ES5398.1 Fault Insertion Board (40-CH)
User's Guide

Contents

1   Introduction

This User's Guide contains the description of the ES5398.1 Fault Insertion Board.

This chapter contains information about the following topics:

- "Properties" on page 6
- "Basic Safety Notices" on page 6
- "Labeling on the Product" on page 12
    - "CE Mark" on page 12
    - "RoHS Conformity" on page 12
- "Product Return and Recycling" on page 13
- "Materials Subject to Declaration" on page 13
- "About this Manual" on page 14

## 1.1	Properties

This section provides a brief overview of the functions and properties of the ES5398.1 Fault Insertion Board. A detailed description can be found in chapter .....

### 1.1.1	Fault Simulation

The ES5398.1 Fault Insertion Board enables fault simulation in real time for 40 ECU channels.

The ES5398.1 has the following properties:

Fault Simulation for the Following Faults:

- Open circuit
- Short circuit to +VBAT_A, +VBAT_B and -VBAT with and without connected load
- Contacts between ECU lines ("pin to pin") with and without connected load.

### 1.1.2	Block Diagram for Fault Simulation

A block diagram for fault simulation is shown in Fig. 1-1.
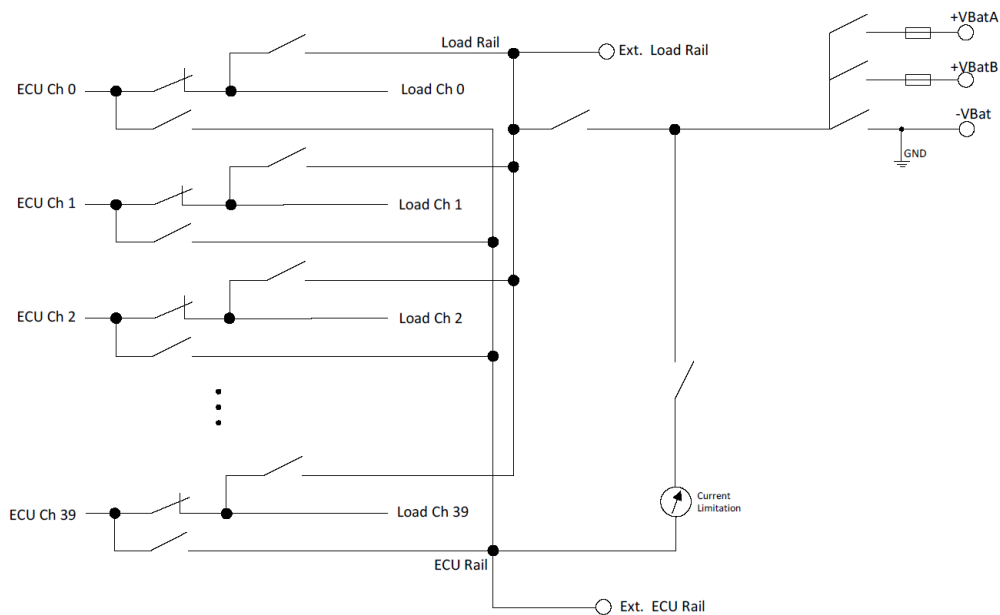
Fig. 1-1	Block diagram of ES5398.1

## 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 notify you of extremely important information. Please read this information carefully.

CAUTION!
Identifies a hazard with low risk of minor or moderate physical injury or damage to property 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

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

Note
The User's Guide and the Product Safety Advice must be read carefully 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 lead to damages or injuries to one's health or damages to 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 ES5398.1 is a plug-in board for the ES5300 system housing which is used to simulate electrical fault cases. This simulation of fault cases is used to test the diagnostics functions of an ECU.

The ES5398.1 plug-in board consists of the following:

- Relays and MOSFET switches for simulating electrical fault cases for 40 channels
- Interface for simulating the vehicle battery

     The simulation of the vehicle battery itself is not part of the ES5300 housing and cannot be installed here.

- Interface to the ES5300 system housing

The ES5398.1 may be installed and operated only in the ES5300.1-A housing and the ES5300.1-B Housing.

The intended use of the ES5398.1 in an ES5300.1-A housing or ES5300.1-B housing is:

- Use in industrial lab facilities or workplaces
- Hardware interface for ECUs in a hardware-in-the-loop test system
- Cooperation with ETAS software which supports the ES5300.1-A housing or the ES5300.1-B housing
- Interface in cooperation with software programs that operate the standardized, documented and open APIs of ETAS software products

The ES5398.1 is not intended for the following:

- Use within a vehicle on the road
- Use as part of a life support system
- Use in applications where misuse can lead to injury or damage
- Use in environments in which conditions prevail that fall outside the specified ranges: See "Ambient Conditions" on page 36
- Use with signal conditioning that falls outside the specified ranges: See "Technical Data and Standards" on page 35 (voltages, currents and power input)

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.

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. With any deviating operation, the 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 meet the specification in Tab. 2-1 on page 20!*
> *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 theES5300.1-A housing or the ES5300.1-B housing via the PCIe Backplane Connector.

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)). This requirement is met by lab power supplies that comply with IEC/EN 60950 or IEC/EN 61010.

- 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 a Plug-in Board

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 plug-in board. Wait at least three minutes before removing the plug-in board.

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 con-necting the ECU and external loads). The cables used must be suitable particularly for occurring currents, voltages and temperatures and flame-retardant in accordance with one of the following standards IEC 60332-1-2, IEC 60332-2-2, UL 2556/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 and 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 the ES5300.1-B. For this reason, install front plates in all free slots!*

Transport and Installation

To avoid damage to the hardware caused by electrostatic discharge, please observe the following precautionary measures:

> **CAUTION!**
>
> *Some components of the ES5398.1 can be damaged or destroyed by electrostatic discharges. Leave the plug-in card in its transport packaging until its installation.*
> *The ES5398.1 may be removed from the transport packaging, configured and installed only at a workplace that is secured against electrostatic discharges.*

> **CAUTION!**
>
> *In order to prevent damage to the plug-in boards 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.*

1.2.5 Connecting/Disconnecting Devices

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

- Do not apply any voltages to the connections of the ES5398.1 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 cable.

- 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   Labeling 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
C E	Marking for CE conformity (see "CE mark" on page 7)
(e)	Marking for China RoHS, see chapter (see "RoHS conformity" on page 7)
🗑	Marking for conformity with WEEE directive (see "Product return and recycling" on page 8)

Please observe the information in the chapter "Technical Data and Standards" 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 EC Directive 2002/95/EC restricts the use of certain hazardous substances in electrical and electronic equipment (RoHS conformity).

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

China

With the China RoHS marking affixed 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.

1.4   Product Return and Recycling

The European Union (EU) issued 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 or 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 general 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 ("ETAS Contact Addresses" on page 39).

1.5   Materials Subject to Declaration

Some products from ETAS GmbH (e.g. modules, boards, cables) use components with materials that are subject to declaration in accordance with the REACH regulation (EC) 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 design and installation of ES5398.1, as well as information about the fuses.

- "Fault Simulation" on page 23
  This chapter contains a description of the fault simulation options and important instructions for connecting the ES5398.1.

- "Connections and Connectors" on page 27
  This section provides a description of the different connections, connectors and pin assignments of the ES5398.1.

- "Technical Data and Standards" on page 35
  This chapter contains the technical data of the ES5398.1. It also contains the norms and standards met.

- "Order Data" on page 37

1.6.1   Using 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

   Possible explanation for step 1...

2. Step 2

   Possible explanation for step 2...

Any concluding comments...

Specific example:

Creating a new file

Before creating a new file, no other files 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 be more than 8 characters long.

3. Click on **OK**.

The new file is 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.	Names of program windows, dialog windows, fields and similar are set 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 design and installation of ES5398.1, as well as information about the fuses.

- "Design of ES5398.1" on page 17
- "Fuses" on page 18
- "Installation in the ES5300.1-A and the ES5300.1-B Housing" on page 20

> ⚠️ **CAUTION!**
>
> *Some components of the ES5398.1 can be damaged or destroyed by electrostatic discharges. Leave the plug-in card in its transport packaging until its installation.*
> *The ES5398.1 may be removed from the transport packaging, configured and installed only at a workplace that is secured against electrostatic discharges. Avoid any contact with the connections of the plug-in card or with conductor paths on the card.*

2.1   Design of ES5398.1

A view of ES5398.1 is shown in Fig. 2-1 and Fig. 2-2.
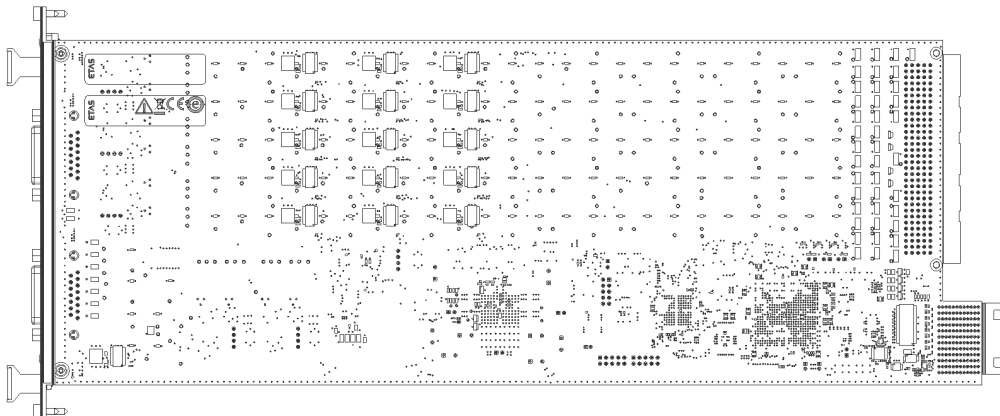
Fig. 2-1   Rear of the ES5398.1 and product markings
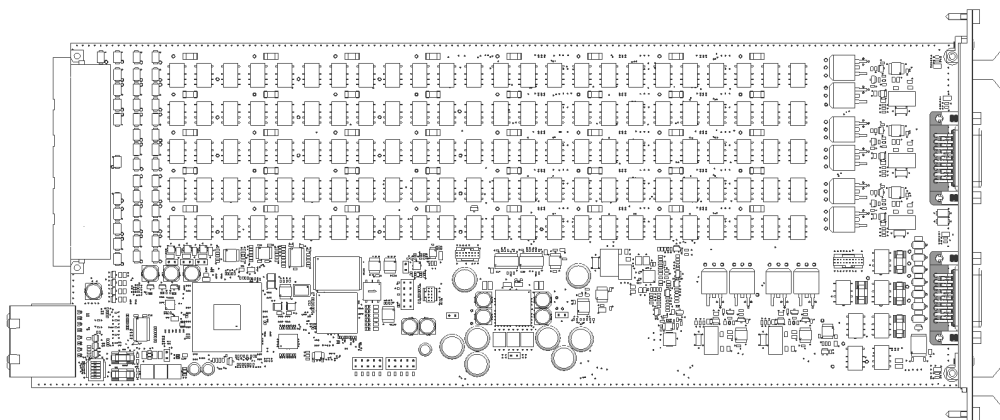
Fig. 2-2   View of the ES5398.1

Location of the Connectors

The location of the connectors on the front panel and backplane side of the ES5398.1 is shown in Fig. 2-3.

CO200 is the backplane connector for connection with the ES5300 housing. CO200 is also used to provide the voltage supply.
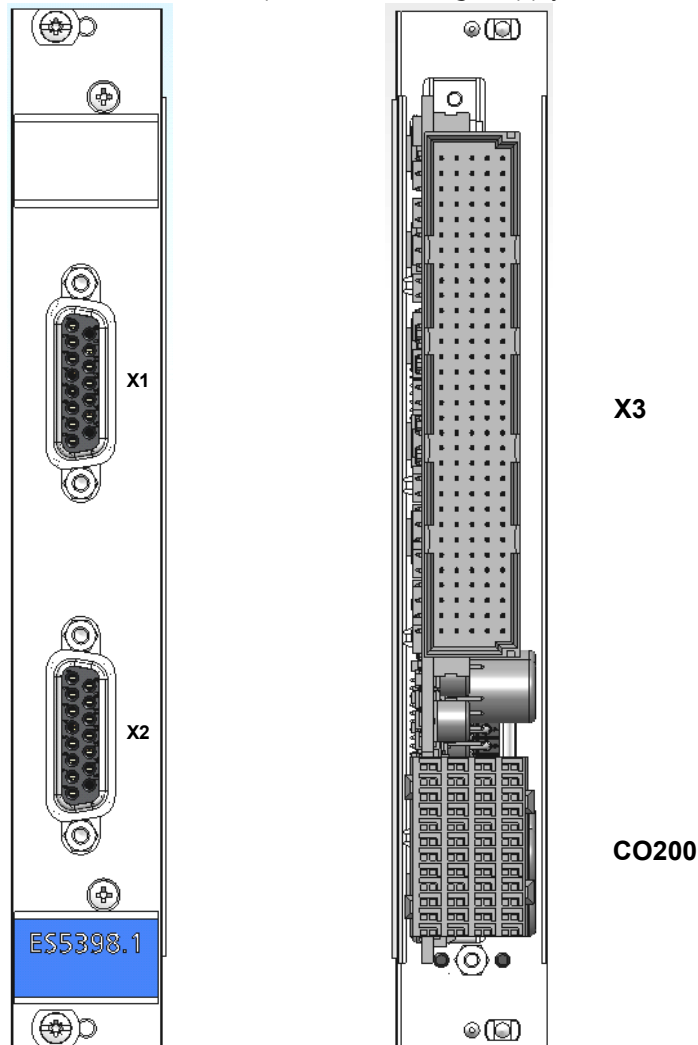
Fig. 2-3   Front panel (left) and backplane side (right) of the ES5398.1

2.2   Fuses

The voltage supply and the fault channels of the ES5398.1 are protected with fuses. 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 ("ETAS Contact Addresses" on page 39).

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

> ⚠ **WARNING!**
>
> *Fire hazard!*
> *Failure to observe the fuse specification can lead to excess currents,*
> *short circuits and fires.*
> *Only use fuses that meet the specification in Tab. 2-1 on page 20.*
> *Never bridge defective fuses! Never change fuses when the ES5300.1*
> *is switched on.*

Position of fuses

Fig. 2-4 shows the position of the fuses.
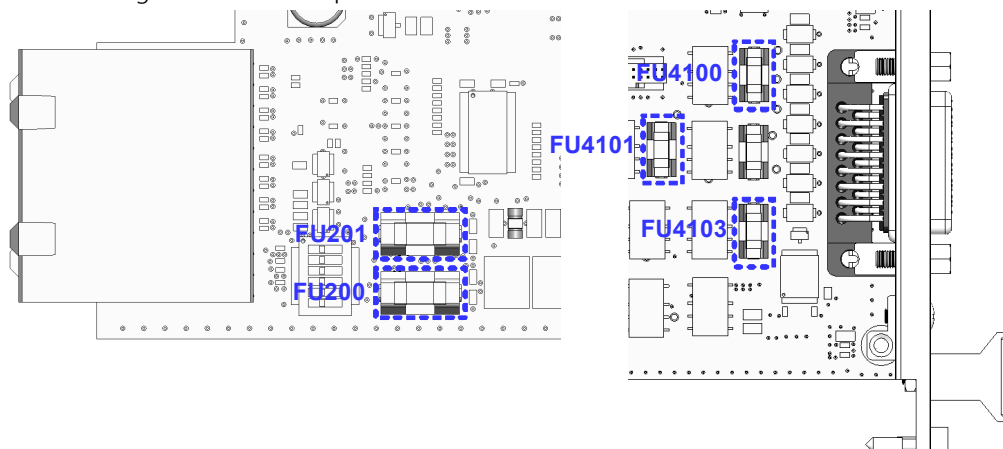
Fig. 2-4   Location of the fuses on the ES5398.1.

> **Note**
>
> *The fuses for protecting each channel are soldered in place and must not be*
> *changed by the user.*

Checking the fuse of a channel

1. Switch off the complete ES5300.1 system.
2. Disconnect the line from X3 to the LABCAR or customer system
3. Check the connection to the ES5398.1 board at the connector X3 using a continuity tester on the corresponding channel.

In the deenergized state, the channel is conductive if the fuse is not defective.

In the event of a fault, the device should be sent to ETAS ("ETAS Contact Addresses" on page 39).

Specification of Fuses

The specification of the fuses is as follows:

Fuse	Type	Specification	Fuse protection of
FU4100	NANO2® Slo-Blo® Fuse 452/454 Series	7 A	VBAT_A
FU4101	NANO2® Slo-Blo® Fuse 452/454 Series	7 A	VBAT_B
FU4103	NANO2® Slo-Blo® Fuse 452/454 Series	5 A	RES_A / B_EXT
FU200	NANO2® Slo-Blo® Fuse 452/454 Series	3 A	12 V
FU201	NANO2® Slo-Blo® Fuse 452/454 Series	2 A	3.3 V

Tab. 2-1   Specification of fuses (manufacturer: Littlefuse)

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

A description for installing the ES5398.1 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.

The installation of the ES5398.1 may be performed only by trained personnel in an ESD-safe area.

⚠️ **CAUTION!**

Do not install the ES5398.1 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.

⚠️ **CAUTION!**

Some components of the ES5398.1 can be damaged or destroyed by electrostatic discharges. Leave the plug-in card in its transport packaging until its installation.
The ES5398.1 may be removed from the transport packaging, configured and installed only at a workplace that is secured against electrostatic discharges. Avoid any contact with the connections of the plug-in card or with conductor paths on the card.

⚠️ **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!

> ⚠️ **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.*

Installation of the ES5398.1 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 ES5398.1 (handle with small blue plate at the front plate must point down!) into the upper and lower rail of the slot and push it in a little.

5. Carefully push in the carrier board until the backplane connector of the ES5398.1 is completely inserted in the socket of the backplane.

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

6. Fix the carrier board by fastening the front plate with screws.

7. Install front plates at all open slots before starting up the ES5398.1.

3 Fault Simulation

This chapter contains a description of the fault simulation options and important instructions for connecting the ES5398.1.

3.1 Properties and Operating Conditions

The ES5398.1 has the following properties and operating conditions:

- Support of up to 12 faults simultaneously (multiple faults) at a nominal voltage of 12 V
- Higher operating voltage +VBAT up to 48 V for single faults possible
- 40 fault channels

3.2 Fault Types

The following fault types are supported

3.2.1 Open Circuit

- In the idle state, each of the 40 channels of the board is conductive.
- The activated channel is opened in the switched fault case for a defined time.
- Available as real-time faults or relay faults.

3.2.2 Short Circuit to +VBAT_A, +VBAT_B and -VBAT
With and Without Connected Load

- In the fault case, one of the battery voltages is connected to the channel for a defined time.
- The ECU can switch short circuits to +VBAT_A, +VBAT_B or -VBAT.
- For the duration of the switched fault case, the connected load can be isolated.
- Current monitoring in the fault path switches off the fault after a few milliseconds if the cut-off current is exceeded.
- This fault is available as a real-time fault or as a relay fault.

3.2.3 Contacts Between ECU Lines
("Pin to Pin") With and Without Connected Load

- One channel of the ECU is switched to a different channel of the ECU in the fault case for a defined time.
- For the duration of the switched fault case, the connected load can be isolated.
- This fault is available as a real-time fault or as a relay fault.

3.3 Relay Faults, Real-Time Faults, Multiple Faults

As a general rule, the fault types in sections 3.2.1 to 3.2.3 can be realized as:

- Relay faults (the fault is switched by a relay) or
- Real-time faults (the fault is switched by a semiconductor switch)

The following relay faults can be combined into multiple faults:

- Open circuit
- Short circuit to +VBAT_A, +VBAT_B and -VBAT

Up to 12 faults can be activated simultaneously

The fault type and the parameters are selected using the software supplied.

3.4 Protection of the Fault Channels

All channels are protected against overcurrent by means of safety fuses.

Note

The fuses for protecting each channel are soldered in place and must not be changed by the user.

In the following, the additional protection for each fault type is described and the extra preventative measures to be taken by the user are listed.

3.4.1 Relay Fault

The board is equipped with voltage monitoring. This is used to protect the relay installed on the board.

- The nominal operating voltage VBAT is 12 V, but may be exceeded up to the cut-off voltage of typically 30 V.
- When switching faults, the operating voltage is monitored and the fault simulation is discontinued when the cut-off voltage is exceeded.

CAUTION!

The switching capacity of the relays (see "Technical Data" on page 35) must not be exceeded. Exceeding the switching capacity can result in fires as a result of the plug-in board overheating.

3.4.2 Real-Time Fault

Voltage monitoring is not active for real-time faults. There is, however, an electronic current limit for real-time faults and for the "short circuit to VBat" faults (see "Technical Data" on page 35).

- "When switching real-time faults, a nominal operating voltage >12 V is possible. The maximum permitted operating voltage is 60 V.

WARNING!

Fire hazard!
The maximum permitted operating voltage for real-time faults is 60 V. Do not exceed this voltage!
Even exceeding the maximum permitted operating voltage only briefly can destroy the board. This results in the risk of fire caused by overheating.

- When switching a real-time fault, the current is monitored and the fault simulation terminated when the cut-off current is exceeded.

> **Note**
>
> Real-time faults are switched using semiconductor switches. As a result, in the opened state, small residual currents can flow. This can result in a change to the resistance of the fault path of a fault configuration.

3.5   Master/Slave Operation

The 40 channels of the ES5398.1 can be expanded by interconnecting several boards in master/slave operation.

The connectors X1 and X2 on the front panel of the board are used to connect the boards. The pin assignment and other connection instructions can be found in "Connections and Connectors" on page 27. Additional technical specifications are contained in "Technical Data" on page 35.

> ⚠ **WARNING!**
>
> *Fire hazard!*
> *Special precautionary measures apply for cabling for master/slave operation. The safety instructions in the chapter "Connectors X1 and X2" on page 32 must be followed.*
> *Failure to observe this can result in destruction of the ES5398.1 and cause a fire.*

4   Connections and Connectors

This section provides a description of the different connections, connectors and pin assignments of the ES5398.1.

- "Backplane Connector CO200" on page 27
- "Connector X3" on page 29
- "Connecting Cable" on page 34

4.1   Backplane Connector CO200

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

Counterplug (in ES5300): ERNI ERMet ZD 4-pair straight male multi-point connector (4-12) (order no. 973096)
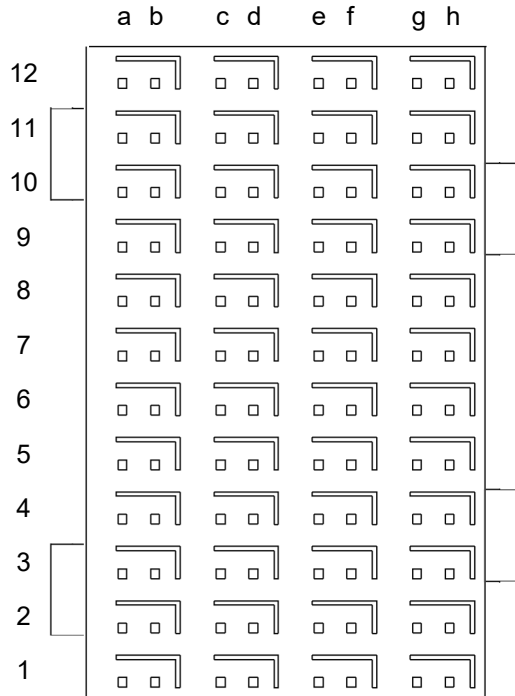

Fig. 4-1   Connector to backplane (top view)

- 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   Connector X3

The connector X3 enables the connection to an electronic control unit (ECU).

Type: Erni Eurocard DIN 41612 connector, 5 rows, male
Order number: 384299

Counterplug: HARTING DIN 41612 connector
Order number: 02 05 000 0003

Crimp contacts: Harting crimp contacts
Order number: 02 05 000 2511

> **Note**
>
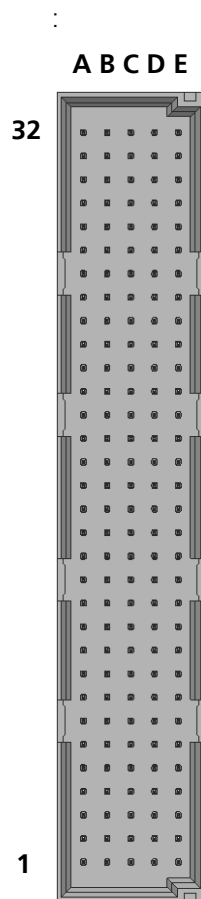> *Crimp tongs, for example from Harting, are necessary for attaching the crimp contacts.*

:

Fig. 4-2   Connector X3

The pin assignment is as follows

Row	Signal	Row	Signal	Row	Signal	Row	Signal	Row	Signal
A1	LOAD_CH_0	B1	ECU_CH_1	C1	ECU_CH_1	D1	LOAD_CH_1	E1	LOAD_CH_1
A2	LOAD_CH_0	B2	ECU_CH_0	C2	ECU_CH_0	D2	LOAD_CH_2	E2	LOAD_CH_2
A3	ECU_CH_3	B3	LOAD_CH_3	C3	LOAD_CH_3	D3	ECU_CH_2	E3	ECU_CH_2
A4	ECU_CH_3	B4	ECU_CH_4	C4	ECU_CH_4	D4	LOAD_CH_4	E4	LOAD_CH_4
A5	LOAD_CH_5	B5	ECU_CH_6	C5	ECU_CH_6	D5	LOAD_CH_6	E5	LOAD_CH_6
A6	LOAD_CH_5	B6	ECU_CH_5	C6	ECU_CH_5	D6	LOAD_CH_7	E6	LOAD_CH_7
A7	ECU_CH_8	B7	LOAD_CH_8	C7	LOAD_CH_8	D7	ECU_CH_7	E7	ECU_CH_7
A8	ECU_CH_8	B8	ECU_CH_9	C8	ECU_CH_9	D8	LOAD_CH_9	E8	LOAD_CH_9
A9	LOAD_CH_10	B9	ECU_CH_11	C9	ECU_CH_11	D9	LOAD_CH_11	E9	LOAD_CH_11
A10	LOAD_CH_10	B10	ECU_CH_10	C10	ECU_CH_10	D10	LOAD_CH_12	E10	LOAD_CH_12
A11	ECU_CH_13	B11	LOAD_CH_13	C11	LOAD_CH_13	D11	ECU_CH_12	E11	ECU_CH_12
A12	ECU_CH_13	B12	ECU_CH_14	C12	ECU_CH_14	D12	LOAD_CH_14	E12	LOAD_CH_14
A13	LOAD_CH_15	B13	ECU_CH_16	C13	ECU_CH_16	D13	LOAD_CH_16	E13	LOAD_CH_16
A14	LOAD_CH_15	B14	ECU_CH_15	C14	ECU_CH_15	D14	LOAD_CH_17	E14	LOAD_CH_17
A15	ECU_CH_18	B15	LOAD_CH_18	C15	LOAD_CH_18	D15	ECU_CH_17	E15	ECU_CH_17
A16	ECU_CH_18	B16	ECU_CH_19	C16	ECU_CH_19	D16	LOAD_CH_19	E16	LOAD_CH_19
A17	LOAD_CH_20	B17	ECU_CH_21	C17	ECU_CH_21	D17	LOAD_CH_21	E17	LOAD_CH_21
A18	LOAD_CH_20	B18	ECU_CH_20	C18	ECU_CH_20	D18	LOAD_CH_22	E18	LOAD_CH_22
A19	ECU_CH_23	B19	LOAD_CH_23	C19	LOAD_CH_23	D19	ECU_CH_22	E19	ECU_CH_22
A20	ECU_CH_23	B20	ECU_CH_24	C20	ECU_CH_24	D20	LOAD_CH_24	E20	LOAD_CH_24
A21	LOAD_CH_25	B21	ECU_CH_26	C21	ECU_CH_26	D21	LOAD_CH_26	E21	LOAD_CH_26

Row	Signal	Row	Signal	Row	Signal	Row	Signal	Row	Signal
A22	LOAD_CH_25	B22	ECU_CH_25	C22	ECU_CH_25	D22	LOAD_CH_27	E22	LOAD_CH_27
A23	ECU_CH_28	B23	LOAD_CH_28	C23	LOAD_CH_28	D23	ECU_CH_27	E23	ECU_CH_27
A24	ECU_CH_28	B24	ECU_CH_29	C24	ECU_CH_29	D24	LOAD_CH_29	E24	LOAD_CH_29
A25	LOAD_CH_30	B25	ECU_CH_31	C25	ECU_CH_31	D25	LOAD_CH_31	E25	LOAD_CH_31
A26	LOAD_CH_30	B26	ECU_CH_30	C26	ECU_CH_30	D26	LOAD_CH_32	E26	LOAD_CH_32
A27	ECU_CH_33	B27	LOAD_CH_33	C27	LOAD_CH_33	D27	ECU_CH_32	E27	ECU_CH_32
A28	ECU_CH_33	B28	ECU_CH_34	C28	ECU_CH_34	D28	LOAD_CH_34	E28	LOAD_CH_34
A29	LOAD_CH_35	B29	ECU_CH_36	C29	ECU_CH_36	D29	LOAD_CH_36	E29	LOAD_CH_36
A30	LOAD_CH_35	B30	ECU_CH_35	C30	ECU_CH_35	D30	LOAD_CH_37	E30	LOAD_CH_37
A31	ECU_CH_38	B31	LOAD_CH_38	C31	LOAD_CH_38	D31	ECU_CH_37	E31	ECU_CH_37
A32	ECU_CH_38	B32	ECU_CH_39	C32	ECU_CH_39	D32	LOAD_CH_39	E32	LOAD_CH_39

⚠️ **WARNING!**

Fire hazard!
For contacts with the same names, the following applies: Both contacts must always be connected!
Failure to observe this can result in destruction of the ES5398.1 and cause a fire.

4.3   Connectors X1 and X2

Type: Conec D-Sub 15 socket UNC 4-40, current rating: 7.5 A
Order number: 164A12979X

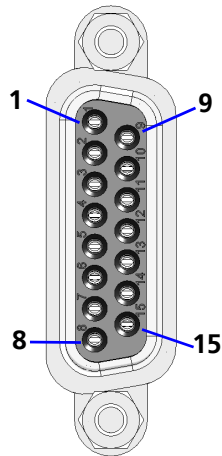Counterplug:Conec D-Sub 15 pin , current rating: 7.5 A
Order number: 163A11079X
:

Fig. 4-3

The pin assignment is as follows:

Pin	Signal
1	+VBAT_A
2	+VBAT_B
3	-VBAT
4	LOAD_RAIL
5	ECU_RAIL
6	Reserved
7	Reserved
8	Reserved
9	+VBAT_A
10	+VBAT_B
11	-VBAT
12	LOAD_RAIL
13	ECU_RAIL
14	Reserved
15	Reserved

When connecting the board, the following instructions must be followed:

General Instructions for Connection:

> ⚠️ **WARNING!**
>
> *Fire hazard!*
>
> *- For contacts with the same names, the following applies: Both contacts must always be connected!*
>
> *- The pins with the signal description "reserved" must not be connected.*
>
> *- The maximum continuous current and the permitted peak current must not be exceeded (see "Technical Data" on page 35).*
>
> *- The switching capacity of the relays (see "Technical Data" on page 35) must not be exceeded.*
>
> *- The maximum permitted operating voltage for real-time faults is 48 V. The absolute maximum nominal voltage on the board is 60 V. Do not exceed this voltage of 60 V. Even exceeding 60 V only briefly can destroy the board.*
>
> *- Only positive voltages may be connected to +VBAT_A and +VBAT_B. Only voltages with the reference potential connected to -Vbat may be connected to +VBAT_A , +VBAT_B and all fault channels.*
>
> *- The ground of the ECU and the simulated battery voltage of the system must always be connected to -Vbat.*
>
> *Failure to observe this can result in destruction of the ES5398.1 and cause a fire.*

Instructions for Master/Slave Operation:

> ⚠️ **WARNING!**
>
> *Fire hazard!*
>
> *- When connecting several ES5398.1 boards together, only 1:1 cable may be used to prevent incorrect cabling.*
>
> *-The sockets X1 and X2 in the front panel of the board are used to connect several boards.*
> *When operating more than one board in master/slave operation, a common feeder line must be used for +VBAT_A, +VBAT_B and -VBAT. The lines for +VBAT_A and +VBAT_B must be protected externally with a fuse of maximum 10 A.*
>
> *Failure to observe this can result in destruction of the ES5398.1 and cause a fire.*

4.4   Connecting Cable

Use only approved cables in the manufacture of cable harnesses (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 be suitable particularly for occurring currents, voltages and temperatures and flame-retardant in accordance with one of the following standards IEC 60332-1-2, IEC 60332-2-2, UL 2556/UL1581VW-1!*

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

5   Technical Data and Standards

This chapter contains the technical data of the ES5398.1. It also contains the norms and standards met.

5.1   Technical Data

> **Note**
>
> *The maximum permissible number of ES5398.1 Fault Insertion Boards used in a LABCAR HiL system (ES5300.1-A or combination of ES5300.1-A and ES5300.1-B) is 15.*

Relais

Relais in use	TE Axicom IM06DGR
Number of cycles in operation	100,000 at 30 V DC / 2 A, resisitive

Fault Channels

Number of fault channels	40
Nominal operating voltage for all fault types	12 V
Maximum operating voltage (real-time fault)	48 V
Absolute maximum voltage per channel	60 V
Maximum continuous current per channel	2.5 A rms
Maximum permitted peak current per channel	5 A for 1 s
Maximum permitted total current over all channels	40 A
Maximum permitted switching load per channel	60 W
Cut-off voltage (relay fault)	Typically 30 V
Cut-off current (VBAT- and real-time fault)	Typically 5 A
Maximum resistance between ECU_CH and LOAD_CH	150 mΩ

Power Supply

Current consumption	250 mA @ +3.3 V DC 500 mA @ +12 V DC

Electrical Data ES5300.1-A, ES5300.1-B PCI Backplane

Maximum permissible power consumption	24 W for 12 V 1 W for 3.3 V

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
Maximum contamination level	2
Temperature during operation	5 °C to 40 °C (41 °F to 104 °F)
Relative humidity	0 to 95% (non-condensing)
Altitude	Max. 2000 m above sea level

Physical Dimensions

Height	4 U
Width	5 HP

5.2   Norms and Standards Met

The ES5398.1 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 IEC 61326-1. Avoid potential radio interference when using the module outside of the industrial settings by using 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.*

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

6   Order Data

Order name	Short name	Order number
ES5398.1 Fault Insertion Board	ES5398.1	F-00K-110-971
Scope of delivery		
ES5398.1 Fault Insertion Board		

7   ETAS Contact Addresses

ETAS HQ

Etas GmbH

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

Index