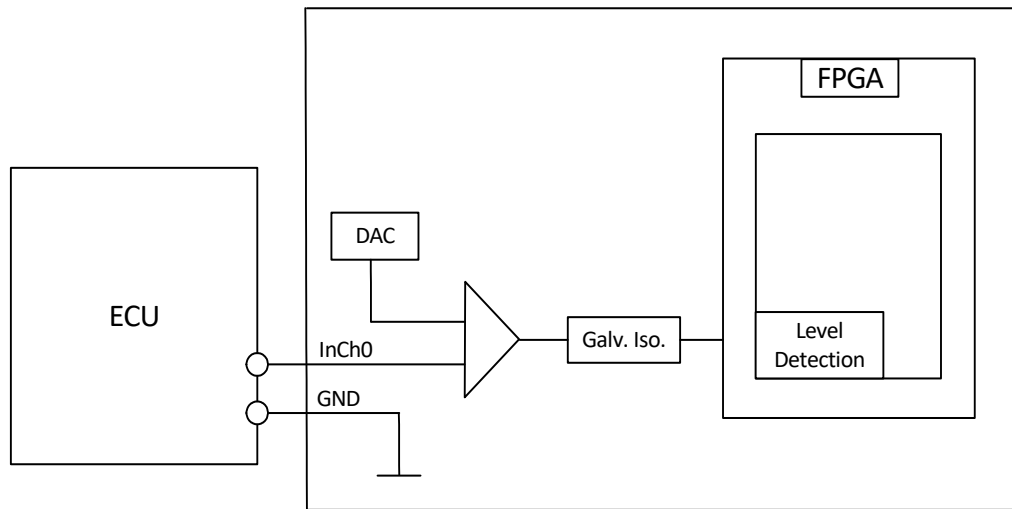


Fig. 1-2 Block diagram of an input channel.

1.1.2 Digital Outputs of ES5321.1

Every one of the 32 outputs is implemented as push-pull circuit (one high side and one low side driver each per channel). The output voltage level is predefined at I/O connector CO9000 by one of the external reference voltages Out_Ref_1 or Out_Ref_2 (see Fig. 1-1 and Fig. 1-3).

The following output modes are available:

- PWM
- Digital Out
- Multi-pulse
- SENT

Fig. 1-3 shows the block diagram of an output channel.

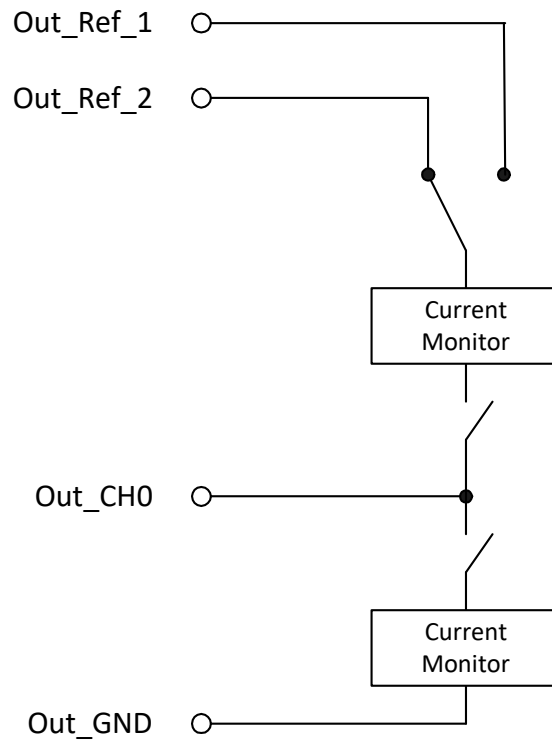


Fig. 1-3 Block diagram of an output channel.

1.2 Basic Safety Notices

Please 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 safety of systems that use the product is the responsibility of the system integrator!

General Safety at Work

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

1.2.4 Intended Use

Application Area of the Product

The ES5321.1 is an add-on card for the ES5300.1-A Housing and the ES5300.1-B Housing for simulating digital signals (PWM, high/low, SENT protocol).

The ES5321.1 add-on card consists of

- the add-on card itself. (The add-on card does not feature any expansion slots.)
- PCIe and I²C interfaces to the ES5300.1 system housing
- Digital input and output interfaces to the ECU

The ES5321.1 may be installed and operated only in the ES5300.1-A Housing and the ES5300.1-B Housing and not as a Stand-alone-unit.

The intended use of the ES5321.1 in an ES5300.1-A Housing or ES5300.1-B Housing is:

- Use 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 ES5321.1 is **not** intended to be used:

- Within a vehicle on the road.
- As part of a life support system.
- As part of a medical application.
- In applications where misuse can lead to injuries or damages.
- In environments in which conditions prevail that fall outside the specified ranges: see "Ambient Conditions" on page 36.
- With signal conditioning that falls outside the specified ranges: see "Technical Data" on page 35 (voltages, currents and power consumption).

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 the User's Guide for the product! 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.

**CAUTION!**

If to a channel of a galvanic group an external voltage is applied that is higher than the reference voltage, then cross currents may occur and the reference voltage may be affected.

This may lead to damage to channels of the respective reference group.

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 over-temperature 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 ES5321.1 can be damaged or destroyed by electrostatic discharges. Leave the plug-in card in its transport packaging until it is installed. Only remove, configure and install the ES5321.1 at a workplace that is protected against electrostatic discharges.

**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 back-plane 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 ES5321.1 that do not correspond to the specifications of the respective connection. The exact specification of the I/O hardware is located in the manuals of the corresponding boards.
- Do not connect or disconnect any devices while the ES5300.1-A Housing, the ES5300.1-B Housing or external devices are switched on. First, switch off the ES5300.1-A Housing or the ES5300.1-B Housing by shutting down the real-time PC and by activating the On/Off switch at the rear and 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 |
|  | Marking for CE conformity see "CE Mark" on page 14 |
|  | Marking for China RoHS, see "RoHS Conformity" on page 14 |
|   | Marking for conformity with WEEE directive see "Product Return and Recycling" on page 15 |
|  | Marking for KCC Conformity see "KC Marking" on page 15 |

Please observe the information in the chapter "Technical Data" on page 35.

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 guideline 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. 1-4 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 39).

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
- "Construction, Installation and Fuses" on page 19
- "In- and Output-Signals" on page 25
- "Connections and Connectors" on page 29
- "Technical Data" on page 35

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 preliminary 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 must not exceed 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>. | Keyboard commands are presented in angled brackets starting with capital letter. |

The "Open file" dialog window appears.

Select the `setup.exe` file.

A conversion between the logical and arithmetic data types is *not* possible.

Names of program windows, dialog windows, fields and similar are set in quotation marks.

Text in selection lists, program code, as well as path and file names are displayed in `Courier` font.

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 Construction, Installation and Fuses

In this chapter you can find information about construction, installation into the ES5300.1-A Housing and ES5300.1-B Housing, fuses and LEDs.

- "ES5321.1 PWM I/O Board (48/32-CH)" on page 19
- "Backplane Connector "CO200" and "CO9000" " on page 19
- "Fuses" on page 20
- "Installation in the ES5300.1-A and the ES5300.1-B Housing" on page 21
- "Connecting Cable" on page 22
- "LEDs on the ES5321.1 Backside" on page 23

2.1 Scope of Supply

You can find the scope of supply in chapter "Ordering Information" on page 38

2.2 ES5321.1 PWM I/O Board (48/32-CH)

A top view of the ES5321.1 is shown in Fig. 2-1 on page 19.

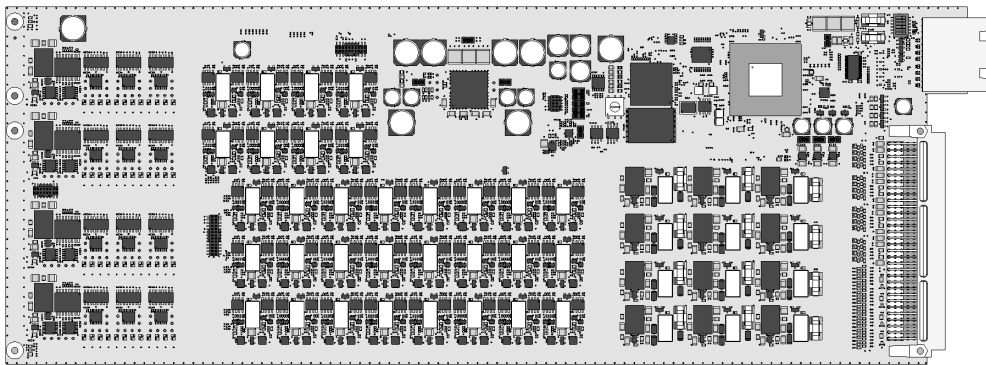


Fig. 2-1 ES5321.1 PWM I/O Board (48/32-CH).

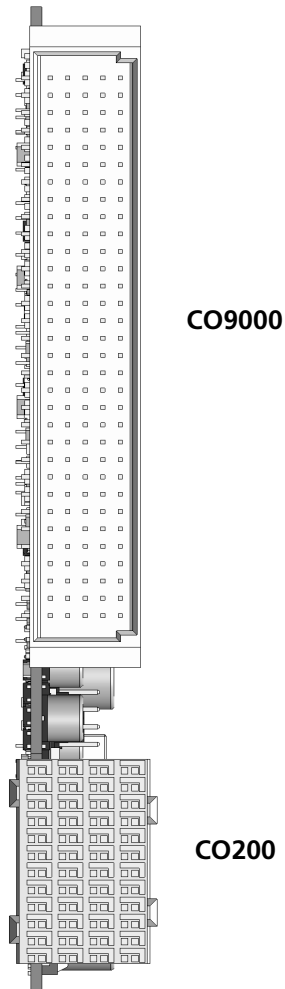
2.3 Backplane Connector "CO200" and "CO9000"

The connection of ES5321.1 to the ES5300.1-A Housing or to the ES5300.1-B housing is done via the PCIe connector "CO200" (on page 20).

The connector "CO9000" allows connecting an ECU (on page 20).

You can find the pin assignment for CO200 and CO9000 in "Connections and Connectors" on page 29.

The pin assignments of the plugs are located in the chapter "Connections and Connectors" on page 29.



Connectors "CO200" and "CO9000".

2.4 Fuses

The signal paths of the ES5321.1 PWM I/O Board (48/32-CH) are secured with fuses (2 A). In case of a fuse defect, we recommend to send the board to ETAS for further testing. For this purpose, the device should be sent to ETAS (see "ETAS Contact Addresses" on page 39).

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



WARNING!

Fire hazard!

Use only fuses that meet the specification in Tab. 2-1 on page 21!

Never bridge defective fuses!

Failure to observe the fuse specification can lead to excess currents, short circuits and fires.

Fig. 2-2 shows the position of the fuses.

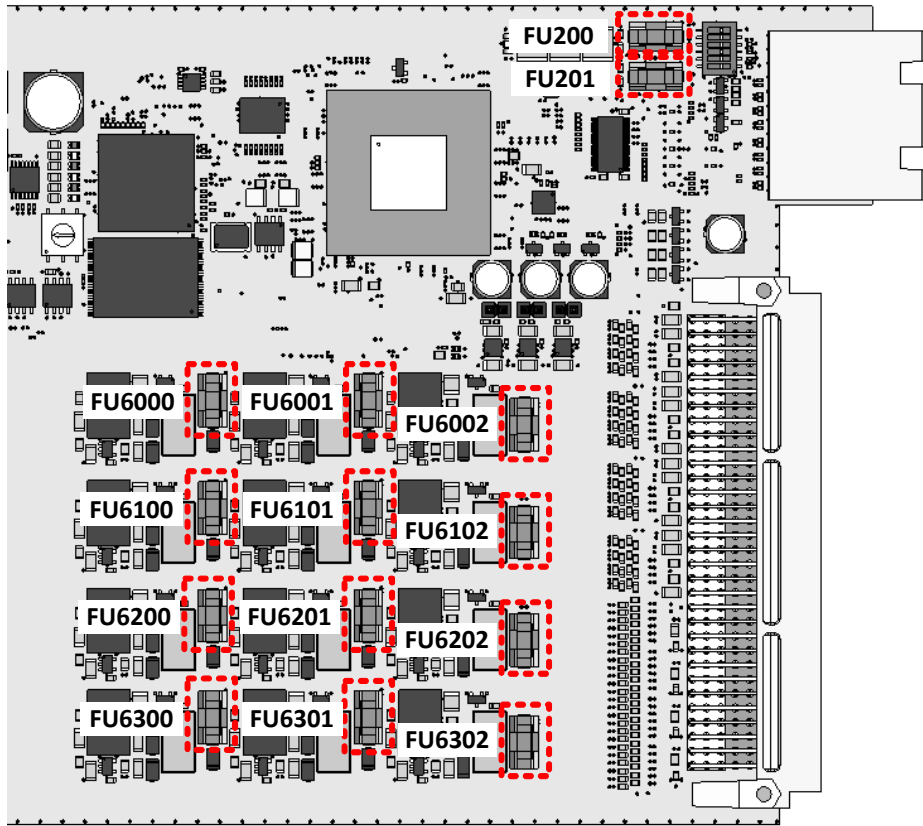


Fig. 2-2 Position of fuses (in red) on the ES5321.1.

| Type | Manufacturer | Order no. |
|---|--------------|-----------|
| NANO2® Slo-Blo® fuse, T 2 A, 452/454 series | Littlefuse | 154 002.T |

Tab. 2-1 Fuses

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

A description for installing the ES5321.1 in the ES5300.1-A Housing or the ES5300.1-B Housing is located in the manual for the ES5300.1-A Housing or the ES5300.1-B Housing.



CAUTION!

Do not install the ES5321.1 while the ES5300.1-A Housing or the ES5300.1-B Housing is switched on. First, switch off the ES5300.1-A housing or the 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.

The installation of the ES5321.1 may be performed only by trained personnel in an ESD-safe area.

**CAUTION!**

Some components of the ES5321.1 can be damaged or destroyed by electrostatic discharges. Leave the plug-in board in its transport packaging until it is installed. Only remove, configure and install the ES5321.1 at a workplace that is protected against electrostatic discharges.

**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 or ES5300.1-B. For this reason, install front plates in all free slots!

2.6 Connecting Cable

Use only approved cables for creating cable assemblies (e.g. for connecting the ECU and external loads). The cable length must not exceed 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!*

2.7 LEDs on the ES5321.1 Backside

There are LEDs on the backside of the ES5321.1. Their position is highlighted in Fig. 2-3 and their meaning is explained in Tab. 2-2.

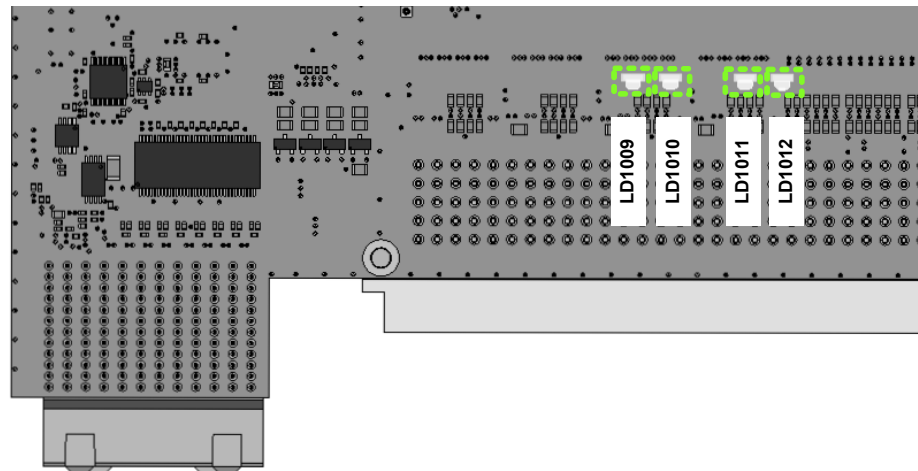


Fig. 2-3 Position of LEDs

| LED | Color | Status | Meaning |
|------------|--------------|---------------|--|
| LD1009 | FP LED 0 | Yellow | IP Protection Status |
| | | | Off |
| | FP LED 1 | Green | ETAS Identifikation |
| | | | Blink |
| | | Aus | 0: Default |
| | | | |
| LD1010 | FP LED 2 | Yellow | Output Error Lowside |
| | | | Off |
| | FP LED 3 | Green | Alle SENTIN NIOS #0 and NIOS #1 channels ready for SENTIN Messages |
| | | | Off |
| | | Blink | 1: No Error |
| | | | |
| LD1011 | FP LED 4 | Yellow | Output Error Highside |
| | | | Off |
| | FP LED 5 | Green | Alle SENTIN NIOS #2 and NIOS #3 channels ready for SETIN Messages |
| | | | Off |
| | | Blink | 1: No Error |
| | | | |
| LD1012 | FP LED 6 | Yellow | Output Overcurrent Error |
| | | | Off |
| | FP LED 7 | Green | Alle SENTOUT NIOS #0 and NIOS #1 channels ready for SETIN Messages |
| | | | Off |
| | | Blink | 1: No Error |
| | | | |

Tab. 2-2 Meaning of LEDs

3 **In- and Output-Signals**

This chapter features an overview of the supported measuring methods for the PWM input signals and of the output modes for the output signals.

- "Supported Measuring Methods for Input Channels" on page 25
- "Output Modes for the Output Signals" on page 28
- "Multi-Pulse Signals" on page 28
- "SENT Signals" on page 28

3.1 **Supported Measuring Methods for Input Channels**

The following measuring methods exist for the 48 measuring inputs:

- Measuring signals with frequencies up to 100 kHz
- Pulse-width measurement (High Time [μ s], Low Time [μ s])
- Additive pulse-width measurement (Additive High Time [μ s], Additive Low Time [μ s])
- Frequency measurement
- Duty cycle measurement (Duty Cycle $L/(L+H)$, Duty Cycle $H/(L+H)$)
- Level measurement (Active High, Active Low)
- Measurement of SENT signals on up to 4 channels

3.1.1 Configuration with ES5436.1 to Measure ECU Digital Output Signals

Digital outputs of ECUs are often configured as open emitter or open collector. In a vehicle, such outputs are connected to small loads.

To measure such digital output signals of an ECU in a HiL setup, the ES5436.1 can be used as load simulation and the ES5321 for measurement.

A schematic diagram for the ECU, the ES5321.1 and the ES5436.1 is shown in Fig. 3-1 on page 27.

The ES5436.1 has 48 current channels for currents in the range of 5 mA to 150 mA. These current channels can be combined with the 48 digital inputs of the ES5321.1 or the ES5321.2.



CAUTION!

Before connecting the ES5436.1, read the ES5436.1 User's Guide.

Technical Data of the ES5436.1 Power Sources

| Output | Data |
|------------------------|---|
| Output current | 5 mA to 150 mA |
| Output voltage | Passive circuit |
| Accuracy | +/- 3 mA at 150 mA |
| Galvanic isolation | max. 60 V to ground potential (functional separation) |
| Overvoltage protection | 60 V abs. max. |

Tab. 3-1 Technical data of the power sources

Note

In the idle state (non activated load channel, operation mode "disabled") the power source's idle state current is ~70 μ A.

Note

If the external voltage +VBAT < 6 V the power source doesn't carry any current.

When connecting the ES5436.1, observe the following note:

Note

The ES5436.1 use cases "Pull-Up", "Pull-Down" and "Bipolar" ("Bipolar" for H-bridge configuration, see ES5436.1 User's Guide) can be configured by software. For this reason, make sure that +VBAT and -VBAT are always connected.

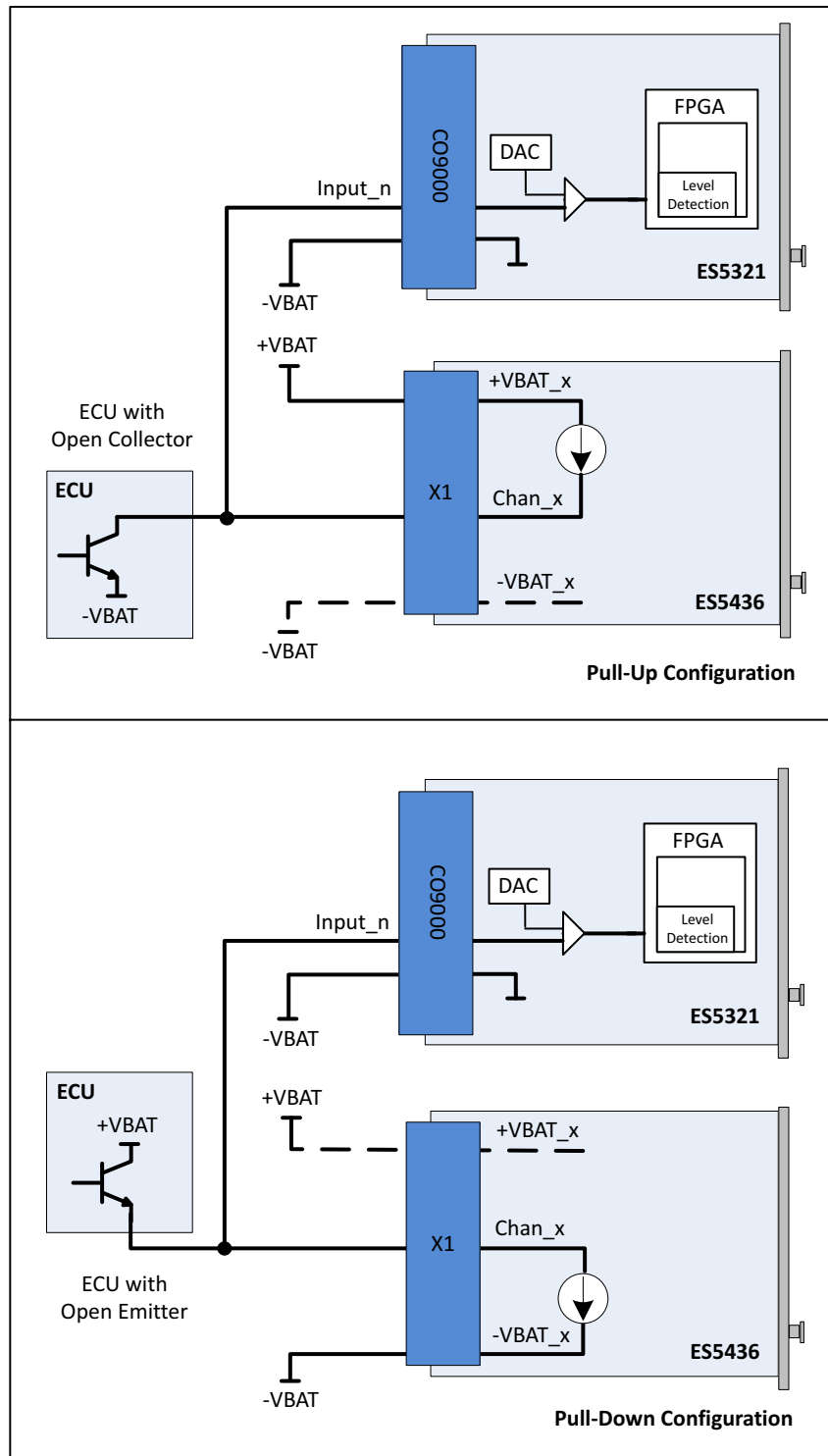


Fig. 3-1 Measurement of digital ECU output signals in the configuration "Pull-Up" or "Pull-Down" using ES5321 for measurement and ES5436.1 as load simulation

3.2 Output Modes for the Output Signals

Every one of the 32 outputs is implemented as push-pull circuit (one high side and one low side driver each per channel). The output voltage level is predefined at I/O connector CO9000 by one of the external reference voltages Out_Ref_1 or Out_Ref_2 (see Fig. 1-1 on page 6 and Fig. 1-3 on page 8).

The following output modes are available:

- PWM: Generating signals with frequencies up to 100 kHz (on up to 32 channels)
- Digital Out
- Multi-pulse: Generating multi-pulse signals with up to eight different period lengths and duty cycles (on up to four channels).
- SENT: Generating signals based on the SENT specification (on up to 16 channels).



CAUTION!

If to a channel of a galvanic group an external voltage is applied that is higher than the reference voltage, then cross currents may occur and the reference voltage may be affected. This may lead to damage to channels of the respective reference group.

3.3 Multi-Pulse Signals

A multi-pulse signal consists of a sequence of several pulses with different frequencies and duty cycles. The multi-pulse function is supported by up to four random output channels of the ES5321.1. Fig. 3-2 on page 28 shows a sequence as an example.

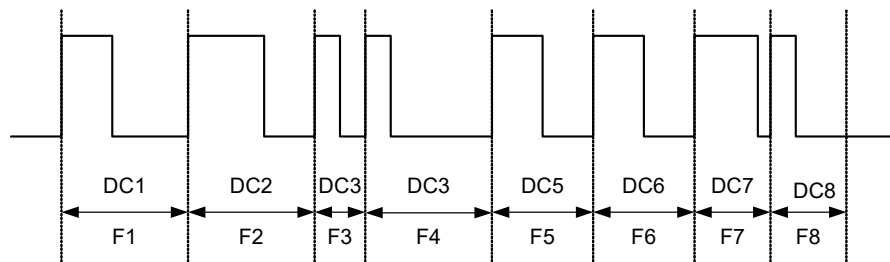


Fig. 3-2 Multi-pulse sequence with eight pulses (F = frequency, DC = duty cycle)

The multi-pulse sequences are output cyclically.

3.4 SENT Signals

The generation of signals according to the SENT specification SAE J2716 is possible on all output channels.

4 Connections and Connectors

This section provides a description of the different connections of the ES5321.1.

- "Backplane Connector "CO200" " on page 29
- "I/O Connector "CO9000" " on page 31

4.1 Backplane Connector "CO200"

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 connector (4-12) (order no. 973096)

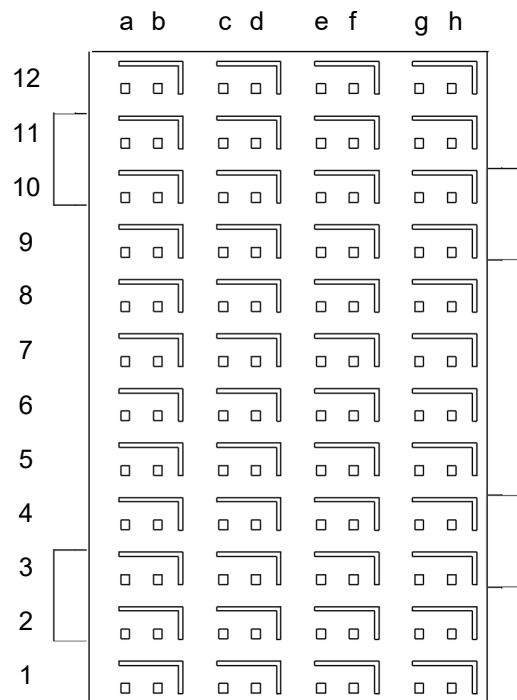


Fig. 4-1 Connector to backplane (top view)

- The pin assignment is as follows:

| | a | b | c | d | e | f | g | h |
|------------------|-----------------|-----------------|--------------|-------------|----------|----------|----------|----------|
| 12 | BN_4 | BN_5 | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. |
| 12-shield | GND | | GND | | GND | | GND | |
| 11 | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. |
| 11-shield | GND | | GND | | GND | | GND | |
| 10 | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. |
| 10-shield | GND | | GND | | GND | | GND | |
| 9 | n.c. | PCIE_WAKEn | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. |
| 9-shield | GND | | GND | | GND | | GND | |
| 8 | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. |
| 8-shield | GND | | GND | | GND | | GND | |
| 7 | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. |
| 7-shield | GND | | GND | | GND | | GND | |
| 6 | PCIE_JTAG_TDI | PCIE_JTAG_TCK | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. |
| 6-shield | GND | | GND | | GND | | GND | |
| 5 | PCIE_JTAG_TMS | PCIE_JTAG_TDO | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. |
| 5-shield | GND | | GND | | GND | | GND | |
| 4 | BN_2 | BN_3 | n.c. | n.c. | n.c. | n.c. | n.c. | n.c. |
| 4-shield | GND | | GND | | GND | | GND | |
| 3 | BN_0 | BN_1 | PCIE_SMBCLK | PCIE_SMBDAT | n.c. | n.c. | VCC24 | VCC24 |
| 3-shield | VCC3_3 | | VCC3_3 | | VCC3_3 | | VCC3_3 | |
| 2 | PCIE_PRSENT2_X4 | PCIE_PRSENT2_X1 | PCIE_PRSENT1 | PCIE_PERSTn | VCC5 | VCC3_3 | VSS12 | VSS12 |
| 2-shield | VCC12 | | VCC12 | | VCC12 | | VCC12 | |
| 1 | VCC12 | VCC12 | VCC12 | VCC12 | VCC5 | VCC5 | VCC3_3 | VCC3_3 |
| 1-shield | VCC12 | | VCC12 | | VCC12 | | VCC12 | |

4.2 I/O Connector "CO9000"

The connector "CO9000" enables the connection to an ECU.

Type: Erni Eurocard DIN 41612 Connector, 5 Rows, male

Manufacturer ordercode: 384299

Counterplug: HARTING DIN 41612 Connector

Manufacturer ordercode: 02 05 000 0003

Crimp-Contacts: Harting Crimp Contacts

Manufacturer ordercode: 02 05 000 2511

Note

To fix the crimp contacts a crimping tool is necessary.

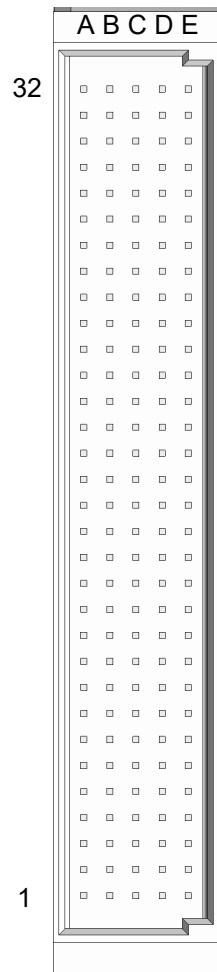


Fig. 4-2 Connector "CO9000"

- The pin assignment is as follows:

- Pin assignment for the input signals:
The four galvanically isolated groups are identified by the colored background.

| Pin | Row A | Row B | Row C | Row D | Row E | | |
|-----|----------|----------|--------------|--------------|--------------|--|---------|
| 32 | Input_46 | Input_47 | -UBATT_DIN_D | -UBATT_DIN_D | -UBATT_DIN_D | | Input D |
| 31 | Input_41 | Input_42 | Input_43 | Input_44 | Input_45 | | Input D |
| 30 | Input_36 | Input_37 | Input_38 | Input_39 | Input_40 | | Input D |
| 29 | Input_34 | Input_35 | -UBATT_DIN_C | -UBATT_DIN_C | -UBATT_DIN_C | | Input C |
| 28 | Input_29 | Input_30 | Input_31 | Input_32 | Input_33 | | Input C |
| 27 | Input_24 | Input_25 | Input_26 | Input_27 | Input_28 | | Input C |
| 26 | Input_22 | Input_23 | -UBATT_DIN_B | -UBATT_DIN_B | -UBATT_DIN_B | | Input B |
| 25 | Input_17 | Input_18 | Input_19 | Input_20 | Input_21 | | Input B |
| 24 | Input_12 | Input_13 | Input_14 | Input_15 | Input_16 | | Input B |
| 23 | Input_10 | Input_11 | -UBATT_DIN_A | -UBATT_DIN_A | -UBATT_DIN_A | | Input A |
| 22 | Input_5 | Input_6 | Input_7 | Input_8 | Input_9 | | Input A |
| 21 | Input_0 | Input_1 | Input_2 | Input_3 | Input_4 | | Input A |

Tab. 4-1 Pin assignment for the input signals of ES5321.1.

- Pin assignment for the output signals:
The four galvanically isolated groups are identified by the colored background.

| Pin | Row A | Row B | Row C | Row D | Row E | |
|-----|---------------|---------------|---------------|---------------|---------------|----------|
| 20 | -UBATT_DOUT_D | -UBATT_DOUT_D | -UBATT_DOUT_D | -UBATT_DOUT_D | -UBATT_DOUT_D | Output D |
| 19 | Output_29 | Output_30 | Output_31 | -UBATT_DOUT_D | -UBATT_DOUT_D | Output D |
| 18 | Output_24 | Output_25 | Output_26 | Output_27 | Output_28 | Output D |
| 17 | REF_B_DOUT_D | REF_B_DOUT_D | REF_B_DOUT_D | REF_B_DOUT_D | REF_B_DOUT_D | Output D |
| 16 | REF_A_DOUT_D | REF_A_DOUT_D | REF_A_DOUT_D | REF_A_DOUT_D | REF_A_DOUT_D | Output D |
| 15 | -UBATT_DOUT_C | -UBATT_DOUT_C | -UBATT_DOUT_C | -UBATT_DOUT_C | -UBATT_DOUT_C | Output C |
| 14 | Output_21 | Output_22 | Output_23 | -UBATT_DOUT_C | -UBATT_DOUT_C | Output C |
| 13 | Output_16 | Output_17 | Output_18 | Output_19 | Output_20 | Output C |
| 12 | REF_B_DOUT_C | REF_B_DOUT_C | REF_B_DOUT_C | REF_B_DOUT_C | REF_B_DOUT_C | Output C |
| 11 | REF_A_DOUT_C | REF_A_DOUT_C | REF_A_DOUT_C | REF_A_DOUT_C | REF_A_DOUT_C | Output C |
| 10 | -UBATT_DOUT_B | -UBATT_DOUT_B | -UBATT_DOUT_B | -UBATT_DOUT_B | -UBATT_DOUT_B | Output B |
| 9 | Output_13 | Output_14 | Output_15 | -UBATT_DOUT_B | -UBATT_DOUT_B | Output B |
| 8 | Output_8 | Output_9 | Output_10 | Output_11 | Output_12 | Output B |
| 7 | REF_B_DOUT_B | REF_B_DOUT_B | REF_B_DOUT_B | REF_B_DOUT_B | REF_B_DOUT_B | Output B |
| 6 | REF_A_DOUT_B | REF_A_DOUT_B | REF_A_DOUT_B | REF_A_DOUT_B | REF_A_DOUT_B | Output B |
| 5 | -UBATT_DOUT_A | -UBATT_DOUT_A | -UBATT_DOUT_A | -UBATT_DOUT_A | -UBATT_DOUT_A | Output A |
| 4 | Output_5 | Output_6 | Output_7 | -UBATT_DOUT_A | -UBATT_DOUT_A | Output A |
| 3 | Output_0 | Output_1 | Output_2 | Output_3 | Output_4 | Output A |
| 2 | REF_B_DOUT_A | REF_B_DOUT_A | REF_B_DOUT_A | REF_B_DOUT_A | REF_B_DOUT_A | Output A |
| 1 | REF_A_DOUT_A | REF_A_DOUT_A | REF_A_DOUT_A | REF_A_DOUT_A | REF_A_DOUT_A | Output A |

Tab. 4-2 Pin assignment for the output signals of ES5321.1.

5 Technical Data and Norms

This chapter features the technical data of the ES5321.1. You may also find norms and standards.

5.1 Technical Data

Inputs

| | |
|--|---|
| Number | 48 |
| Input voltage range | 0 V AC...+56 V AC |
| Input impedance | 1 M Ω |
| Frequency range | 1 Hz...100 kHz |
| Duty cycle | 0%...100% |
| Duty cycle resolution | 0.1% |
| Accuracy in range of 1 Hz to 10 kHz | \pm 0.1% |
| Accuracy in range of 10 kHz to 100 kHz | \pm 0.4% |
| Resolution | 8 ns (125 MHz) |
| Counter | 31 bit |
| Pulse width | 120 ns to 17 s (= $[2^{31} - 1] * 8$ ns); Resolution: 8 ns |
| Programmable thresholds for high/low detection of input signal | +1 V...+10 V |
| Threshold resolution | 10 bit |
| Hysteresis (fix) | max. 0.5 V |
| Glitch filter | 120 ns to 5000 ns or "Off"; resolution; 8 ns |
| Electric strength | \pm 56 V DC \pm 60 V DC for max. 15 seconds |
| Galvanic groups | 4 groups with 12 channels each |
| Max. number of SENT signals | 4 |
| SENT Specification (version) | SAE J2716 |

Outputs

| | |
|---|--|
| Number of channels | 32 |
| External reference voltages | 0 V DC...+56 V DC |
| Voltage drop High-, Low Side Path | about 1 V |
| Output impedance | 11 Ω |
| Electric strength | ± 56 V DC ± 60 V DC for max. 15 seconds |
| Output current | 0...100 mA |
| Frequency range | 1 Hz...100 kHz |
| Duty cycle | 0 %...100 % |
| Accuracy in range of 1 Hz...10 kHz | $\pm 0.04\%$ |
| Accuracy in range of 10 kHz...100 kHz | $\pm 0.4\%$ |
| Accuracy of duty cycle (duty cycle 50%) of 1 Hz...10 kHz | $\pm 0.2\%$ |
| Accuracy of duty cycle (duty cycle 50%) of 10 kHz...100 kHz | $\pm 0.4\%$ |
| Clock rate for PWM generation (numerically-controlled oscillator) | 8 ns |
| Max. number of SENT signals | 16 |
| Max. number of multipulse signals | 4 |
| SENT specification (version) | SAE J2716 |
| Galvanic groups | 4 groups with 8 channels each |

Power Supply

| | |
|---------------------|--------------------------------------|
| Current consumption | 250 mA @ +3.3 V DC 1 A @ +12 V DC |
|---------------------|--------------------------------------|

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 | max. 2000 m/ 6500 ft above sea level |

Physical Dimensions

| | |
|-------------------|--------|
| Height | 4 U |
| Relative humidity | 5 HP |
| Weight | 0,5 kg |

5.2 Fulfilled Norms and Standards

The ES5321.1 meets the following norms and 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 module 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. In this case, the operator may be required to institute reasonable measures.

6 **Ordering Information**

This chapter features the ordering information for the ES5321.1 PWM I/O Board (48/32-CH) as follows:

| Order Name | Short Name | Order Number |
|--|-------------------|---------------------|
| ES5321.1 PWM I/O Board (48/32-CH) Carrier Board | ES5321.1 | F-00K-109-721 |
| Scope of Supply | | |
| ES5321.1 PWM I/O Board (48/32-CH) | | |

Tab. 6-1 Ordering Information for ES5321.1

7 **ETAS Contact Addresses**

ETAS HQ

ETAS GmbH

Borsigstraße 24

70469 Stuttgart

Germany

Phone: +49 711 3423-0

Fax: +49 711 3423-2106

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

Index

A

Accident prevention 10
Application Area 10

B

Backplane connector "CO200" 29

C

CE Declaration of Conformity 14
Cleaning 13
Connecting cable 22
Connecting devices 13
Connections
 Backplane connector 29
 I/O Connector "CO9000" 31
Connections and Connectors 29
Construction 19

D

Declarable Substances 15
Devices
 Connecting 13

E

Electrical Safety 11
ETAS Contact Addresses 39

F

Fuses 19, 20

G

Galvanically Isolated 32, 33

I

I/O Connector "CO9000" 31
Improper use 9
In- and Output-Signals 25
Installation 19, 21
Installation Location 12
Intended Use 10

K

KC Marking 15

L

LEDs 23

M

Maintenance 13
Multi-pulse signals 28

O

Ordering Information 38
Output modes for the output signals
 28

P

Product exclusion if liability 9
Product Labeling 14
Product return 15

Q

Qualification, required 9

R

Recycling 15

Repairs 13

RoHS conformity

China 15

European Union 14

S

Safety at work 10

Safety notices, identification of 9

Safety precautions 9

Scope of Supply 19

SENT signals 28

Signals 25

Standards 37

Standards and norms 37

Supported measuring methods for
input channels 25

T

Technical Data 35

Transport 12

V

Ventilation 12

W

Waste Electrical and Electronic Equip-
ment 15

WEEE return system 15